The Impact of Female Education on Fertility: Evidence from Turkey*†

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Abstract

Development economists have emphasized the role of education for health and human capital formation. Based on the significant relationship between education and economic and social outcomes, policymakers have supported investments in education and urged improvements in educational programs and policies in many developing countries. This paper explores the relationship between female education and fertility in a causal manner using a change in the compulsory schooling law (CSL) in Turkey. More specifically, I use variation in the exposure to the CSL by date of birth as an instrumental variable. The results from reduced-form and instrumental variables estimations indicate that more female education indeed reduces early fertility and moreover these results are robust with respect to a rich set of controls. Additionally, robustness checks by using intensity indicators confirm the reduced-form results. The results indicate that an extra year of female schooling results in between a 0.15 to 0.2 reduction in the number of early births. Exploring heterogeneous effects indicate that the decline in early fertility is larger in provinces with high levels of initial fertility. Moreover, the effect of the CSL on education and early fertility depends on several characteristics of birth-province: initial levels of fertility and education, GDP per capita, urbanization, population density, and agricultural activity. This paper also provides direct evidence that the impact of the educational policy operates through a delay in marriage, which in turn increases the proportion of women postponing childbearing.

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1 Introduction

Development economists have emphasized the role of education for health and human capital formation. Based on the significant relationship between education and economic and social outcomes, policymakers have supported investments in education and urged improvements in educational programs and policies in many developing countries. Economists have long discussed the importance of investment in human capital and examined the economic rate of returns to education (Mincer, 1974; Becker, 1975). However, nonmarket returns and, the factors that influence them, have not been explored as much. In this paper, I investigate the link between female education and fertility, which, as others have pointed out, is an important factor in nonmarket returns to education (Schultz, 1993).

It is well-documented that education is one key determinant of fertility and child health. There is a large literature that explores the relationship between mother's education and child health and fertility (Strauss and Thomas, 1995). The effect of parental education on fertility and child health is widely investigated in terms of the correlations, which, of course, do not imply causality. Therefore, it is important to examine both the determinants of fertility decisions and assess the causal effect of parental education on fertility.

Economic theory provides several mechanisms through which education may affect fertility choices. One theoretical explanation why parental education may lower fertility is that it increases the opportunity cost of childbearing (Becker, 1981; Schultz, 1981), thereby, delaying motherhood. Another possible explanation is that education may affect fertility preferences–for instance, more educated women may prefer fewer but healthier (higher quality) children (Becker and Lewis, 1973). An important channel in which education may influence fertility decisions is through increased knowledge about use of contraceptive methods (Rosenzweig and Schultz, 1985, 1989). Ainsworth et al. (1996) showed that there is a positive association between contraceptive method use and education. Lastly, education is hypothesized to increase women's autonomy and bargaining power in the household, thus, increasing women's participation in fertility decision-making.

On the empirical side, the existing literature documents strong associations between education and child health and fertility (For a survey of the literature, see Strauss and Thomas, 1995). Despite the evidence of a positive correlation between education and health outcomes, the observed association does not imply causality. The omission of third variables–in particular ability (Griliches, 1977) and discount rates (Fuchs, 1982), which have strong correlations with education–causes bias in the relationship between education and the nonmarket returns to schooling. Thus, many studies that treat education levels as exogenous can not answer the question of whether schooling causally affects fertility outcomes.

In this study, I propose to use instrumental variables technique (IV) to evaluate the impact of education on fertility, exploiting the reform of compulsory education system in 1997 in Turkey, which extended the basic educational requirement from five to eight years. The main objectives of the basic education project are to increase the education level to universal standards and to provide assistance to ensure that all children can benefit. In order to accommodate the increased number of primary students, additional classes and schools were constructed and, in addition, new teachers were recruited to meet the increased teacher demand. Moreover, transportation was arranged for children living far away in rural areas or without the ability to pay for transportation and boarding schools were established in order to extend the educational opportunities. The program led to an substantial increase in primary school enrollment rates: 8 year basic education enrollment rates increased by around 4.5% for boys and around 5% for girls in the 1997/1998 Academic Year, compared to the enrollment rates of both sexes in the 1996/1997 Academic Year with the enforcement of the law (Ministry of National Education, 2011).

This paper asks the question of whether education policies (specifically, compulsory schooling laws), and in particular greater education, causally affect fertility. The specific case of Turkey will provide an answer to these questions. Hence, the objective of the study is twofold. First, it evaluates the impact of an important development policy– examining whether educational policies affect female education and fertility. Second, it identifies whether increased education causally affects fertility. In order to explore the causal relationship between female schooling and fertility, I apply instrumental variables method (IV) to overcome the problem of endogeneity and examine whether increased female schooling indeed reduces fertility. The instrument I employ is variation in the exposure to the compulsory schooling law in Turkey in 1997 by date of birth. Recent studies have used similar strategies to undercover the causal effect of schooling on different outcomes of interest.

The results suggest that the education policy had a significant effect on female education and early fertility. In addition, robustness checks by using intensity indicators confirm this relationship. The estimates indicate that more female education reduces early fertility, and the impact of education on fertility before the age of 22 is quite strong (each year of female education reduces fertility before the age of 22 by approximately 0.15 to 0.2 children). The finding that there is a strong and significant effect of education on early fertility indicators is robust with respect to a rich set of controls. Exploring heterogeneous effects indicate that the decline in early fertility is larger in provinces with high levels of initial fertility. Moreover, the effect of the CSL on education and early fertility depends on several characteristics of birth-province: initial levels of fertility and education, GDP per capita, urbanization, population density, and agricultural activity. I also find that the impact of the educational policy on early fertility can be partially explained by the delay in marriage, which in turn increases the proportion of women postponing childbearing.

This paper has several important implications for development policy, especially for Middle East and North Africa (MENA) countries. While Turkey roughly followed a similar demographic transitional history as other MENA countries over the second half of the 20th century, Turkey has recently exhibited a marked divergence from other MENA countries in two particular areas. Firstly, Turkey recently exhibits the low-fertility patterns (postponed marriage and first births and lower fertility rates) of a developed country. Second, the gap in female education levels between urban and rural areas have narrowed dramatically (the difference in the median number of years of education is 0.3 for ever-married women age 15-49 in 2008 (Hacettepe University Institute of Population Studies, 2008)). The compulsory schooling law in 1997 was actually quite successful at increasing female enrollment rates in both rural and urban areas (rural enrollment in grade six increased significantly in the first year of the change in the law, roughly 162%[1]) and, partially as a consequence, the tempo effects (postponed marriage and delayed motherhood) accelerated the fertility transition. These results of the CSL in Turkey is in stark to the results of educational interventions in other MENA countries, such as Egypt[2] and Morocco[3], where significant gaps in female education (especially for the primary school level) between rural and urban areas still persist. Certainly, gender and regional (urban vs. rural, especially female urban and female rural) inequalities in primary school enrollment rates and literacy rates is a primary concern for developing countries. In these regards, there are many important lessons to be learned from the educational policy implemented in Turkey.

The remainder of this paper is organized as follows: Section 2 presents previous literature on nonmarket returns to education; Section 3 provides background on the demographics and the educational policy in Turkey; Section 4 describes the data and the identification strategy; Section 5 presents the empirical strategy and the results; and Section 6 concludes.

[1]http://www.unicef.org/turkey/gr/ge21ja.html
[2]http://www.measuredhs.com/pubs/pdf/FR220/FR220.pdf
[3]http://www.measuredhs.com/pubs/pub_details.cfm?ID=524

2 Previous Literature on Nonmarket Returns to Education

Existing literature documents a strong link between parental education, especially mother's education, and fertility decisions and child health outcomes. Schultz (1993) discussed the monetary and nonmarket returns to education in detail. He emphasizes the importance of various channels in which maternal education improves child health outcomes and affects: "One of the most important discoveries in research on nonmarket returns to women's education is the strong link between a mother's education and her fertility" (Schultz, 1993). Empirical evidence demonstrates that there is a positive and robust association between parental education and child health, in which the effect of paternal education is smaller than the effect of maternal education, and a strong inverse relationship between women's education and her fertility. However, it is also accepted that the observed correlations between parental education and fertility and child health are not causal.

The endogeneity of schooling has been widely discussed in the literature. However, some exogenous variation in parental education will overcome endogeneity problems. Towards this end, the use of instrumental variables (IV) has been commonly used in the recent literature. The ideal methodology to identify causality is to use an exogenous source of variation in schooling that is not related to the outcomes in interest. In an early study, Sander (1995) used IV technique to estimate the causal impact of education on health. The findings of this study support a positive causal impact of schooling on adult health. However, the instruments employed in this study, which are family background variables such as parents schooling, ethnic and regional background variables, are open to question because they may be correlated with the omitted variables. Other early studies that attempted to remove unobserved variables bias concluded that the observed correlations between health and schooling can be at least partly attributed to the direct effect of schooling on health (Berger and Leigh 1989; Leigh and Dhir, 1997). All of these early studies, which attempted to overcome problems of endogeneity, were applied to US data and only examined the relationship between education and health.

One set of recent studies addresses the causal effect of education on adult health. de Walque (2007), Adams (2002), Grimard and Parent (2007), Kenkel et al. (2006), and Webbink et al. (2010) investigated the link between education and adult health or cigarette smoking by employing instruments such as exemption from military service, requirements for high school completion and for the receipt of a General Educational Development High School Equivalency Diploma (GED), and twin's schooling which was introduced by

Ashenfelter and Krueger (1994). These instruments are more likely not to be related with the outcome of interest compared to earlier studies employing IVs to estimate the effect of schooling on health. Despite the improved instruments, the findings of the IV effects of schooling on health in most of these studies are still at least as large as the OLS effects. Recent IV studies measure the causal effect of education on labor market and health outcomes using institutional features of the education system as exogenous variations in schooling (Card, 2001). Compulsory schooling laws (CSLs)–one supply-side innovation–have been used to instrument schooling choices (Card, 2001). Lleras-Muney (2005) addresses the schooling-health relationship by using compulsory education laws to obtain consistent estimates of schooling on adult health. Kemptner et al. (2011) show significant non-monetary returns to adult health by appying IV approach using changes in compulsory schooling laws that took place from 1949 to 1969 in West Germany. Clark and Royer (2010) and Silles (2009) investigate the causal relationship between education and health by the two changes to British compulsory schooling laws. In all of the reviewed papers, it has been shown that there is a strong correlation between education and the selected adult health measure, and, moreover, this relationship is causal. On the other hand, Albouy and Lequien (2009) use schooling reforms that increased the minimum school leaving age in France as an instrument to explore the causal impact of education on health status and found no significant causal relationship between education and health outcomes.

In addition to examining the causal effect of education on own adult health, another, albeit smaller, set of IV studies examine the causal effect of parents' education on child health or fertility outcomes. For example, Currie and Moretti (2003) investigate the relationship between maternal education and birth weight among US white women, using college openings between 1940 and 1990 when the woman is aged seventeen as an instrument for schooling. Their findings indicate that increased education reduces the incidence of low birth weight by changing maternal behavior. One possible pathway for reducing the incidence of low birth weight is by reducing smoking during pregnancy. They find that increased maternal education accounts for approximately 10 percent of the decrease in the probability of low birth weight between the 1950s and the 1980s. Furthermore, they show evidence that the increase in maternal education over the period lead to a reduction in fertility.

In a similar vein, Duflo (2001) uses the primary school construction program in Indonesia as a source of exogenous variation in schooling. She creates an instrument by interacting year of birth and the primary school construction program intensity in the region of birth. The exposure to the program determined by the regional differences in the program intensity and the variation in the program intensity across age cohorts is shown to be a very strong predictor of schooling. She examines the effects of schooling on earnings by the introduced instrument and her findings show that an increase in educational attainment leads to an increase in wages. Breierova and Duflo (2004) estimate the effects of parental education on child mortality and fertility using the same instrument employed by Duflo (2001). They apply the IV methodology in order to identify the effects of average parental education and the difference between maternal and paternal education on fertility and child mortality using the 1995 intercensal survey of Indonesia. The survey consists of fertility and child mortality histories of approximately 120,000 women between the ages of 23 and 50 in 1995. Their estimates suggest that both mother's and father's schooling have a casual impact on reducing child mortality and the magnitude is almost the same. They show that the IV results correct the biased OLS coefficients, although the authors report the results are very preliminary.

Several other studies examine the role of parental education in fertility, child health, and natality outcomes using approaches similar to Breierova and Duflo (2004). For example, Osili and Long (2008) examine the impact of female schooling on fertility in Nigeria by using the Universal Primary Education (UPE) program in Nigeria in 1976. Rather than using the total number of new classrooms constructed as Breierova and Duflo (2004), they employ the state classroom construction funds per capita as a measure of program intensity. Their IV estimate in the estimation of female schooling on the number of births before age 25 is much higher than the OLS estimate, which provides evidence that female education has a causal impact on the reduction of the number of early births. McCrary and Royer (2011) use age at school entry as a source of exogenous variation in schooling and apply a R.D.D. approach to identify the effect of mother's schooling on the probability of low birthweight birth in Texas and California. They observe that school entry policies affect education at motherhood; however, they find little evidence that an increase in mother's education affects fertility choices and infant health outcomes. Lindeboom et al. (2009) identify the causal effect of parental education on child health in UK by using the increase in minimum school leaving age as an instrument in their study. They examine the effect of parental education on child health outcomes at birth, as well as at ages 7, 11, and 16, and conclude that parental education does not causally affect child heath, which is consistent with the findings of McCrary and Royer (2011).

While there is a growing literature examining the causal effect of education on non-market outcomes, there are surprisingly few studies examining the effect of education on fertility in developing countries. Part of the reason for this is difficulty in identifying natural experiments. This is one of the reasons the CSL in Turkey is such an attractive natural experiment. As far as I know, there are only two papers[4], and one of which is a working paper, examining the causal relationship between education and fertility in developing countries. Since education is a cornerstone of development policy, understanding and evaluating the impact of educational interventions is of top priority. Moreover, the results of the two aforementioned papers are mixed and the question is still far from resolved. Breierova and Duflo (2004) find that the average parental education is an important determinant of very early fertility (before the age of 15), whereas the average parental education is unimportant for early fertility (before the age of 25). The paper most similar to this paper is Osili and Long (2008); however, they look at fertility before the age of 25 in Nigera. Both Osili and Long (2008) and I find that female education does in fact matter; however, Osili and Long find larger effects of female education on early fertility. They conclude that one year of education translates into a reduction in early fertility by 0.26 and I find that one year of education translates into a reduction in early fertility by approximately 0.15 to 0.2. Since there are so few papers examining the effect of female education on fertility and Turkey's compulsory schooling law provides a suitable natural experiment, investigation is certainly warranted.

[4]Kirdar et al. (2011) has a discussion paper on the effect of CSL on teenage marriage and teenage births in Turkey, rather than early fertility (before the age of 18 and 22) as examined in this paper. However, they do not explore the causal relationship. In this paper, I examine the causal relationship, as well as examine whether there are heterogeneous effects and provide robustness checks by various measures of intensity.

Empirical studies of nonmarket returns to education

Author(s)	Year	Dependent Variable	Country	Estimation Method	Instrument(s)	Finding(s)
A. Adult Health						
Sander	1995	Odds of Quitting Smoking	United States	IV	Family Background Characteristics	Positive Effect of Schooling on Health
Berger & Leigh	1989	Systolic and diastolic blood pressures, disability, functional limitations	United States	IV, Weighted Least Squares	Family Background Characteristics	Direct effect of schooling on health
Leigh & Dhir	1997	Years of completed schooling, neasure of exercise, and index of disability	United States	Ordered probit, Tobit	Background Characteristics	Schooling has direct and indirect beneficial influences on health
Adams	2002	Functional ability measures and self-reported general health measures	United States	Two-Stage Least squares (2SLS)	Quarter of birth and a set of parental and sibling characteristics	A positive and significant effect of education on health
Kenkel, Lillard & Mathius	2006	Smoking and obesity	United States	IV	Requirements for high school completion and GED receipt	The returns to high school completion include a reduction in smoking (IV estimates are imprecise)
de Walque	2007	Smoking behaviors	United States	IV	A measure of the induction risk faced by each birth cohort of males in Vietnam	Education affects smoking decisions: current smoking and smoking cessation

Webbink, Martin & Visscher	2010	Probability of being overweight	Australia	IV	Twin's schooling	Education reduces the probability of being overweight for men
Grimard & Parent	2007	Smoking behaviors	United States	IV	Vietnam war draft avoidance	Education reduces the probability of smoking (imprecise IV estimates of the effect of education on smoking cessation)
Lleras-Muney	2005	Mortality variables	United States	IV	Changes in Compulsory Schooling Laws	Education has a causal impact on mortality
Silles	2009	Probability of teenage childbearing	Great Britain & Northern Island	IV	Changes in Compulsory Schooling Laws	Increased schooling reduces the incidence of teenage childbearing
Clark & Royer	2010	Mortality, variety of self-reported health outcomes	Britain	R.D.D	Changes to British Compulsory Schooling Laws	Small health effects of extra education
Kemptner, Jürges & Reinhold	2010	Health outcomes and health-related behavior	West Germany	IV	Changes in Compulsory Schooling Laws	Causal effect of education on health outcomes
Albouy & Lequien	2009	Survival rates at the age of 50 or 80	France	non-parametric R.D.D & parametric two-stage approach	Schooling Reform: Minimum School-Leaving age	Not reveal causality of education on health

B. Child Health						
Currie & Moretti	2003	Birth weight	United States	IV	College openings	Education reduces the incidence of low weight
Lindeboom, Llena-Nozal & van der Klaauw	2009	Wide range of variables including health measured at birth & later in childhood	United Kingdom	RD	Schooling Reform: Minimum School-Leaving age	Little effect of a direct causal relationship between parental education and child health
McCrary & Royer	2011	Low-birthweight birth	United States	RD	School entry policies	Little evidence that increase in mother's education affect fertility and infant child health
C. Fertility and Child Health in Developing Countries						
Breierova & Duflo	2004	Child mortality and fertility	Indonesia	Reduced-form & IV	Primary School Construction Program	Parental education has a strong causal effect on the reduction of child mortality
Osili & Long	2008	Early fertility–before age 25	Nigeria	Reduced-form & IV	Universal Primary Education (UPE) Program	Increasing female education reduces early fertility

3 Background

3.1 Marriage and Fertility in Turkey

Turkey's population has increased from 13.6 million in 1927 to 73.7 million in 2010 (Turkish Statistical Institution, 2010). Turkey has a young population structure: the proportion under 15 years of age is 25.6%, while the proportion of population aged 65 and over is 7.2% in 2010 (Turkish Statistical Institution, 2010). Turkey is a predominantly Muslim country (99%) with a majority of Sunni (80-85%) and a minority of Alevi (10-15%)[5]. Turkey is divided into 5 main regions: West, South, Central, North, and East. However, a new regional breakdown has been adopted from the European Union for statistical purposes as of 2002. Accordingly, there are 12 regions (NUTS I) with 81 provinces (Figure 2).

The traditional marriage pattern of Turkey is characterized by the universality of marriage for both sexes: almost all women engage in either civil or religious marriages by the end of their reproductive ages in Turkey according to the demographic surveys. While the proportion of never-married men in the age group 45-49 (3%) is slightly higher than the corresponding share for women (2%) in 2000, the norm for marriage remains widespread in Turkey for both sexes. The crude divorce rate–the number of divorces per 1000 population in a given year–is 1.62% in 2010[6], which is not a very frequent event. Therefore, marriage is a rather stable institution in Turkey due to low levels of marital dissolution. Childbearing out of wedlock is uncommon in Turkey (Hacettepe University Institute of Population Studies, 2008). Hence, age at first birth depends on the age at first marriage, which in turn affects the overall fertility. If the time lapse between first birth and marriage is not shortening over time, rising age at first marriage could influence overall fertility by postponing the first births. Since, the time interval between marriage and first birth has been stable over years on average around 1.6 years in Turkey[7], a delay in age at marriage may result in overall fertility decline in Turkey. The singulate mean age at marriage (SMAM)[8] for both sexes increased by 2 years (24.1 for females and 27.4 for males) over a period of 10 years from 1998 to 2008. Both age at first marriage and birth for females have increased from 1993 to 2008, whereas the total fertility rate has declined over the same period (Figure 5).

Turkey has experienced a rapid fertility decline from the early 1960s and is in the final

[5]the CIA World Factbook. https://www.cia.gov/library/

[6]TurkStat. http://www.turkstat.gov.tr/

[7]http://www.hips.hacettepe.edu.tr/eng/index.html

[8]It is defined as the average number of years lived as single (never-married) for females or males before they get married for the first time among those who marry before age 50.

stage of its fertility transition with 2.16 children per woman in 2008. The total fertility rate, TFR–defined as the average number of children that would be born to a woman by the end of her childbearing period if she were to experience the exact current age-specific fertility rates–exceeded 6 children per woman until the mid-1960s, dropped to 5 in the late-1970s, and dropped further to around 3 in the late-1980s. Afterwards, the TFR continued to decline, though with at a slower pace, coming down to a rate of 2.16 in 2008. Hence, total fertility rate in Turkey has fallen to a rate close to the fertility replacement level[9]. Despite the overall declines in fertility levels for the whole country in the last decades, there has been a marked difference in fertility levels by educational levels within the country. In 2008, ever-married women aged 15-49 with no education have on average 2.65 births–around one child more than those who completed high school or higher (1.53 births on average). In all demographic surveys, it appears that total fertility rates decrease by the level of education, which is consistent with the known inverse relationship between fertility and education. Moreover, the surveys show that the gap in total fertility rates between urban and rural areas have been closing–from 1.39 in 1978 to 0.7 in 1993 and to 0.6 in 2003. Table 2 presents the trends in age-specific rates over the 1993-2008 period with corresponding total fertility rates. The age-specific rates over this period indicate that fertility has been decreasing in general, but TFR has not dramatically declined at all ages except for the 20-24 and 15-19 age cohort, which declined by 40% and 60%, respectively. What is more interesting is that fertility is the highest for the 25-29 age cohort, rather than the 20-25 age cohort, for the first time in 2008.

It should be emphasized that fertility behavior varies greatly by educational level of women. Moreover, age at marriage show remarkable differences across women with different education levels. For instance, ever-married women aged 25-49 with less than five years of education in 2008 tend to marry almost three years earlier than those who completed secondary education, and more than five years earlier than those who completed high school or higher. From these findings, we can identify the specific paths through which education affects fertility. That is, the aforementioned relationship suggests that education postpones marriage in a significant manner, thereby, shedding light on the negative association between education and fertility.

[9]Replacement fertility is the level of fertility at which a population replaces itself, and is roughly 2.1 children per woman for most of the developed countries.

Table 2: Age-specific (per 1,000 women) and Total Fertility Rates

Age Groups	TDHS-1993	TDHS-1998	TDHS-2003	TDHS-2008
15-19	56	60	46	35
20-24	179	163	136	126
25-29	151	150	134	133
30-34	94	93	78	91
35-39	38	42	38	36
40-44	12	13	12	10
45-49	0	1	2	1
TFR	2.65	2.61	2.23	2.16

Source: Hacettepe University Institute of Population Studies (HUIPS)
Notes: 1993 rates refer to the year before the survey; 1998, 2003 and 2008 rates refer to the 3-year period before the survey.

3.2 The Turkish Demographic Transition

Turkey has undergone rapid socio-demographic and health changes, albeit with regional disparities, that characterize the demographic behavior of the country. Tabutin and Schoumaker (2005) discussed that Turkey, as most of the MENA countries[10], began its demographic transition in the 1950s and 1960s, while the transitional histories of North Africa (Morocco, Algeria, Libya, Egypt, and Tunisia are included in the paper) and the Middle East (countries in this region in the paper are Syria, Iraq, Iran, Jordan, Lebanon, and Palestine including Israel and Turkey) generally have followed a similar pattern from 1950s to 2000s, with almost identical initial and final rates of crude births, crude deaths, natural increase, and annual growth of population.

Turkey's population is over 70 million today, which is almost a sixfold increase since 1927. The crude birth rate fell from close to 50% in 1950 to 17% in 2011, while crude death rate fell from 23.5% to 6% during the same period. Life expectancy at birth rose from around 35 years during the Second World War to around 75 years in 2011. High total fertility rates in Turkey, around 6-7 children per woman until the mid-1960, fell substantially to a rate close to the fertility replacement level in 2008 (2.16 per woman). The infant and child under five mortality rates, which were extremely high in the early-1960s (over 200 per thousand live births), stand at 20 per thousand live births in 2008.

[10]The MENA (The Middle East and North Africa) Region of the World Bank includes 21 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, Yemen.

Turkey is now in its final stage of demographic transition with a 17% birth rate, a 6% death rate, and an annual growth rate of 1.235%. Moreover, Turkey now shows a marked demographic change in terms of fertility characteristics such as late marriage, low fertility, and high controlled fertility with the increased prevalence of birth control methods.

As of the 1910s and early-1920s, the Turkish population, particularly the male population, substantially decreased as a consequence of the World War I and the War of Independence. After the establishment of the Republic in 1923, the Turkish Government endorsed pronatalist policies up to mid-1950s in order to increase the population, especially the working age population. A series of laws were passed to promote population growth, including greater financial incentives by providing tax exemptions based on the number of children, monetary awards to women who had six or more children, modest child support payments to public sector employees, among others (Altıok, 1978). Moreover, during the period, the sale and import of contraceptives other than for medical purposes was prohibited. Additionally, pronatalist policies also aimed to dissuade abortions. Starting in 1926, induced abortion was considered illegal and subsequent jurisprudence increased penalties for induced abortion. Moreover, pronatalist marriage laws were passed: The Turkish Civil Code in 1926 established the legal minimum age for marriage to be 18 years for men and 17 for women and subsequent laws in 1938 reduced the minimum age of marriage further to 17 years of age for men and 15 for women.

During the Second World War, the rate of natural increase depressed despite the pronatalist policies (10.6 per thousand in 1940). Afterwards, during 1945-1950 period, the rate of natural increase rose sharply to 21.7 per thousand. In the following period (1950-1955), the rate of natural increase rose further to 27.7. The population of the country increased from 13.6 million in 1927 to about 24 million in 1955 due to the increase in births with the help of pronatalist policies and mostly the decline in mortality as a consequence of improved health and medical services. However, this population expansion became a concern, especially for economic development.

During the late-1950s, intellectuals and bureaucrats began to discuss the adverse effects of rapid population growth (Hancıoglu, 1997). Policy makers began to argue the need for a change in the population policies of the government following the military coup of May 1960. After the military intervention, the State Planning Organization as a branch of the Prime Minister's Office was established. An antinatalist approach arose by the officials of both the Ministry of Health and the State Planning Organization. The officials emphasized the importance of the damages to the economy caused by the rapid increase in the population and the need for change in the population policies in the First Five-year Development Plan (1963-1967). Accordingly, the advocators of antinatalist policies enacted a legal framework for the changes in family planning by the First Population Planning Law (No. 557) in April 1965. The 1965 Family Planning Law extended the use of contraceptives, disseminated birth control information, and provided services to avoid pregnancy. Moreover, the sale, importation, and distribution of contraception was made legal again, but sanctions on sterilization and abortion persisted, except for women under survival risks. The Family Planning Division within the Ministry of Health and Social Assistance also encouraged smaller family size and better child care techniques through the media. The Second and Third Five-year Plans (1967-1972, 1973-1977) followed the same objective of decreasing the fertility and mortality rates. As a result of the antinatalist policies, fertility dropped down to 5 children per woman in the late 1970s from over 6 per woman in 1965. Despite the bans and increased penalties for induced abortion, the program was not successful in preventing illegally induced abortion. A new law on May 1983 concerning high maternal mortalities due to illegal abortions, legalized induced abortion upon request for up to ten weeks gestation and sterilization for both sexes. Moreover, the law allowed trained nurses and midwives to insert IUDs. The changes in the Population Planning Program resulted in an increase in the prevalence of modern contraceptives, with mostly changes in the use of IUD, and a decrease in induced abortions later in the late-1990s. Although fertility sharply dropped down to 3.6 per woman on average in 1985 from over 6 per woman in 1955, the population doubled from 24 to 51 million during this period with rather slow decreases in the rate of natural increase due to a quicker fall in the mortality rates (Figure 3).

Along with other structural changes aimed to promote economic development starting in the 1980s, there have been profound changes in fertility and demographic behavior. In the 1980s, both the birth rate and mortality rates continued to fall; however, in the 1990s the mortality rates began levelling off while birth rates continued to decline. The result has been that the rate of natural increase has declined since the 1980s and fell even further thereafter. Moreover, over the period of 1955 to 1985 there has been a strong shift in the family system, which has resulted in less traditional extended families to more nuclear families.

Turkey is in the final stages of its demographic transition today with a fertility rate close to the replacement fertility rate, different family structures in terms of marriage and family size, low mortality rates, and a slower population growth rate. According to TurkStat, population will rise to around 85 million in 2025 and rise further around 95 million in 2050. Thereafter, the population is expected to stabilize and fertility levels will be under replacement levels, thus the country will complete its demographic transition. Although, it should be stressed that the demographic transition process varies within the country–there are pronounced regional disparities, especially between the East and West regions.

3.3 Education and Compulsory Schooling Law in Turkey

3.3.1 Turkey's Education System

After the establishment of the Republic of Turkey in 1923, the Government carried out radical curricular and structural educational reforms. One major reform was the democratization of the education system[11]. Since the establishment of the Republic of Turkey, the education system has been highly centralized and governed by the Ministry of National Education (MONE). MONE is in charge of making all educational related policy decisions, preparing the curriculum of educational institutions, and monitoring implementation in cooperation with provincial offices.

The Turkish National Education System has two parts: formal and non-formal education. Formal education is the regular education conducted within schools, while non-formal education is out-of-school education institutions for those who have never entered the formal education system or have left it, such as public education centers, vocational training centers, and practical art schools for girls.

Formal education in Turkey consists of pre-school, primary, secondary and higher education. Prior to the law change in 1997, five years of primary education was compulsory for all citizens. In 1997, compulsory primary education was increased from five to eight years. Following primary school, students may choose to attend one of the following secondary educational programs: general, vocational or technical high schools. It was proposed to make the secondary education compulsory; however, no laws have yet been passed. Universities, faculties, institutes, higher education schools, conservatories, higher vocational education schools and application and research centers provide higher education for at least 2 years after secondary education. Entry to higher education is subject to performance on a centralized nationwide placement test, which makes it very competitive for those who want to enter into tertiary level education.

Pre-primary education is offered to children up to age 6 on a voluntary basis before compulsory primary education. It is a well-known fact that the early years are very important in developing a child's mental, physical, and emotional growth. Turkey had low

[11] the Unification of Education Law no 430 issued on 06.03.1924.

pre-school enrollment rates, less than 20% till late 2005 (Ministry of National Education, 2011). MONE had the objective to increase this rate up to 25% by 2010. Despite the fact that MONE achieved its goal and increased the rates to about 29% in 2010, Turkey still has low levels of pre-school enrollments among the lower-middle income countries.

The basic 8-year primary education level gross enrollment rate[12] is 107.58% in 32,797 private and public schools with 503,328 teachers (Ministry of National Education, 2011). As of 2010, there are more than 4.5 million students in secondary schools with a 93.34% gross enrollment rate. According to the Council of Higher Education (YOK), there are 163 higher education institutions in 2010 with approximately 3 million students. The gross enrollment rate at the tertiary level is 30% in 2005 (Ministry of National Education, 2011).

3.3.2 Compulsory Schooling Law and Trends in Education

In 1997, the Turkish government took a "big bang" approach to education reform. With the enactment of the Basic Education Law No. 4306[13], compulsory schooling was increased from five to eight years. The main objective of the 8-Year Basic Education Program was to increase the education level to universal standards. The program included construction of schools and classes in order to accommodate a greater number of students. New primary school teachers were recruited to overcome the teacher constraint problem. Education is provided free of charge in public schools. The Program aimed at providing opportunities for all children to stay in school at least to the eighth grade. For that purpose, the Government offered services such as bussing and boarding schools, especially to the children of poor families, and provided low-income students with free textbooks, school meals, and student uniforms.

In order to enforce the law, the Government offered a new Primary School Diploma for only those who complete the 8th grade. The abolishment of a diploma for students with 5 years of education was a crucial step to increase the education level since the primary school diploma opens doors to the workforce. Therefore, it created incentives to attend school by abolishing diploma.

In order to improve access for children in rural areas, transportation expenses to children living at least 2.5 km away from nearby village schools were covered by the Government under the Bussed Primary Education Scheme launched in the 1989/1990 Academic Year to provide transportation to and from primary education schools. In addition, re-

[12]MONE calculates the gross schooling rate by dividing the total number of students in a specific level of education by the population in the theoretical age group.

[13]Compulsory education was extended to 8 years with Law No 4306 dated 18.08.1997 as of the 1997/1998 Academic Year.

gional boarding primary schools (YIBO) were established to provide primary education services to the settlements in villages that have no schools. According to MONE, there were 687,056 children bussed to the primary schools, and 539 YIBO with 247,563 students in the 2010/2011 Academic Year.

The CSL had an impressive impact on enrollment rates of both sexes, especially on female enrollments in rural areas. The net primary enrollment rate[14] increased from 84.74 in the 1997/1998 Academic Year to 93.54 in the 1999/2000 Academic Year (Ministry of National Education, 2011). The increase in the net primary enrollment rate for females was more than for males: 90.25 to 98.41 for males and 78.97 to 88.45 for females. The sex ratio[15] in primary education rose from 85.63 to 88.54. At present, the net primary enrollment rate is 98.41 for both sexes, 98.59 for boys and 98.22 for girls, and the sex ratio is 100.42. Over ten million children in all types of education institutions, including regional boarding primary schools receive 8 years of basic education in about 33,000 schools with approximately 503,000 teachers.

Figure 4 shows the trend in the number of students in basic education by academic year. From the figure, we can see that the CSL in 1997 had a significant effect on student primary school participation. Enrollments increased by around 15% from 9.08 in the 1997/98 Academic Year to 10.48 in the 2000/01 Academic Year.

4 Data and Identification Strategy

4.1 Data

I base my analysis mainly on 2008 Turkish Demographic and Health Surveys (TDHS-2008). The TDHS surveys are demographic health surveys conducted every five years by Hacettepe University Institute of Population Studies (HUIPS) since 1998. The survey provides detailed information on demographic and socioeconomic characteristics of each member of the household. It also records information on the fertility history of all ever-married women of reproductive ages at 15-49 present in the household. The survey would be carried out to 11,911 households; however, 10,525 households from the available 11,911 households were successfully interviewed, which yields an approximate response rate of 88%. Among 10,525 interviewed households, 8,003 women were ever-married of repro-

[14] The net primary enrollment rate is calculated by dividing the number of students of a theoretical age group enrolled in a specific level of education by the population in that age group.

[15] Sex Ratio indicates the relative greatness of female gross schooling ratio as compared to male gross schooling ratio in a specific educational year and level of education. It is calculated by dividing the female gross schooling ratio by the male gross schooling ratio multiplied 100.

ductive ages at 15-49. The response rate for the ever-married sample is approximately 92%.

TDHS-2008 uses two types of questionnaires; namely the Household Questionnaire and the Individual Questionnaire for ever-married women of reproductive ages. The Individual Questionnaire targets the women who are ever-married women of reproductive ages at 15-49 and collects data on background characteristics, reproduction, knowledge and use of family planning, maternal care and breastfeeding, marriage, fertility preferences, women's work and status, sexually transmitted diseases and HIV, maternal and child anthropometry, and immunization and health. Whereas, the Household Questionnaire targets all usual members of and visitors to the household and collects information on the socioeconomic and demographic characteristics of the households, housing characteristics and welfare of the elderly people. The TDHS-2008 data is appropriate for the purpose of this paper since it contains information on the education, year and region of birth, fertility and marriage history of women. Table 3 presents summary statistics for the sample of women between the ages of 18 and 50. There are 10,788 women in this sample, of which 6,084 have children. The average level of completed female schooling is 6.38. Primary school is defined as 5 years of completed education, and secondary school is defined as 8 years of completed education hereafter. The average fertility–the number of ever-born children–is 1.82 for the entire sample, 0.58 for fertility before the age of 22, and 0.14 for fertility before the age of 18.

The education trends related educational data is provided by the Turkish Statistics Institute and MONE. The important sources of data for this paper are the National Education Statistics books by MONE, Turkey's Statistical Year Books and detailed education data by TurkStat. The sources contain detailed information on the enrollment rates in formal and non-formal education for both sexes, number of teachers, number of schools and classes in the relevant level of education for different age groups in all regions and for all academic years. I use mid-year population projections provided by TurkStat for the number of primary school age children in the province of birth in 1995 (80 provinces).

Table 3: Descriptive Statistics of TDHS-2008

	Mean
Female Age	32.14
Female Age in 1997 Cohort Dummy Fractions	
Age 7 in 1997	0.04
Age 8 in 1997	0.04
Age 9 in 1997	0.04
Age 10 in 1997	0.04
Age 11 in 1997	0.04
Female Years of Completed Education	6.38
Completed primary school	0.78
Completed secondary school	0.37
Completed high school	0.28
Advance education	0.12
Fraction of married women	0.68
Fraction of married women before age 22	0.48
Fraction of women having no kids at the time of the survey	0.38
Fraction of women having no kids before age 22	0.65
Number of children ever born	1.82
Number of children before age 22	0.58
Number of children before age 18	0.14
Number of Observations	10788
Number of Female With Children	6084

Notes: The sample includes all female between the ages of 18 and 50 at the time of the survey.

4.2 Identification Strategy: Effect of the Compulsory Schooling Law on Education and Fertility

An individual's exposure to the compulsory school law (CSL) is determined by her/his date of birth. A Turkish child that was 12 or older in 1997, when the CSL took place, had already graduated from primary school in 1997 since most Turkish children attend primary school between the age of 6 and 11, and therefore did not benefit from the policy. On the other hand, children aged 11 or younger in 1997 ("exposed") would be potentially affected by the CSL. I use the 2008 TDHS data set, therefore, the children potentially exposed to the education policy were between the ages of 18 and 22 at the time of the survey, while the unexposed were aged 23 and over. The exposed cohort is a young group at the time of the 2008 TDHS survey, thereby, limiting the analysis to early fertility indicators rather than completed fertility. I use the number of children born before age 22 as a key dependent variable due to the fact that the fertility history of the exposed cohort is censored.

Table 4 shows means of education, fertility before age 22, and fertility before age 18 for different cohorts. Years of education is the completed years of schooling and fertility is defined as the number of children ever born. In Panel A, I compare the years of education, the number of children before age 22, and the number of children before age 18, of women exposed to the change in schooling (aged 7 to 11 in 1997) to women who were not exposed (aged 12 to 15 in 1997). An exposed female received on average 1.75 more years of education and her early fertility before age 18 was 0.04 lower. These differences are the causal effect of the CSL on education and fertility if the identification assumption–that time trends in educational attainment and fertility levels do not account for the change between cohorts without the CSL–is valid. In Panel B, I have a control experiment to account for this mean reversion. The education and fertility levels of the women that were aged 12 to 15 in 1997 and 16 to 19 in 1997 should not differ since they were not affected by the CSL. The estimated differences are close to 0 and insignificant for education and fertility before age 18. Although these results are preliminary, it provides evidence that the differences are not driven by time trends in schooling and fertility before age 18. However, it seems like there is a time trend in the fertility levels before age 22. For that reason, I calculate the differences-in-differences (DID) estimate as the difference of the difference in Panel A and Panel B for fertility before age 22 to account for time trends. The DID estimator suggests that one year increase in education causes a decrease in fertility before age 22 by 0.215 for women aged 7 to 11 in 1997.

Table 4: Means of Education and Fertility by Cohorts

	Years of Education		Fertility Before Age 22			Fertility Before Age 18	
Panel A		Difference		Difference	DID		Difference
Age 7-11 in 1997	7.890	1.751*	0.264	-0.301*	-0.215*	0.060	-0.039*
(Exposed)	(0.092)	(0.139)	(0.014)	(0.026)	(0.052)	(0.006)	(0.011)
Age 12-15 in 1997	6.139		0.565			0.099	
(Not exposed)	(0.103)		(0.025)			(0.001)	
Panel B-Control							
Age 12-15 in 1997	6.139	0.085	0.565	-0.086*		0.099	-0.024
(Not exposed)	(0.103)	(0.143)	(0.025)	(0.036)		(0.001)	(0.015)
Age 16-19 in 1997	6.054		0.651			0.123	
(Not exposed)	(0.100)		(0.027)			(0.011)	

Notes: *Significant at 0.01 level.
Standard errors are in parentheses.

5 Empirical Methodology and Results

5.1 Effect of the CSL on Education

5.1.1 Differences-in-differences (DID)

To estimate the impact of the CSL on education, I can simply compare the average education of women exposed and unexposed to the law based on year of birth in a regression framework as follows:

$$E_i = a_1 + T_i\delta_1 + X_i\theta + \epsilon_i \tag{1}$$

where E_i is the education of an individual i, a_1 is a constant, and T_i is a dummy indicating whether individual i belongs to the "treated" age group (exposed). X_i is a vector of province-specific control variables, province of birth fixed effects, interactions between the number of primary school aged children in the province of birth (in 1995) and their year of birth dummies, and interactions between the enrollment rate in the province of birth (in 1995) and cohort of birth dummies. In the estimation of all specifications here and the rest of the study, I correct the standard errors for clustering at the province level.

I use equation 1 to estimate the effect of the law on education for two samples. Table 5 (columns 1-4) reports the effect of the CSL on the number of years of schooling completed.

Panel A compares the education levels of women aged 7 to 11 in 1997 (exposed) with the education levels of women aged 12 to 15 in 1997 (unexposed). I present several specifications starting with the baseline model of no control (column 1). In column 2, I control only for the province of birth to account for time-invariant, unobserved differences across provinces[16]. In column 3, I add control for the interaction of a cohort of birth dummy and the primary school aged population in the province of birth in 1995. The estimates of these specifications indicate that the law increased the education levels of females aged to 7 to 11 in 1997 by 1.747 to 1.976 years.

The identification assumption will be violated if the increase in schooling is larger in areas where the initial enrollment rates are lower. That is, the estimates would be upwardly biased due to mean reversion. Thus, I introduce the control for enrollment rates in the province of birth in 1995 interacted with cohort of birth dummies in addition to the controls to deal with this problem. In column 4, I present the results of the specification that control for the mean reversion as well as the other controls in specification 3. The estimate suggests that exposure to the CSL increased the completed years of schooling by 2.23 for the treated group compared to the women unexposed to the CSL. The estimated coefficient is slightly larger when I account for the possibility of mean reversion, indicating that it does not confound the effect of the CSL. In sum, the estimates suggest that there is a significant and positive effect of the CSL on the number of completed schooling for females.

I address the concern of pre-existing trends in educational attainment across cohorts in Panel B of Table 5. I compare the education levels of the cohort aged 12 to 15 in 1997 to the cohort aged 16 to 19 in 1997. In theory, neither cohort should have been affected by the CSL. Furthermore, the education levels across these cohorts should not differ systematically. If education levels were already increasing prior to the change in compulsory schooling then there should be a positive and significant coefficient for the cohort of aged 12 to 15 in 1997 in the estimation results reported in Panel B. However, I find no evidence of pre-existing trends in schooling–the coefficients are typically small and insignificant, thereby, providing some evidence that the identification assumption is satisfied. Thus, this control experiment allows me to conclude that the impact of the CSL on education found in Panel A is reliable[17].

[16]There are 80 provinces included in the estimations based on the 1995 boundaries of Turkey. Düzce became a province in November 1999. In all the estimations throughout the study, women born in Düzce are assumed to be born in Bolu since Düzce broke off Bolu.

[17]The DID estimate can be determined by subtracting the estimate in Panel B from the estimate in Panel A in Table 5.

5.1.2 Reduced form

I implement the identification strategy in a generalized regression framework of equation 2 as follows:

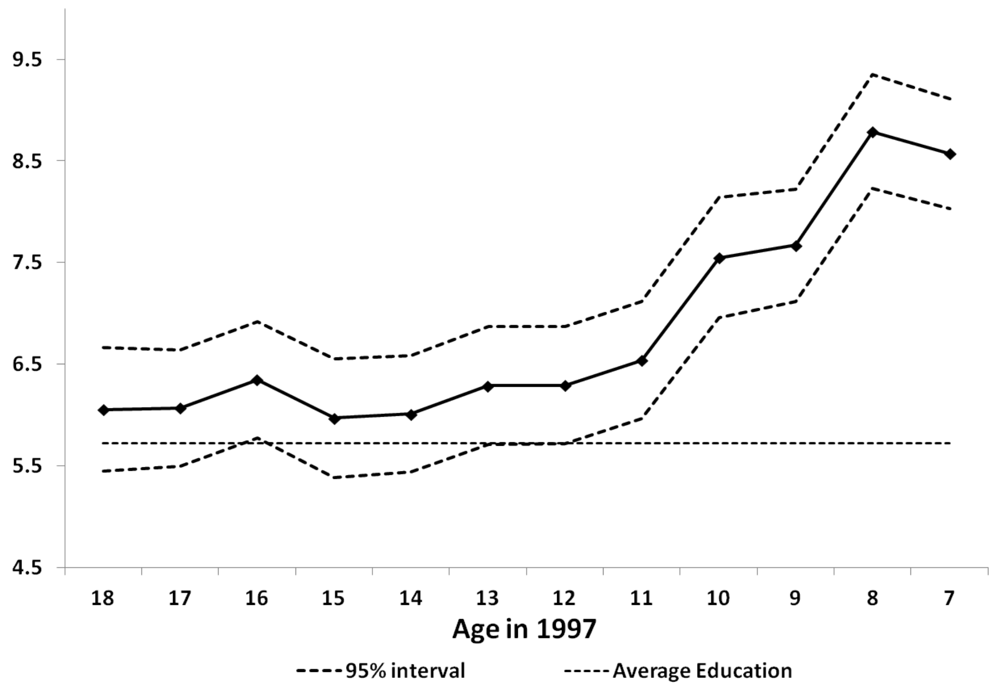
$$E_{ijk} = a + \alpha_{1j} + \sum_{l=7}^{18}(d_{il})\gamma_{1l} + \sum_{l=7}^{18}(C_j \times d_{il})\delta_{1l} + \ {}_{ijk} \tag{2}$$

where E_{ijk} is the education of an individual i, born in province j, in year k. d_{il} is a dummy that indicates whether individual i is age l in 1997 (a year-of-birth dummy). As in Duflo (2001), a is a constant, α_{1j} is a province of birth fixed effects, and C_j is a vector of province-specific variables. Females aged 19 in 1997 is the control group and hence this dummy is omitted from the regression. In these unrestricted estimates, each coefficient γ_{1l} estimates the impact of CSL on a given cohort.

Children aged 12 and older in 1997 were unlikely to have been affected by the change in compulsory schooling. Thus, I expect the coefficients of interest would be zero for women aged greater than 11 in 1997. Specifically, I can test this restriction by $\gamma_{1l=0}$ for $l > 11$. I expect the pattern of the coefficients γ_{1l} to start increasing from l=11 to 7 and be significantly positive.

In Figure 1, I plot the impact of the compulsory schooling law on female schooling for each cohort. More specifically, each dot on the solid line is the sum of the average education and the coefficient for each cohort (γ_{1l} for each l) from the regression of education equation (2) with no controls. The average education of the omitted age cohort of 19 in 1997 is shown by the horizontal dotted line and the broken lines are the 95-percent confidence interval bands. The pattern is consistent with expectations–that the change in compulsory schooling had no impact on the education of cohorts unexposed to it and had a positive effect on the education of the cohorts 11 and younger. The age cohort in 1997 coefficients (γ_{1l} for each l) from the regression results of equation (2) with no controls (see Appendix for coefficients) are jointly significant for l=4 to 11, and insignificant for l=12 to 18 (The F-statistics are 34.97 (p=0.000) and 1.01 (p=0.419) respectively). These results support the identification strategy and indicate that the CSL had an effect on female education.

Figure 1: The Impact of the Compulsory Schooling Law on Female Schooling For Each Cohort



5.1.3 Restricted Estimation

I impose the restriction of the coefficients being zero for age greater than 11 ($\gamma_{1l=0}$ for $l > 11$) since the CSL did not affect the cohorts unexposed to it, which is justified by the discussion in the above section. Thus, I estimate the impact of the program as follows:

$$E_{ijk} = a + \alpha_{1j} + \sum_{l=7}^{11}(d_{il})\gamma_{1l} + \sum_{l=7}^{11}(C_j \times d_{il})\delta_{1l} + \ _{ijk} \quad (3)$$

In this specification, the reference group is now the women aged 12 to 19 in 1997. This specification has the advantage of improving the precision and efficiency of the estimates.

I present the results for different specifications in Table 6. As expected, the CSL has larger effects on younger cohorts in all specifications. The estimated effects are all positive and statistically significant (except the estimate of age 11 in 1997 cohort in column (4)). In general, they follow the expected pattern of decreasing with the age in 1997. The F-statistics for testing the joint significance of the 5 age cohorts are reported in the Table. The set of age cohort estimates are jointly significant. The F-ratios reported in Table 6 are much larger than the rule of thumb that the instruments are weak if the first stage

F-ratio is less than 10[18]. The estimates of the increase in female schooling due to the 1997 CSL range from 0.439 to 2.691 in the baseline specification of no control (column (1) of Table 4). The results suggest that the education of the youngest cohort increases by 2.5 years due to the CSL. These estimates increase as I add more controls to the baseline. Succinctly, the estimates imply that the CSL caused increases in female schooling.

5.2 Effects of the CSL on Fertility

I use the same identification strategy to determine the effect of the CSL on fertility. Similar to the specifications for the effect of the CSL on education, I add controls for enrollment rates in 1995, interacted with years of birth dummies in the regressions, in order to capture any time-varying factors correlated with pre-program enrollment rates. In order to account for the fact that the fertility history of younger women is censored, I use the number of children born before age 22 and before age 18 as the dependent variables[19].

5.2.1 Differences-in-Differences

Analogous to equation (1), I estimate the impact of the CSL on fertility:

$$Y_i = a_2 + T_i\delta_2 + X_i\theta + \ _i \tag{4}$$

$$Y_i = a_2 + G_i\beta_2 + T_i\delta_2 + X_i\theta + \ _i \tag{5}$$

where Y_i is the fertility of a woman i, G_i is a categorical variable indicating whether individual i belongs to the group aged 7-11, 12-15, or 16-19 in 1997, and the other parameters are defined similar to equation (1). The outcomes of interest are the number of children before age 22 and before age 18.

I estimate equation 4 for fertility before age 18 for two subsamples. Results are reported in Table 5 (columns 5-8). In Table 5, comparison groups are formed based on the year of birth. In Panel A, I define the treated group as women aged 7 to 11 in 1997 (exposed) and women aged 12 to 15 in 1997 (unexposed) are used as the control group. The results suggest that the CSL decrease fertility before age 18 by 0.04. As in the education case, I report the control experiment in Panel B of Table 5 to check whether the results are driven by differential time trends across cohorts. It appears that time trends do not confound the

[18]Critical F-ratio of 10 is suggested by Staiger and Stock (1997). Cameron and Trivedi (2005) use this rule of thumb, but they also propose a less strict rule of thumb of critical F-ratio of 5.

[19]The youngest women in the sample are 18.

impact of the CSL on fertility before age 18. The coefficients of the control experiment are small and insignificant. In both comparisons of Panel A and Panel B, the coefficients are increasing as I add controls to the baseline specification of no control, similar to the education estimates.

According to Table 4, pre-existing time trends across cohorts "that are not due to the change in compulsory schooling" confound the estimate of the effect of the CSL on the number of children before age 22. For that reason, I estimate equation 5 for the whole sample in which I compare the fertility before age 22 of women aged 7 to 11 in 1997 (exposed) with women aged 12 to 15 in 1997 (unexposed). In this estimation, I add a variable to equation 4 in order to account for the time trends–G_i is a categorical variable indicating whether individual i belongs to the group aged 7-11, 12-15, or 16-19 in 1997. This estimation gives me the difference-in-difference estimate of the impact of the CSL on fertility before age 22. I present the results in Table 7. The estimates indicate that the CSL decreased fertility before age 22 by approximately 0.22 on average. The coefficients again increase when I add controls.

5.2.2 Reduced form

I run the following specification that allows for unrestricted reduced form estimation:

$$Y_{ijk} = a_2 + \alpha_{2j} + \sum_{l=7}^{18}(d_{il})\gamma_{2l} + \sum_{l=7}^{18}(C_j \times d_{il})\delta_{2l} + \nu_{ijk} \tag{6}$$

where Y_{ijk} is the outcome of interest of an individual i, born in region j, in year k. The other parameters are defined similar to equation (2).

In Panel A of Table 8, I present the F-statistics with their associated p-values for testing whether the set of γ_{2l} are jointly significant for $l \leq 11$ and for $l \geq 12$ for fertility outcomes.

In all the regressions on fertility before age 22 (columns 1-4 of Panel A of Table 8), the woman's age cohorts in 1997 are jointly significant at the 1% level after the change in compulsory schooling. The F-statistics are generally insignificant for the set of age cohorts in 1997 before the introduction of the CSL. The only significant F-statistic for joint significance test is the one in specification 3. It is significant at the 10% level. Other than that, the age cohorts are jointly insignificant.

Columns 5-8 present the F-statistics of joint significance test for number of children before age 18. None of the F-statistics are significant for the unexposed cohorts, implying that the decrease in fertility before age 18 is not due to the pre-existing time trends. The

F-statistics are all jointly significant for the exposed cohorts at the 1 % level.

These results suggest that the CSL has an impact on reducing fertility. The insignificant F-statistics for the set of unexposed cohorts validates that the reduction in early fertility are not driven by time trends.

5.2.3 Restricted Estimation

In Panel B of Table 8, I present the F-statistics with their associated p-values for testing whether the set of γ_{2l} are jointly significant for $l \leq 11$ for fertility outcomes of the following restricted reduced form specification:

$$Y_{ijk} = a_2 + \alpha_{2j} + \sum_{l=7}^{11}(d_{il})\gamma_{2l} + \sum_{l=7}^{11}(C_j \times d_{il})\delta_{2l} + \nu_{ijk} \tag{7}$$

I present the F-statistics for the joint significance test in the regressions on fertility before age 22 in columns 1-4, while columns 5-8 present the F-statistics in the regressions on fertility before age 18. In all specifications for both of the fertility outcomes of interest, the set of age cohorts in 1997 are all jointly significant at all conventional significance levels.

5.3 Effects of Female Schooling on Fertility: IV and OLS Estimates

OLS estimates of the following equation for the impact of education on fertility may suffer from biased estimates if schooling (E_{ijk}) is correlated with unobserved factors (ν_{ijk}).

$$Y_{ijk} = a_2 + \alpha_{2j} + \pi E_{ijk} + \sum_{l=7}^{18}(C_j \times d_{il})\delta_{2l} + \nu_{ijk} \tag{8}$$

Estimates of equation (2) not only answer the question of whether CSL caused an increase on female education, but it also forms the first stage of a two-stage least squares (2SLS) methodology to identify the causal impact of education on fertility. The set of age cohorts in 1997 are the excluded valid instruments in the above equation under the assumption that CSL had no direct effect on fertility outcomes other than by changing educational attainment of women (Breierova and Duflo, 2004). I also use a single instrument–the treatment dummy for women aged 7-11 in 1997–to determine the impact of female education on fertility.

Table 9 presents both OLS and IV estimates of the effect of female schooling on fertility–with and without controls analogous to the other estimations in this paper. Panel

A and B of Table 9 report estimates for fertility outcomes, measured as fertility before age 22 and before age 18, respectively.

The first line of Panel A displays the OLS estimates, which shows a significant negative impact of female schooling on fertility before age 22 with a one-year increase in education correlated to a 0.06 reduction in the number of children before age 22. This result corresponds to about 13% reduction in fertility starting at the mean (0.46 in the sample of women age 18-30). The second and third lines of Panel A present the 2SLS results with different instruments, which are very similar to each other–slightly higher for the IV estimates using age cohorts in 1997. The estimates range from 0.14 to 0.19 across different specifications, hence, a one-year increase in female education reduces fertility by 0.14 to 0.19 births, which is a reduction of 30 to 41% in fertility. These results show that a one-year increase in female education cause a great amount of decrease in fertility in Turkey. These 2SLS estimates are significantly different from the OLS estimates, thereby, suggesting that the standard OLS estimates may indeed underestimate the effect of female education on fertility.

Similarly, the IV estimates of the effect of female schooling on fertility before age 18–shown in Panel B–are significantly different from the OLS estimates. They are also higher than the OLS estimates consistent with the view that the magnitude of the effect under OLS estimation can be biased. Although OLS and 2SLS deliver different results, they both characterize a significant negative impact of female education on early fertility. OLS estimate suggests that a one-year increase in female education reduces fertility by around 0.015-close to 17% reduction starting at the mean (0.0896 in the sample of women age 18-30), while 2SLS estimates suggest that it reduces early fertility by around 0.03–about a 33% reduction in early fertility. The IV estimates reveal a smaller effect of female schooling on fertility before age 18 compared to before age 22, yet there is an appreciable reduction in early fertility.

5.4 Is there a heterogeneous effect?

The causal effect of education on fertility is likely to depend on certain characteristics. That is, there are heterogeneous effects–possibly for both the effect of the CSL on education[20] and fertility and education on fertility. To examine this hypothesis, I split the sample into various subsamples of birth-province and used the specifications that include

[20] I also test whether the effect of the CSL on education differs by parental education and ethnicity (Appendix B). The results provide evidence that the CSL was more successful at increasing education of women with lower levels of parental education; however, most of the estimates are insignificant to be conclusive. Moreover, the effect does not seem to differ by parental ethnicity.

all controls in Tables 5 (column 4) and 7 (column 4), and Table 9 (column 4 and 2SLS with "Age cohorts in 1997" instrument) in these subsamples.

A. Pre-change levels of education and fertility in the province of birth

One hypothesis is that it is easier to increase education when the baseline level is lower and, similarly, to reduce fertility when the baseline level is higher (Barham, 2011). I explore heterogeneity of both the effect of female education on fertility and the effect of the CSL on education and fertility according to the baseline (pre-change) levels of fertility and education by diving the sample into provinces (by birth) with average fertility or education of the unexposed cohort above (or below) the sample median.

Table 10 (first row; columns 2-5) suggests that the CSL increased education levels more in provinces where the initial levels were lower than the sample median. Second, it (second row; columns 2-5) shows that the effect of the CSL on fertility before age 22 was higher for provinces where pre-change levels of fertility were above the median and pre-change levels of education were below the median. Third, the impact of education on fertility (third row; columns 2-5) is higher in provinces with high levels of initial fertility. These results indicate that in fact heterogeneous effects are present and dependent on pre-fertility and pre-education levels in birth-provinces.

B. Pre-change characteristics of the province of birth

Another possible source of heterogeneity is population density (population density in each province prior to CSL in 1990). Population density can partially explain heterogeneous intensity effects as females in sparsely populated provinces are more likely to be further away from schools. Thus, less densely population provinces are likely to be more affected by the CSL because they are more likely to become closer to a school after the law change. Other possible sources of heterogeneity are income and the urbanization rate (the percentage of population in cities), which can be examined using per-capita GDP and the urbanization rate of the province.[21] Finally, heterogeneous effects may be present for households engaged in agricultural production.[22]

The results are reported in Table 11. As expected, the effect of the CSL on education (first row) is higher in provinces with lower population density, lower urbanization rates,

[21] I use the per-capita GDP and the urbanization rate in 1990 (prior to CSL).

[22] To test this, I use province data from 2001 (the earliest data I could get by province level is 2001) and assume that the percentage of households engaged in agricultural activity has not changed significantly over the four years since the change of the CSL in 1997.

and lower income levels. On the other hand, the effect of the CSL on education does not appear to depend on agricultural activity, when dividing the sample by province of birth according to agricultural activity. The second row of Table 11 presents the results of the effect of the CSL on fertility for different sub-samples. These results suggest that the CSL decreased the fertility levels more in lower income provinces–parallel to the result of the effect of the CSL on education–and the effect of the CSL on fertility was higher in provinces where the percentage of HHs engaged in agricultural activity was higher than the median. However, the effect does not depend on urbanization and population density, when I divide the sample into sub-samples according to province population density and urbanization rates. The impact of education on fertility (row 3) is slightly higher in provinces with lower population density, higher urbanization rates, and more HH's engaged in agricultural production; however, there is little variation across sub-samples. Moreover, the impact of education on fertility does not significantly depend on income.

5.5 Robustness checks by intensity measure of the CSL in the province of birth

In order to answer the question of whether the impact of the CSL depends on some measure of intensity, I use the number of children bussed in the 2000/2001 Academic Year per 1,000 primary school aged children (in 1995) in each province of birth.[23,24] This intensity measure is advantageous since it exists for all the provinces, and, moreover, it represents the actual number of students bussed in each province. This is preferable to an intensity measure calculated by the planned numbers because it provides more information on the allocation of schooling inputs to the provinces.[25] I examine if the impact of the CSL was higher for females born in higher intensity provinces as follows:

[23] I do not have data for the number of children bussed to primary schools at the province level for the 1997/1998 Academic Year when the CSL became effective–the earliest data by province level is for the 2000/2001 Academic Year; however, I have data from the 2000/2001 Academic Year on. I look at the changes in the number of children bussed between the 2000/01 and the 2001/02 Academic Year to corroborate the assumption that it has not changed much between the 1997/98 and the 2000/01 Academic Year. I also compared the results of the effects of the CSL to the ones in which I exclude the provinces where the change in the number of students bussed is greater than 25% (in absolute value) and got similar results. Thus, it is plausible to use the data for the 2000/01 Academic Year to measure the intensity of the CSL.

[24] I also use the 1990 Population Census of Turkey rather than the 1995 population projections for the intensity measure–obtained similar results.

[25] The intensity measure is also calculated in a different way to capture the variation by province for only females. That is, the number of female children bussed per 1,000 primary school aged female children in each province of birth is the intensity measure in the analysis. The findings follow the same pattern, therefore, I do not report the results.

$$E_{ijk}(or\ Y_{ijk}) = a + \alpha_j + \sum_{l=7}^{11}(Intensity_j \times d_{il})\gamma_l + \sum_{l=7}^{11}(C_j \times d_{il})\delta_l + \ _{ijk} \quad (9)$$

where E_{ijk} and Y_{ijk} are the education and fertility before the age of 22 of an individual i, born in province j, in year k. d_{il} is a dummy that indicates whether individual i is age l in 1997 (a year-of-birth dummy), C_j is a vector of province-specific variables, and α_j is a province of birth fixed effects. $Intensity_j$ is the intensity measure in the province of birth. γ_l gives the reduced-form estimate of the effect of the CSL on either education or fertility of each cohort in the treated group. In equation 9, the omitted group is the females aged 12 to 19 in 1997.

The results for different specifications are presented in Table 12. Columns (1)-(4) show the estimated effects of the CSL on years of education. The coefficients are all positive and mostly statistically significant (except the estimates of the interaction between the dummy for age 11 in 1997 and intensity measure in columns (3) & (4)). The F-statistics (reported in the table) show that the interaction terms are jointly significant. Column (4), which includes all controls, suggests that the CSL increased the education of females aged 8 in 1997 by 1.3 years given that 92.56 children were bussed per 1,000 children on average. I also find that a 100 increase in the number of students bussed increase the years of education of this cohort by 1.4, which corresponds to a 0.36 standard deviation gain in years of education (the standard deviation of the mean is 3.9).

Columns (5)-(8) present the results for the impact of the CSL on fertility. The estimates shown in column (5) are all negative and significant. The effects are larger for younger cohorts; however, they became same for females aged 7-9 in 1997 as I include controls (column (8)). Moreover, the effect is insignificant for females aged 10 & 11 in 1997 in column (8). In column (8), I estimate that an increase in the number of children bussed per 1,000 by 100 would decrease the number of early births by 0.1 for females aged 7-9 in 1997. The average number of children born before age 22 in the sample is 0.46, thus, there is a reduction of about 22% in early births.

An alternative measure of the intensity of the CSL is the additional number of classrooms: the difference in the number of classrooms between the 1997/98 and the 1996/97 Academic Year. That is, I use the additional number of classrooms per 1,000 children (in 1995) in each province of birth as the intensity measure rather than the number of students bussed.[26] This measure represents the actual changes in the number of class-

[26] There are 5 provinces–Ağrı, Çanakkale, Giresun, Kilis, and Bartın–that actually decreased the number of classrooms in between these periods. This stems from closing down some village schools in these provinces due to the unification purposes. Rather, the students from the closed schools were transferred

rooms, thereby, giving more insight on the allocation of schooling inputs to the provinces. I estimate equation 9, where $Intensity_j$ is defined as the additional number of classrooms per 1,000 children (in 1995) in the province of birth.

Table 13 examines the effects of the CSL on both education and fertility using an intensity measure calculated by the changes in the number of classrooms. The coefficients of the interactions, as shown in columns (1)-(4), are all positive and generally significant and jointly significant for all of the specifications (F-statistics are given in the table). As expected, the effect is larger for younger cohorts–with the greatest effect on the education levels of the females aged 8 in 1997. As shown in column (4), one additional classroom per 1,000 children increases the years of schooling of this cohort by 0.195 years. The average number of additional classrooms per 1,000 children is 9.42, thus, the CSL is estimated to increase the education of females aged 8 in 1997 by 1.84 years (the average years of schooling is 6.8 years).

The effects of the CSL on fertility before age 22 for different cohorts are presented in columns (5)-(8). The coefficients of the interactions are all negative and jointly significant for all specifications. They are all significant in columns (5)-(7) and significant for females aged 7-9 in 1997 in the last column. The estimates of the effect of the CSL on fertility are higher for younger cohorts with the greatest effect on the youngest cohort. The estimate in column (8) for the youngest cohort suggests that an increase of 10 classrooms per 1,000 children decreases early fertility by 0.23 births, which corresponds to a 50% reduction in early fertility at its mean value of 0.46.

Overall, the results indicate that the CSL has an impact on female education and early fertility, and this result holds for several indicators of intensity.

5.6 Further Analysis: The Effect of the CSL on Marriage and The Probability of Giving Birth

In this section I show that female schooling has an impact on fertility and discuss several mechanisms through which education may affect fertility. One possible way is through marital status–schooling reduces the incidence of pregnancy by delaying marriage since

to the schools in the cities and some of the classrooms were united instead of adding classrooms to accommodate more students. As a consequence the intensity measure is negative in these provinces. However, the results are robust to the exclusion of these provinces (214 observations in these 5 provinces) or to adding a constant to the intensity measure of all provinces in order to avoid negative measures. In any case, the estimated coefficients are little higher in these robustness checks and do not statistically differ from the ones found in the analysis with negative intensity measures–results are available upon request.

childbearing out of wedlock is uncommon in Turkey. I explore the impact of the CSL on the probability of being married and the probability of having no children before age 22. Since childbearing usually takes place within marriage, I expect the impact would have a similar magnitude for both outcomes.

Table 7 displays results of whether CSL has an impact on the probability that a woman remains single and does not have kids before the age of 22. Estimations of different specifications for both outcomes produce statistically significant coefficients with expected signs. The estimates from a linear probability model (LPM) suggest that the CSL decreases the probability of getting married before 22 by almost 1.5 percent for exposed women, while it raises the probability of having no kids by almost 2 percent for the same group. Thus, I provide evidence that the documented fall in fertility before the age of 22 may be partly explained by increasing the proportion of women who postpone childbearing due to the delay in marriage.

6 Conclusion

It is well-known that there is a negative association between education and fertility. In this paper, I explore the relationship between female education and fertility in a causal manner using a change in the compulsory schooling law in Turkey. The results of the paper suggest that the CSL led to an increase in female schooling and a decrease in the number of early births. The CSL increased the educational attainment of women by approximately 2 years, while it reduced fertility measured by the number of children before age 22 by 0.22 on average. The effects remain robust with different specification tests, hence, the CSL had a significant effect on both female education and early fertility.

I identify the causal impact of education on fertility by using the variation in female schooling generated by the CSL. The constructed IV estimates for a number of different specifications are much higher and statistically different than the corresponding OLS estimates. The reported IV estimates suggest that female schooling causes a reduction in early fertility. In particular, an extra year of female schooling results in between a 0.15 to 0.2 reduction in the number of children born before age 22. Therefore, this study adds to the earlier literature of conventional OLS estimates not being accurate measures of the effect of female education on early fertility.

It should be noted that the findings are of interest to policy makers since it has been widely pointed out that early childbearing adversely affects mother and child morbidity and mortality, labor market participation, and educational opportunities. In the sample of analysis, 48% of the women aged 22 at the time of the survey (2008) have been married at least once and most had at least one child, which warrants attention to reduce early fertility in Turkey. Although early fertility is an imperfect indicator of completed fertility (Osili and Long, 2008), there is a strong correlation (0.47) between the two and, importantly, 62% of first births occurred before the age of 22 for women who completed their fertility. This suggests that early fertility, while not perfect, is in fact an important factor in total fertility. Moreover, this demonstrates that educational interventions in developing countries–especially ones with high early fertility rates such as in Turkey–might be an effective policy tool for curbing fertility issues. In addition, the education policy may have effects on other social outcomes not explored here, such as improved child health or nonmarket outcomes. These considerations deserve future research.

Education influences fertility decisions in many different ways. I discuss several channels and provide direct evidence that the impact of the educational policy can be partially explained by the delay in marriage, which in turn increases the proportion of women postponing childbearing. However, there are, of course, more channels, such as increasing the time interval between first birth and marriage or changing preferences for lower fertility rates. Examining alternative mechanisms provides another interesting area for future research.

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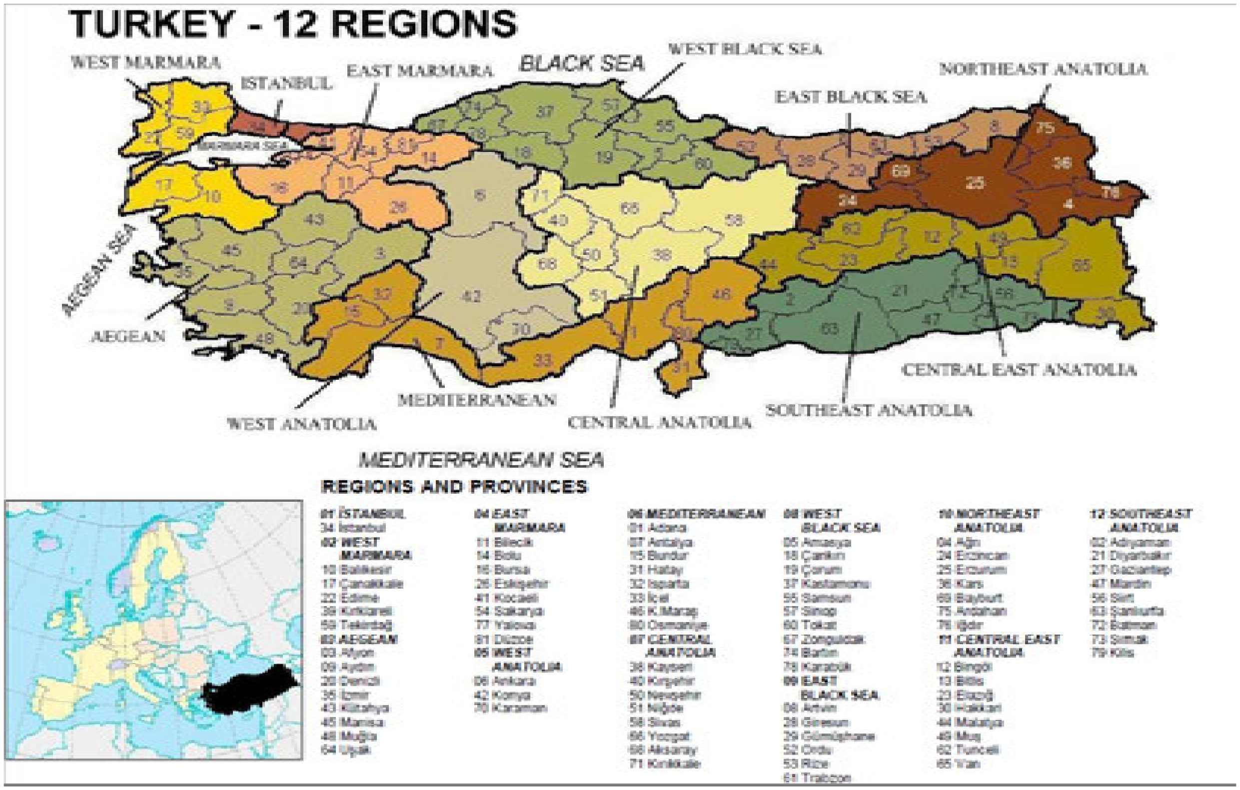
Figure 2: Administrative Regions and Provinces of Turkey



Source: Turkey Demographic and Health Survey 2008 Main Report; Hacettepe University Institute of Population Studies

Figure 3: Crude Birth Rate, Crude Death Rate and Crude Rate of Natural Increase; Source: Estimates for 1955 to 2003 period are from Turkish Health Statistics, 2006; for years from 2005 to 2025 are from TurkStat (Scale per 1000 population)

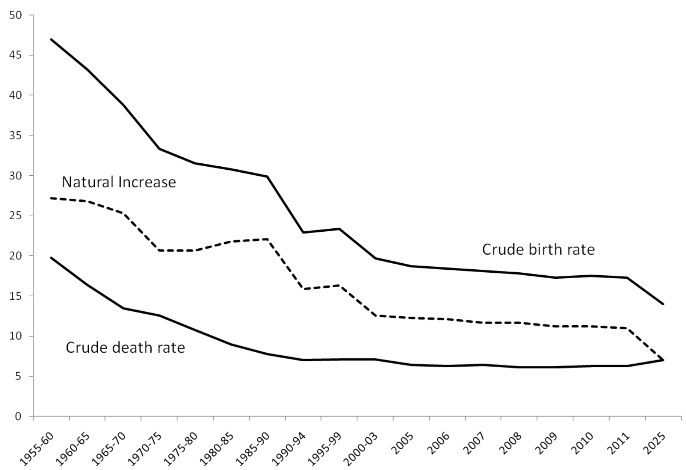


Figure 5: Total Fertility Rate (TFR), Mean Age at First Marriage (MAFM), Mean Age at First Birth (MAFB); Source: TurkStat, Hacettepe University Institute of Population Studies (HUIPS)

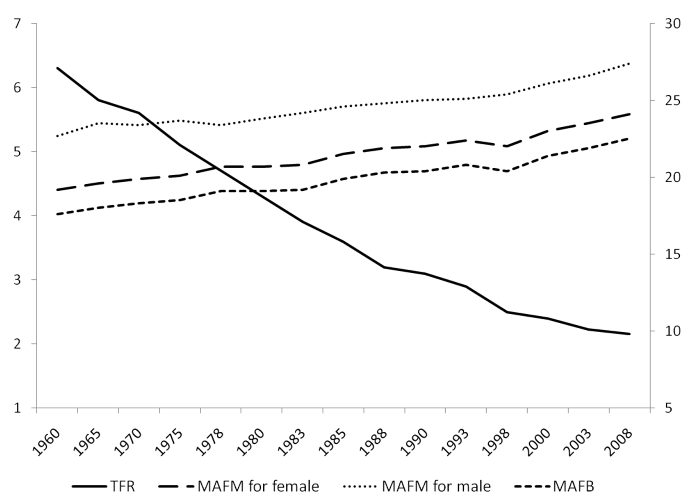


Figure 4: Number of Students in Primary School by Academic Year

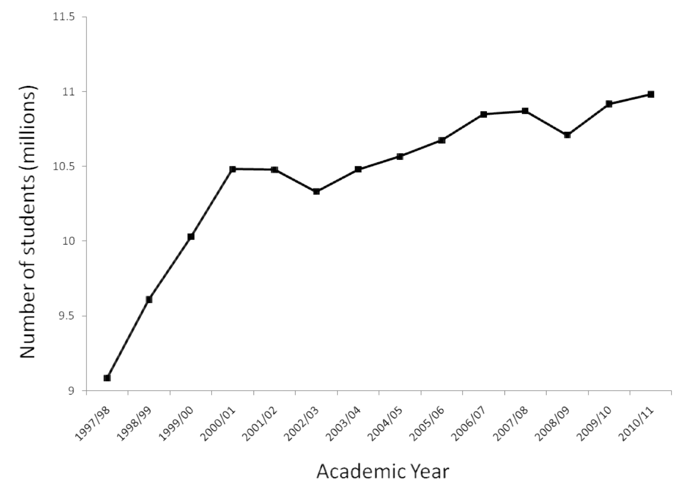


Table 5: Effect of the CSL on Education and Fertility Before Age 18

		Dependent Variable							
		Years of Education				Fertility Before Age 18			
	Observations	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Women Aged 7-11 to 12-15 in 1997									
Women ages 7 to 11 in 1997 dummy	3,327	1.747***	1.839***	1.976***	2.231***	-0.039***	-0.043***	-0.051***	-0.039*
		(0.174)	(0.155)	(0.183)	(0.283)	(0.011)	(0.012)	(0.015)	(0.022)
Panel B: Women Aged 12-15 to 16-19 in 1997									
Women ages 12 to 15 in 1997 dummy	2,735	0.090	0.250	0.349**	0.267	-0.024	-0.030	-0.033	-0.051
		(0.153)	(0.113)	(0.148)	(0.287)	(0.016)	(0.017)	(0.022)	(0.034)
Control Variables:									
Province of birth dummies		No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year of birth*Number of children in 1995		No	No	Yes	Yes	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995		No	No	No	Yes	No	No	No	Yes

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 6: First Stage Coefficients: Effects of the CSL on Completed Years of Schooling (Restricted Specification)

	Dependent Variable: Years of Education			
Age in 1997 Cohort Dummies	(1)	(2)	(3)	(4)
Cohort 7 (age = 7 in 1997)	2.475***	2.602***	2.898***	3.449***
	(0.249)	(0.230)	(0.268)	(0.370)
Cohort 8 (age = 8 in 1997)	2.691***	2.669***	2.963***	3.522***
	(0.263)	(0.207)	(0.230)	(0.328)
Cohort 9 (age = 9 in 1997)	1.573***	1.860***	2.047***	2.307***
	(0.280)	(0.217)	(0.265)	(0.407)
Cohort 10 (age = 10 in 1997)	1.448***	1.451***	1.542***	0.883**
	(0.248)	(0.223)	(0.248)	(0.379)
Cohort 11 (age = 11 in 1997)	0.439**	0.805***	0.752***	0.439
	(0.215)	(0.214)	(0.262)	(0.386)
Control Variables:				
Province of birth dummies	No	Yes	Yes	Yes
Year of birth*Number of children in 1995	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995	No	No	No	Yes
F-statistics	28.22	43.10	42.00	30.07
Adjusted R-square	0.065	0.310	0.312	0.316
Observations	4,684	4,684	4,684	4,684

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

The F-statistics test the hypothesis that the coefficients of the cohort dummies are jointly zero.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 7: Effect of the CSL on Fertility Before Age 22, Marital Status, and No kids

Dependent Variable	(1)	(2)	(3)	(4)
Fertility Before Age 22	-0.216***	-0.216***	-0.204***	-0.326***
	(0.0592)	(0.0593)	(0.0741)	(0.0462)
R-squared	0.043	0.102	0.108	0.115
Probability of Having No kids				
Before Age 22	0.146***	0.143***	0.124***	0.188***
	(0.0316)	(0.0318)	(0.0381)	(0.0256)
R-squared	0.038	0.081	0.089	0.099
Probability of Being Married				
Before Age 22	-0.164***	-0.161***	-0.140***	-0.144**
	(0.0331)	(0.0336)	(0.0388)	(0.0580)
R-squared	0.045	0.091	0.102	0.114
Control Variables:				
Province of birth dummies	No	Yes	Yes	Yes
Year of birth*Number of children in 1995	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995	No	No	No	Yes

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

All specifications have 4,684 observations.

Treatment: Age 7-11 in 1997; Control: Age 12-15 in 1997.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 8: Reduced Form Coefficients on Year of Birth Dummies

	Dependent Variable							
	Fertility Before Age 22				Fertility Before Age 18			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Unrestricted Reduced Form								
F-statistics for age 7-11 in 1997	28.78	23.93	28.07	11.06	3.75	3.89	4.42	3.39
	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.002)	(p=0.002)	(p=0.001)	(p=0.005)
F-statistics for age 12-18 in 1997	1.74	1.73	1.83	0.82	1.01	1.50	1.36	1.04
	(p= 0.110)	(p=0.114)	(p=0.092)	(p=0.575)	(p=0.421)	(p= 0.164)	(p=0.217)	(p= 0.403)
R-squared	0.061	0.118	0.121	0.122	0.010	0.058	0.060	0.062
Panel B: Restricted Reduced Form								
F-statistics for age 7-11 in 1997	67.47	52.10	51.63	18.93	7.41	7.05	7.25	4.15
	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.000)	(p=0.002)
R-squared	0.058	0.115	0.118	0.121	0.007	0.056	0.058	0.061
Control Variables:								
Province of birth dummies	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year of birth*Number of children in 1995	No	No	Yes	Yes	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995	No	No	No	Yes	No	No	No	Yes
Observations	4,684	4,684	4,684	4,684	4,684	4,684	4,684	4,684

Notes: p-values associated with the F-statistics are in parentheses.
Standard errors are adjusted for clustering on the province of birth.
The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 9: Effects of Female Schooling on Fertility Outcomes: OLS and 2SLS Estimates

Method	Instrument	(1)	(2)	(3)	(4)
Panel A: Dependent Variable: Fertility Before Age 22					
OLS		-0.0664***	-0.0669***	-0.0639***	-0.0581***
		(0.0047)	(0.0037)	(0.0039)	(0.0041)
2SLS	Treatment Dummy	-0.192***	-0.184***	-0.186***	-0.142***
		(0.0243)	(0.0196)	(0.0221)	(0.0247)
2SLS	Age cohorts in 1997	-0.191***	-0.189***	-0.190***	-0.145***
		(0.0217)	(0.0186)	(0.0204)	(0.0197)
Panel B: Dependent Variable: Fertility Before Age 18					
OLS		-0.0180***	-0.0161***	-0.0158***	-0.0151***
		(0.0022)	(0.0019)	(0.0018)	(0.0019)
2SLS	Treatment Dummy	-0.0283***	-0.0291***	-0.0312***	-0.0265**
		(0.0070)	(0.0067)	(0.0078)	(0.0111)
2SLS	Age cohorts in 1997	-0.0295***	-0.0304***	-0.0322***	-0.0292***
		(0.0061)	(0.0061)	(0.0071)	(0.0078)
Control Variables:					
Province of birth dummies		No	Yes	Yes	Yes
Year of birth*Number of children in 1995		No	No	Yes	Yes
Year of birth*Enrollment rate in 1995		No	No	No	Yes

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

All specifications have 4,684 observations.

Treatment: Age 7-11 in 1997; Control: Age 12-19 in 1997.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 10: Heterogeneity of the impact and the CSL effect by pre-change levels of fertility and education

		Pre-Change Province of Birth Characteristics			
	Whole	Pre-change education		Pre-change fertility	
	Sample	<Median	>=Median	<Median	>=Median
	(1)	(2)	(3)	(4)	(5)
1) Effect of the CSL on Education					
Treatment	2.231***	3.047***	1.870***	2.467***	2.044***
(7-11 vs 12-15)	(0.283)	(0.482)	(0.274)	(0.331)	(0.368)
2) Effect of the CSL on Fertility					
Treatment	-0.326***	-0.555***	-0.170***	-0.170***	-0.625***
(7-11 vs 12-15)	(0.0462)	(0.0841)	(0.0355)	(0.0381)	(0.0701)
3) Impact of Female Education on Fertility					
Years of Education	-0.145***	-0.167***	-0.102***	-0.0867***	-0.236***
(Treatment: 7-11 vs 12-19)	(0.0197)	(0.0251)	(0.0182)	(0.0126)	(0.0275)

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

Notes: Median pre-program education is 6.428; median pre-program fertility is 0.5769.

Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth.

Table 11: Heterogeneity of the impact and the CSL effect by pre-change province characteristics

	Whole	Pre-Change Province of Birth Characteristics							
		Density		GDP		Urbanization		%HH in Agriculture	
	Sample	<Median	>=Median	<Median	>=Median	<Median	>=Median	<Median	>=Median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1) Effect of the CSL on Education									
Treatment	2.304***	2.701***	1.593***	2.747***	1.704***	2.745***	1.765***	2.339***	2.097***
7-11 vs 12-15	(0.236)	(0.355)	(0.422)	(0.408)	(0.394)	(0.500)	(0.382)	(0.377)	(0.473)
2) Effect of the CSL on Fertility									
Treatment	-0.326***	-0.381***	-0.303***	-0.413***	-0.291***	-0.393***	-0.318***	-0.287***	-0.421***
7-11 vs 12-15	(0.0462)	(0.0592)	(0.0754)	(0.0803)	(0.0501)	(0.0792)	(0.0612)	(0.0623)	(0.0718)
3) Impact of Female Education on Fertility									
Years of Education	-0.145***	-0.151***	-0.138***	-0.153***	-0.153***	-0.131***	-0.167***	-0.130***	-0.161***
(Treatment: 7-11 vs 12-19)	(0.0197)	(0.0194)	(0.0331)	(0.0198)	(0.0304)	(0.0226)	(0.0311)	(0.0236)	(0.0256)

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

Notes: Median population density is 63.14 (per square kilometers); median GDP is $1908; median urbanization rate is 48.168%; median % HH engaged in agricultural activity is 73.744 %.

Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth.

Table 12: Effects of the CSL by Year of Birth and Intensity Measure (Number of Students Bussed)

	Dependent Variable: Years of Education				Dependent Variable: Number of kids before age 22			
Coefficients of the interactions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age 7 in 1997 * Number of students bussed	0.020***	0.018***	0.016***	0.012***	-0.003***	-0.003***	-0.003***	-0.001***
per 1000 children in province of birth	(0.003)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Age 8 in 1997 * Number of students bussed	0.020***	0.018***	0.016***	0.014***	-0.003***	-0.002***	-0.002***	-0.001***
per 1000 children in province of birth	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Age 9 in 1997 * Number of students bussed	0.017***	0.015***	0.014***	0.012***	-0.002***	-0.002***	-0.002***	-0.001*
per 1000 children in province of birth	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Age 10 in 1997 * Number of students bussed	0.012***	0.010***	0.009***	0.004**	-0.001*	-0.001*	-0.001	0.000
per 1000 children in province of birth	(0.002)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Age 11 in 1997 * Number of students bussed	0.005*	0.004**	0.003	0.001	-0.001**	-0.001***	-0.001**	-0.000
per 1000 children in province of birth	(0.003)	(0.002)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Control Variables:								
Province of birth dummies	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year of birth*Number of children in 1995	No	No	Yes	Yes	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995	No	No	No	Yes	No	No	No	Yes
F-statistics	20.87	25.42	21.60	16.12	16.33	11.59	7.52	2.79
R-square	0.074	0.303	0.310	0.319	0.032	0.081	0.089	0.108
Observations	4,684	4,684	4,684	4,684	4,684	4,684	4,684	4,684

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

The F-statistics test the hypothesis that the coefficients of interactions are jointly zero.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Table 13: Effects of the CSL by Year of Birth and Intensity Measure (Number of Additional Classrooms)

	Dependent Variable: Years of Education				Dependent Variable: Number of kids before age 22			
Coefficients of the interactions	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age 7 in 1997 * Additional Classrooms	0.153***	0.194***	0.187***	0.134***	-0.037***	-0.042***	-0.041***	-0.023***
per 1000 children in province of birth	(0.047)	(0.031)	(0.040)	(0.041)	(0.004)	(0.004)	(0.005)	(0.008)
Age 8 in 1997 * Additional Classrooms	0.181***	0.220***	0.222***	0.195***	-0.034***	-0.037***	-0.036***	-0.018***
per 1000 children in province of birth	(0.043)	(0.024)	(0.029)	(0.029)	(0.003)	(0.003)	(0.005)	(0.006)
Age 9 in 1997 * Additional Classrooms	0.089**	0.146***	0.141***	0.103***	-0.022***	-0.027***	-0.026***	-0.012*
per 1000 children in province of birth	(0.039)	(0.022)	(0.028)	(0.029)	(0.004)	(0.004)	(0.006)	(0.006)
Age 10 in 1997 * Additional Classrooms	0.069**	0.106***	0.093***	0.010	-0.009**	-0.014***	-0.016***	-0.010
per 1000 children in province of birth	(0.028)	(0.017)	(0.023)	(0.030)	(0.004)	(0.004)	(0.005)	(0.006)
Age 11 in 1997 * Additional Classrooms	0.008	0.081***	0.078***	0.060**	-0.008**	-0.014***	-0.012***	-0.006
per 1000 children in province of birth	(0.027)	(0.016)	(0.019)	(0.025)	(0.003)	(0.003)	(0.004)	(0.005)
Control Variables:								
Province of birth dummies	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Year of birth*Number of children in 1995	No	No	Yes	Yes	No	No	Yes	Yes
Year of birth*Enrollment rate in 1995	No	No	No	Yes	No	No	No	Yes
F-statistics	6.44	26.33	16.44	10.52	35.75	32.55	15.90	2.73
R-square	0.035	0.304	0.306	0.313	0.038	0.097	0.099	0.111
Observations	4,684	4,684	4,684	4,684	4,684	4,684	4,684	4,684

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

The F-statistics test the hypothesis that the coefficients of interactions are jointly zero.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.

Appendix

A. The CSL on different levels of education

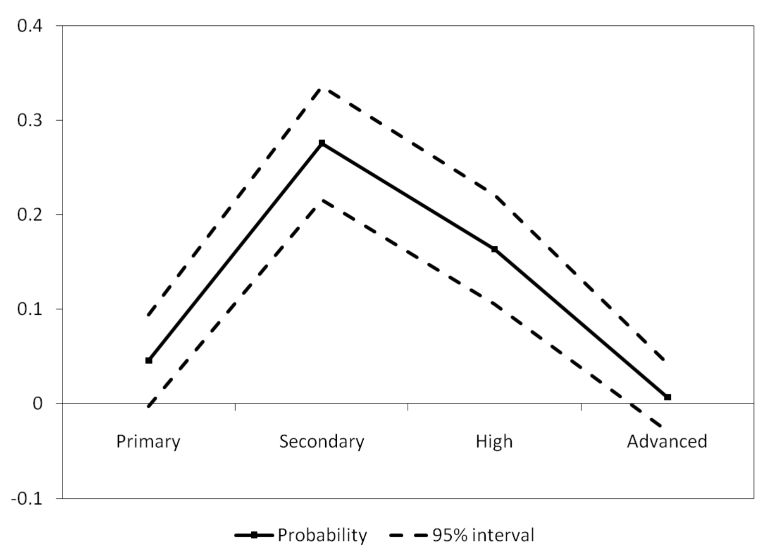
Following Duflo (2001), I estimate the equation below to check if the CSL succeeded in effecting mainly the targeted groups since the impact of the CSL on fertility depends on it.

$$E_{im} = d + G_i\beta_t + T_i\hbar_m + \ _i \tag{10}$$

where E_{ikm} is a schooling variable which takes value 1 if individual i completed m level of education, 0 otherwise. d is a constant, β_t accounts for group time fixed effects (7-11; 12-15; 16-19 in 1997), and T_i is a dummy indicating whether individual i belongs to the "treated" age group (exposed). $\hbar_m$ is the estimated impact of the CSL for 4 different levels of education (m): primary (5 years of education), secondary (8 years of education), high (11 years of education), and advanced (more than 11 years of education). Figure 6 presents the estimated probabilities from a linear probability model (LPM) with corresponding 95% confidence intervals.

The effect of the CSL is the highest for the probability of completing 8 years of education, at the level of the goal of the education policy. There is evidence that the CSL increased the likelihood of completing high school (11 years), and a negligible effect on the probability of completing advanced education. Despite the small spillovers, the program substantially increased schooling through the level of education associated with the CSL.

Figure 6: Probability of Completing at Least "M" Level of Education



B. Heterogeneous effects by parental characteristics

In this section, I test whether the effect of the CSL on education differs by parental education and ethnicity. Since exposure to the treatment is at a rather young age (females aged 7-11 in 1997), the role of parent's education is likely a significant factor. In particular, females with high level of parental education are likely to achieve a level of education beyond the legal requirement even without the CSL and, therefore, are less affected by a change in the law. Ethnicity is not directly observable; however, mother and father's mother tongue can be used as a proxy. One possible hypothesis is that non-Turkish-mother-tongue parents may be less likely to send their children to school as a consequence of the CSL because the education is in Turkish, which may or may not benefit children in communities where non-Turkish languages are commonly spoken (especially Kurdish). In other words, the effect of the CSL on education is likely heterogeneous across both parent's education and parent's mother tongue and uncovering these effects may provide valuable insights.

Towards this end, I use either two-way or three-way interaction: interact treatment dummy with the parental education or ethnicity or interact cohort dummies with treatment dummy and the parental education or ethnicity. I use mother's education dummies and mother's mother-tongue dummies to test the relationship as follows:

$$E_i = a + T_i\delta + \sum_{k=1}^{3} ME_{ik}\mu_k + \sum_{k=1}^{3}(ME_{ik} \times T_i)\beta_k + X_i\theta + {}_i \qquad (11)$$

$$E_i = a + T_i\delta + \sum_{k=1}^{3} ME_{ik}\mu_k + \sum_{l=7,k=1}^{l=19,k=3}(T_i \times ME_{ilk} \times d_{il})\gamma_{lk} + X_i\theta + {}_i \qquad (12)$$

where E_i is the education of an individual i, a is a constant, and T_i is a dummy indicating whether individual i belongs to the "treated" age group. X_i is a vector of province-specific control variables, province of birth fixed effects, interactions between the number of primary school aged children in the province of birth (in 1995) and their year of birth dummies, and interactions between the enrollment rate in the province of birth (in 1995) and cohort of birth dummies. d_{il} is a dummy that indicates whether individual i is age l in 1997 (a year-of-birth dummy). ME_{ik} is a dummy for individual i's mother's k categories of educational attainment–there are 4 categories: mothers with no education (0-4 years of education), primary education (5-7 years of education), secondary education (8-10 years of education), and higher education (11-higher years of education). In the specifications above, the omitted category is the one with mother's no education. I use analogous specifications to examine whether the effect of the CSL depends on parental ethnicity. The three categories of the proxy variable–mother's mother-tongue–to indicate mother's ethnicity are Turkish, Kurdish, and others (Turkish is the omitted category in the specifications.).

Table 14 presents the results of the estimations of equation 11 and 12. The results, shown in Part A of the Table, are consistent with the idea that the effect of the CSL on education declines with the level of parent's education. However, only the interaction between treatment and mother's education category of primary school is significant in Column (1) of Part A; whereas the same interaction is significant for only females aged 7, 8, and 9 in 1997 in Column (2) of Part A. These results provide evidence that the CSL was more successful at increasing education of women with lower levels of parental education; however, it should be noted that most of the estimates are insignificant to be conclusive. In Part B of the Table 14, I present the results of the estimation of equation 12 for heterogeneous effects by parental ethnicity. It suggests that females with Kurdish mothers at the age of 9 & 10 in 1997 are actually negatively affected by the change in the law compared to the ones with Turkish mothers; however, the interaction terms are mostly insignificant and do not provide too much support that the effect differs by parental ethnicity. I also did the same exercises to examine if the effect of the CSL on education varies by father's education level and ethnicity and the results followed the same pattern.

Table 14: Heterogeneity of the CSL effect on education by mother's education and ethnicity

	Part A: Mother's Education		Part B: Mother's Ethnicity	
	Dependent Variable: Years of Education		Dependent Variable: Years of Education	
Variables	(1)	(2)	Variables	(3)
Treatment	1.599***	1.591***	Treatment	2.456***
	(0.293)	(0.292)		(0.226)
ME (primary)	1.664***	1.664***	Mother's ethnicity (Kurdish)	-3.057***
	(0.163)	(0.162)		(0.263)
ME (secondary)	3.198***	3.199***	Mother's ethnicity (Other)	-2.293***
	(0.398)	(0.396)		(0.676)
ME (higher)	5.023***	5.010***		
	(0.627)	(0.625)		
Treatment*ME (primary)	0.559**			
	(0.267)			
Treatment*ME (secondary)	0.00186			
	(0.548)			
Treatment*ME (higher)	-0.825			
	(0.669)			
Treatment*ME (primary)*Cohort 7		1.153***	Treatment*Other*Cohort 7	-1.053
		(0.331)		(1.657)
Treatment*ME (secondary)*Cohort 7		0.229	Treatment*Kurdish*Cohort 7	-0.388
		(0.727)		(0.450)
Treatment*ME (higher)*Cohort 7		-1.061		
		(0.646)		
Treatment*ME (primary)*Cohort 8		0.970***	Treatment*Other*Cohort 8	0.820
		(0.342)		(1.302)
Treatment*ME (secondary)*Cohort 8		-0.428	Treatment*Kurdish*Cohort 8	-0.0161
		(0.768)		(0.445)
Treatment*ME (higher)*Cohort 8		-0.876		
		(0.687)		
Treatment*ME (primary)*Cohort 9		1.038***	Treatment*Other*Cohort 9	-0.388
		(0.364)		(0.928)
Treatment*ME (secondary)*Cohort 9		0.490	Treatment*Kurdish*Cohort 9	-1.123**
		(0.641)		(0.429)
Treatment*ME (higher)*Cohort 9		-0.325		
		(0.881)		
Treatment*ME (primary)*Cohort 10		0.0704	Treatment*Other*Cohort 10	-0.703
		(0.403)		(0.523)
Treatment*ME (secondary)*Cohort 10		-0.0703	Treatment*Kurdish*Cohort 10	-1.154**
		(0.860)		(0.571)
Treatment*ME (higher)*Cohort 10		-0.905		
		(0.963)		
Treatment*ME (primary)*Cohort 11		-0.667	Treatment*Other*Cohort 11	0.173
		(0.500)		(1.531)
Treatment*ME (secondary)*Cohort 11		-0.122	Treatment*Kurdish*Cohort 11	-0.747
		(1.828)		(0.477)
Treatment*ME (higher)*Cohort 11		-0.0463		
		(0.748)		
Adj. R-squared	0.356	0.358	*Adj. R-squared*	0.364
Observations	4,186	4,186	*Observations*	4,537

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth.

C. First Stage Coefficients: Effects of the CSL on Completed Years of Schooling (Unrestricted Specification)

Age in 1997 Age Cohorts	Dependent Variable: Years of Education
Cohort 7 (age = 7 in 1997)	2.854***
	(0.322)
Cohort 8 (age = 8 in 1997)	3.070***
	(0.311)
Cohort 9 (age = 9 in 1997)	1.952***
	(0.368)
Cohort 10 (age = 10 in 1997)	1.827***
	(0.329)
Cohort 11 (age = 11 in 1997)	0.818***
	(0.249)
Cohort 12 (age = 12 in 1997)	0.573
	(0.299)
Cohort 13 (age = 13 in 1997)	0.569
	(0.251)
Cohort 14 (age = 14 in 1997)	0.291
	(0.269)
Cohort 15 (age = 15 in 1997)	0.268
	(0.305)
Cohort 16 (age = 16 in 1997)	0.627*
	(0.242)
Cohort 17 (age = 17 in 1997)	0.348
	(0.266)
Cohort 18 (age = 18 in 1997)	0.335
	(0.251)
F-statistics	34.97
Adjusted R-square	0.316
Observations	4,684

*Significant at 0.1 level. ** Significant at 0.05 level. ***Significant at 0.01 level.

The F-statistics test the hypothesis that the coefficients of the treated cohort dummies (7-11) are jointly zero.

Notes: Standard errors are in parentheses. Standard errors are adjusted for clustering on the province of birth. The number of children in 1995 is the number of primary school age children in the province of birth in 1995 (80 provinces). Enrollment rate in 1995 is the number of children enrolled in primary school in 1995 (obtained from TurkStat) divided by the number of primary school age children in the province of birth in 1995.