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Essays on Religiosity and Women's Empowerment

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by

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Declaration of Authorship

I, Melike KÖKKIZIL, declare that this thesis titled, "Essays on Religiosity and Women's Empowerment" and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.

- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.

- Where I have consulted the published work of others, this is always clearly attributed.

- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.

- I have acknowledged all main sources of help.

- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed:

Date: August 22, 2021

Abstract

Religion represents an important determinant of economic agents' attitudes. Thus, the interest of scholars in the social norms rooted in the religious culture is not new, and the debates over their implications on economies have been active since the establishment of modern social sciences. But, over and above this, populist right-wing parties are getting more power nowadays, and religious sentiments of people have been one of the several instruments that the political figures frequently address when they aim to please voters quickly. Therefore, it is an unsurprising circumstance that a young economist takes a greater interest in religiosity's economic and social consequences.

This thesis is about the effects of Muslim religiosity on gender inequality in education. Religious traditions of society have historically given a particular form to the formal and informal rules shaping attitudes and decisions. The patriarchal nature of most religious traditions brings different ideal roles to men and women, with some negative consequences for women's abilities. Although the female disadvantage in a religious context does not remain confined to Islam, most Muslim-majority countries today exhibit poor performance in gender equality. With this motivation, the thesis examines the effect of Muslim religiosity on human capital, which stands as the essential element of economic development and gender equality. The first chapter focuses on the STEM skills of students from Muslim countries and investigates whether religiosity explains the deep-rooted gender inequalities in the Islamic world because such skill formation will dictate the future of economies in the long run. The other chapter concentrates on the first generation of the Turkish Republic, the first secular Muslim-majority country, and explores how parental religiosity affects women's educational attainment and their later life outcomes in Turkey. In these studies, Ramadan constitutes the exogenous source of variation in religiosity.

Chapter 1 analyzes the origins of gender inequalities in Muslim countries by examining the effect of religiosity on female and male students' achievements in Mathematics and Sciences. Using Trends in International Mathematics and Science Study test scores of eighth-graders in Muslim countries, I show that STEM performances of female students significantly worsen in the three months after Ramadan. Yet, Ramadan does not affect male students' scores. This result is due to increased religiosity and subsequent reinforcement of traditional gender norms among parents. I further provide evidence of increased gender stereotypes, proxied by low female self-confidence, negative peer pressure on females, in the aftermath of Ramadan.

Chapter 2 analyzes the effects of parental religiosity on female offsprings' educational and other life-long outcomes. The occurrence of Ramadan at the time of the primary school enrollment period reduces girls' chance to complete primary education. It arises from the salience of traditional gender norms that religiosity engenders. Parental religiosity has persistent effects on females' labor market outcomes. They become less likely to be in the labor market and income-earners and less likely to work in professional jobs. Instead, increased religiosity at the critical age of schooling increases the number of children that women have given birth and the probability of women being out of the labor force due to household responsibilities.

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Chapter 1

Religiosity and Gender Gap in STEM Performances

1.1 Introduction

Many Muslim countries persistently exhibit poor performance in gender equality (Figure 1.1). Countries in the MENA region display one of the lowest female enrollment rates at most educational levels; Arab women's economic participation is the lowest in the world, and women are least represented in the Arab States (UNDP, 2005; IPU, 2006). On this problematic state of the women, dependency of the economies on oil-income (Ross, 2008), and the sexual clash of civilizations (Inglehart and Norris, 2003; Norris, 2011) constitute the main theories of political sciences. Recent studies, such as Jayachandran (2015), show that culture and norms may be as important as economic factors in explaining cross-country variation in the gender gap.

This paper investigates whether Muslim religiosity explains the deep-rooted gender inequalities in Islamic countries by examining its differential effects on eighth-grade female and male students' Mathematics and Sciences (STEM) test performances.[1] A large body of the literature on the gender STEM gap highlights gender

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[1] Ross (2008) claims that oil-rich economies limit women's role in the labor market, resulting in low participation of females in politics. The sexual clash of civilization hypothesis by Inglehart and Norris (2003) counterargue to the petroleum patriarchy hypothesis and asserts that the religious traditions that leave a deep imprint upon gender norms have substantial impacts on the decisions of Muslim women in their labor force and political participation. From a different perspective, Jayachandran (2015) finds that cross-country variation in economic development level is insufficient to explain the existing inequality, although gender gaps in every dimension of the index are larger in low-income countries. As such, reviewing the literature on the relationship between women empowerment and development, Duflo (2012) concludes that the interrelationship between these factors may be too weak to be self-sustaining women empowerment. However, this study focuses on the countries with sharp gender inequalities and investigates the role of religiosity in their human capital, which is the essential element of economic development and gender equality.

roles, societal inequalities, and gender-biased school environments as key drivers (Guiso et al., 2008; Dickerson et al., 2015; Breda et al., 2018; Lippmann and Senik, 2018).[2] Cultural traits of parents (Nollenberger et al., 2016), the school environment including gender stereotypes of teachers (Muralidharan and Sheth, 2016; Lavy and Sand, 2018; Alan et al., 2018; Carlana, 2019), and even sexist content of textbooks (Donovan et al., 2019) matter a lot for females' achievements. Moreover, female STEM underperformance due to the stereotypical obstacles they have encountered in their early schooling age can make them choose less demanding high schools (Carlana, 2019) and less math-intensive fields in later grades (Joensen and Nielsen, 2015). The lower performances in STEM, therefore, can hold girls back and engender the lack of women in this field, all of which cause negative and significant contributions to the gender earnings gap (Joensen and Nielsen, 2015; Carlana, 2019; Card and Payne, 2021).

For the empirical investigation, I use the Trends in International Mathematics and Science Study (TIMSS) database over the 1995-2015 period and focus on the eighth-graders in Muslim-majority countries and their STEM performances. TIMSS provides internationally comparable and reliable information on students' STEM performances and is recognized as the longest- and largest-ever dataset on students' achievements. The identification strategy relies on the "as good as random" assignment of students to the environment with different levels of religiosity. Specifically, I use Ramadan as a shock to religiosity since the time spent for religious practices increase in this month due to Ramadan fasting, which is a long-lasting and different form of Islamic practicing than the usual ones.[3] Ramadan moves backward by 10-11 days each year due to the Islamic calendar having a lunar-based system. The examination dates idiosyncratically vary since TIMSS determines the participating country's

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[2] Hedges and Nowell (1995); Machin and Pekkarinen (2008); Ellison and Swanson (2010); Contini et al. (2017) are some empirical findings on boys outperform in mathematics than girls, and girls outperform in reading than boys. Such outcomes have sparked the debate on nature vs. nurture. Hedges and Nowell (1995); Kimura (1999); Baron-Cohen (2004) are some of the studies on *innate* abilities of females and males. Nonetheless, Fryer Jr and Torelli (2010) revealed the absence of math gender gap in the US upon school entry, but girls lose two-tenths of a standard deviation over the first years of school. As such, most of the studies focus on the role of culture in nurturing talents. Kahn and Ginther (2017) reviews this literature through gender perspectives.

[3] Given the particular way of religious practicing of Ramadan fasting, Ramadan increases religiosity both at extensive and intensive margins for the following reasons. Firstly, non-prayers are more likely to participate in this specific spiritual practice; therefore, religiosity increases extensively. Secondly, people substantially increase time spent on religiosity, so it increases religiosity at the intensive margin.

examination season by the hemisphere that the country is located (Mullis et al., 2004).[4] The main idea behind the identification is that students perform in a more religious environment if their exam periods coincide with the one just after Ramadan. I provide supporting evidence showing that female and male students with examination dates near and far from Ramadan have comparable background characteristics with their counterparts in terms of their age, ethnicity, and parental education levels.[5] Since gender differences in STEM performances are the main interest of this study, my econometric specification includes an interaction of Ramadan with students' gender. My empirical strategy includes country-specific time fixed effects that absorb the common characteristics of the eighth-grade students in the same year and country. Therefore, I estimate the impact of Ramadan by comparing the test scores of female and male students whose testing dates coincide with the first three months after Ramadan with the average scores for the rest of same-gender students within the same cohort.

I find that the point estimates of Ramadan for male students on their STEM performances are around zero and statistically insignificant. Among female students, Mathematics performances tend to be lower in the Ramadan examinations by 14.1 score points. The estimated effect is statistically significant and sizable; it reflects 17% of a standard deviation. The estimate on Sciences scores is even more substantial: Female students examined in Ramadan underperform in Sciences by 20.2 score points, equivalent to 25% of a standard deviation. Therefore, the estimates suggest that STEM gender gaps in Muslim-majority countries stem from girls' underperformance. These results are robust to alternative treatment definitions: Results are robust when the comparison group becomes the students with the same gender and background characteristics in terms of age, language spoken at home, parents' educational levels, and within the same cohort of the same country. I further find that the estimated effect for females increases as the examination date is closer to the end of Ramadan, while it disappears seven months after the last Ramadan. The impact for boys does not change with distance; moreover, a placebo regression ran on non-Muslim countries

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[4] Ramadan may have shaped the school calendar of Muslim-majority countries, or while the vast majority of the students are fasting, officials may abstain from surveying for the sake of acquiring comparable data. Nevertheless, the stakeholders of TIMSS, such as national research coordinators or national authorities, will unlikely have legitimate reasons concerning when to carry it out in the aftermath of Ramadan month. After all, this study compares the average STEM performances of the students surveyed within the first three months after Ramadan with the average scores of the ones tested after that period.

[5] On average, male and female students with non-native families are 1.1 and 1.3% points more likely to be tested in Ramadan rather than other periods at a 95% of confidence level. However, including or excluding non-native speakers from the estimated samples or inclusion as controls do not change my findings, meaning that such differences do not drive my results.

produces no significant effect.

Physical strains of Ramadan fasting and the potential differences in the participation between female and male students in religious fasting are also found unlikely to derive gender-based effects. I find that men and women in Muslim-majority countries comparable to the students are equally likely to be raised religiously, using World Values Survey. In addition, I further check with several strategies if sex differences in puberty age lead females to higher likely to be religiously fast compared to male students. Still, the results are not in line with the puberty hypothesis. However, I find that Ramadan undermines girls' performance in STEM through the higher salience of traditional gender norms. To examine the effect of Muslim religiosity on gender norms, I use the Arab Barometer. My identification strategy relies on that the distance of interview dates from the most recent Ramadan is orthogonal to any characteristics that may affect adults' opinions. Likewise, the balance test confirms that the women and men interviewed near Ramadan have similar socioeconomic backgrounds with the same-gender interviewees surveyed in the other periods. The results reveal that, as the society expects to be more religious and modest for a woman than a man, females' self-reported religiosity increases in the subsequent periods of the holy month. But, more importantly, females give more conservative answers to gender norms questions in the aftermath of Ramadan. Thus, due to the more pronounced dominance of religious values in daily life during Ramadan, social pressures result in an equilibrium where women report in such a way that they curb their progressiveness and commit to the tradition, as in line with the preference falsification theory by Kuran (1997).

Going back to the student achievement data, I further find that the conservative values become more apparent in the school environment, and thus gender gaps in STEM performances become visible. For example, the increased religiosity leads to self-confidence problems among girls. This finding is in line with Bordalo et al. (2019) showing that gender stereotypes cause females to experience less confidence in themselves while doing the tasks attributed to males, including STEM performances. Also, Ramadan leads peers to perceive her STEM success as less significant. It also relates to the literature on the Acting White hypothesis that emphasizes the significance of negative peer pressure, especially on minority groups in academic performances and the career choices, such as Austen-Smith and Fryer Jr (2005); Fryer Jr and Torelli (2010); Bursztyn et al. (2017, 2018). Similarly, the higher the salience of traditional gender norms, the lower the return of educational activities in the labor market over the return to group membership. Therefore, it implies that female students act as Muslim women: they underperform in the exams by lowering

their educational efforts.

This study relates to a broader literature analyzing the role of religion in the development and accumulation of human capital.[6] Becker and Woessmann (2009); Botticini and Eckstein (2012) argue that Protestants and Jews, compared to Catholics, have better economic outcomes due to the investment in literacy. Becker and Woessmann (2008) shows that Protestantism had a positive influence on gender equality in primary education. Squicciarini (2020) shows more religious locations had lower economic development after Catholicism in France during the Second Industrial Revolution. Distinctively than this literature, I focus on the more recent situation of the students and their skill formation, which will dictate the future of economies in the long run. Nowadays, the gender gap in enrollment ratios is getting much better; however, the causes behind the gender differences in STEM abilities still require further investigation. With this purpose, this study identifies the effect of religiosity on Muslim students' STEM skills that ultimately contribute to individuals' economic and social outcomes.

This study is closely related to a broad literature on religion and gender inequalities in attitudes and outcomes. Guiso et al. (2003); Seguino (2011); Schnabel (2016) identify that a religious upbringing, including Muslim, fosters attitudes inconducive to female education and employment. Norton and Tomal (2009); Cooray and Potrafke (2011) show a robust positive association of Muslim population share of countries with the gender gap in their educational attainment, after controlling for several characteristics that may point to gender differences across countries. Seguino (2011); Schnabel (2016) find the negative association of religiosity with the attitudes and outcomes related to gender equality. However, these studies above operate religious denomination or the extent that individuals are involved in religious practices. The key challenge of these studies with establishing a causal effect is selection into religiosity and the omitted bias problem; that is, Islam also captures the factors other than itself significant to female education or attitudes toward women's empowerment.[7] This study addresses these empirical challenges by exploiting the exogenous variation in daily distances of examination dates to the ending date of Ramadan.

The current study also contributes to the literature on how Ramadan fasting

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[6] Iannaccone (1998) and Iyer (2016) overview of the literature on the economics of religion. Basedau et al. (2018) also reviews the studies on the causal effects of religion on socioeconomic outcomes. Kuran (2004) discusses the role of Islam in the underdevelopment of the Middle East and Kuran (2018) reviews and discusses the recent findings on Islam with the methodological strains of them and aspects of future research.

[7] Kuran (2018) reviews the recent findings on Islam and economic development and discusses the aspects of future research.

affects student achievements, such as Afifi (1997); Oosterbeek and van der Klaauw (2013); Hornung et al. (2018). Oosterbeek and van der Klaauw (2013) find that the university students in Amsterdam with an origin from Muslim-dominant countries lower their grades for the courses taught in Ramadan month compared to the same courses taught in other periods and the other students.[8] In contrast to Oosterbeek and van der Klaauw (2013) and this study, Hornung et al. (2018) find that increases in fasting hours improve the educational outcomes in Muslim-majority countries. The main distinction from Hornung et al. (2018) is that this paper exploits the exogenous timing of Ramadan. Moreover, it focuses on the effects for different subgroups of Muslims, such as females and males.[9]

The study is also related to the literature on gender stereotypes and the gender gap in achievements. Alan et al. (2018) identify that teachers' traditional norms negatively affect the math and verbal skills of female students in Turkey by transmitting traditional beliefs to girls. Carlana (2019) reveals significant consequences of implicit gender stereotypes acquired by teachers for the success of females in Italy and the field of study they choose in a higher grade. Bordalo et al. (2019) shows that stereotypes contribute to gender gaps in self-confidence in achieving a task attributed to a particular gender. Consistently, Jouini et al. (2018) shows that any stereotype of lower ability leads to gaps in confidence as well as in performances. This study adds the literature that religion may reinforce norms and stereotypes. Religious beliefs can engender favorable preferences of males on attaining advanced levels of education and unfavorable preferences regarding women's working outside the home.

The remainder of this paper proceeds as follows. Section 1.2 focuses on the existing literature in economics on religiosity and/or religion. It also includes brief information on how Ramadan can reinforce social norms. Section 1.3 provides information on datasets used in this study. Then, I explain the identification strategy of this paper in Section 1.4. Section 1.5 reports the main results on STEM scores, including robustness checks, in addition to discussion of the findings. Section 1.6 focuses on the mechanisms derived from such outcomes, with additional supporting pieces of evidence. Finally, Section 1.7 includes concluding remarks and some policy-suggestions.

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[8] Oosterbeek and van der Klaauw (2013) find that the adverse effects of Ramadan are similar for male and female students. The differences in our results are likely because the female Muslim students in the Netherlands are least likely to be exposed to conservative expectations of a Muslim society.

[9] Concerning the measurement of religiosity, the distances of testing dates to Ramadan may have some advantages relative to variation in annual fasting hours because their increases may lower the likelihood to participate in the religious activity. Therefore, the causes behind the higher performance of Muslim students that perform in years having higher fasting hours may remain uncertain.

1.2 Background

A society's religious ideas and traditions give a particular form to the formal and informal rules shaping attitudes and decisions. The norms rooted in religions and their implications for economies have been actively debated since the establishment of modern social sciences (Guiso et al., 2003).

Recent studies point to the importance of religion in attitudes, depending on the specific forms of beliefs that the religions bring. For example, the seminal paper, Guiso et al. (2003), evaluates whether the religions predominant worldwide are associated with the beliefs conducive to higher per capita income and higher economic growth, such as the attitudes toward cooperation, the government, legal rules, or thriftiness. Guiso et al. (2003) finds that the Christian religions are positively associated with most of the beliefs conducive to good economies, while Islam is mostly negatively correlated to it.[10] Consistently with the previous study, Barro and McCleary (2003); McCleary and Barro (2006) find a negative correlation of religious behavior with economic performances. Despite such associations, Bénabou et al. (2015) suggests that religiosity, regardless of its specifics, works at cross-purposes with creativity and innovations. Campante and Yanagizawa-Drott (2015) is the only study that can infer causality in this topic and finds that religiosity has negative implications for economic performance, despite increases in subjective well-being among followers.

The patriarchal nature of most religious traditions brings different ideal roles to men and women, with some negative consequences for women's abilities(Basedau et al., 2018).[11] Many findings focusing on gender and religion argue the suppressing role of religion in women-right in society, including their inclusions rights into educational institutions and the labor market. For example, conservative attitudes toward women are prevalent in all religious denominations (Guiso et al., 2003; Seguino, 2011; Schnabel, 2016). Religious people of every denomination tend to attain less egalitarian gender values, but that the estimated effect is found twice as strong for Muslims than any other religion (Guiso et al., 2003). Consistently, the gender gaps in educational attainment levels are more pronounced in the countries with Muslim dominance (Norton and Tomal, 2009; Cooray and Potrafke, 2011). The

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[10] Kuran (2004) discusses the role of Islam in the underdevelopment of the MENA region and Kuran (2018) reviews the recent findings along with a discussion on methodological strains and the potential aspects of future research.

[11] See Holm and Bowker (1994) for women and religion, and Basedau et al. (2018) for the literature review on the causal effects of religion on socio-economic development.

disadvantage observed for females in a religious context does not remain confined to their educational acquisitions: the low rate of female labor force participation is also associated with patriarchal norms and religiosity (Guner and Uysal, 2014; Dildar, 2015). Even more, the misperception regarding the social norms complicates female labor force participation decisions in Saudi Arabia (Bursztyn et al., 2020). However, the previous literature has some challenges regarding revealing a causal effect of Muslim religiosity on women empowerment since active religiosity is not random and even problematic and unethical to be randomized. Therefore, such analysis requires an exogenous instrument that increases religiosity. In this aspect, Ramadan constitutes a relevant natural experiment.

The Islamic calendar follows the lunar phase cycle, so the dates drift by around 11 days relative to the sun year. Therefore, Ramadan dates do not remain in the same seasons, retrogressing over time as a month of the Islamic calendar. During Ramadan, Muslims should observe one of the Islamic pillars, fasting every day from dawn to sunset over this holy month. Therefore, strict rules on religious participation in the activity with a long duration strengthen the religiosity in micro and macro levels to a great extent. Weekly search-trend data of Google on Allah confirms sharp increases of religiosity in Ramadan month. (Figure 1.5a). The pattern is similar for the worldwide data and one of the Muslim-majority countries, meaning that the growing attention of non-Muslims to Islamic culture is least likely to induce such a pattern. More importantly, the idiosyncratic variation of Ramadan dates allows disentangling the effect on religiosity from the other confounding factors, such as the seasonal environment.

Ramadan is not only the month Muslims observe religious fasting but also a time of socialization. The daily routine in Ramadan includes pre-dawn and fast-breaking meals taking place in squares as charity activities and then congregating in mosques after fast-breaking to pray together there (Colussi et al., 2021; Akay et al., 2013). At the end of Ramadan month, Muslims celebrate the ending of this holy month in a three-day sacred festival, visiting relatives and acquaintances. Consequently, all these activities result in increased time spent on religious activities and reinforcing cultural traits.

Traditions appertain to Islamic culture may result in acquiring the norms inconducive to gender equality. For example, one of the two most authentic Hadith books in Islam prescribes that mosques should be gender-segregated. Accordingly, reserving the praying places behind the imam –leading prayers in mosques– to males and allocating the most hidden places to women enables the most appropriate way

of collective praying in mosques (see Siddiqui (1976), Book 4, Hadith 881). Likewise, women today have been praying behind partitions or in separate areas, not in the main hall (Figure 1.5b). Also, imams have been men all along, especially in Muslim territories. Consequently, an intense exposure of females to these kinds of coordination in sacred places due to their faith strengthened by Ramadan may reinforce the idea that men ought to have a superior role in every aspect of life. A qualitative study conducted among Muslim women in Norway and the UK suggests in a similar way that women's engagement with the mosque can lead to the reproduction of established forms of male power (Nyhagen, 2019). Thus, it is likely that Ramadan induces devotion to religion, resulting in a commitment to the traditional values of society.

1.3   Data

This study mainly employs two different data sources. First, to test the effect on the STEM gender gap, I use TIMSS from 1995 to 2015. Second, to investigate the link between religiosity and gender norms, I use the rounds from 2009 to 2015 of the Arab Barometer. This section starts with describing the TIMSS database and then focuses on the Arab Barometer. More detailed information on the sample structures, including descriptive statistics, data-cleaning process, and methods applied for country selection, can be found in the Data Appendix part.

Students' STEM Achievements: Trends in International Mathematics and Sciences (TIMSS) is a global education survey that quadrennially measures the student achievements of the participating countries worldwide (Figure 1.7). Starting the first study in 1995, TIMSS is the internationally comparable and reliable database with the most prolonged time period on students' STEM skills. So far, eighth-graders who pursue

their education in 75 different countries have been participating in this survey.[12][13]

In building the scheme of its sampling and implementing such a large-scale assessment survey, the International Association for the Evaluation of Educational Achievement (IEA) coordinates the National Research Coordinators of countries in collaboration with the Statistics of Canada. To ensure national authorities meet the standards of TIMSS, the abovementioned stakeholders exert substantial efforts, starting from constructing the design of questions to providing a representative sample and even evaluating student performances. To better measure the eighth-graders' skills from different countries, IEA determines the schedule of examinations according to the participating countries' school calendars, i.e., the two or three months before the end of eighth grade. Since the timelines of school activities differ by the hemisphere that countries belong to, schools in the Southern hemisphere typically close in November-December while ending in June-July in the Northern part.

Thanks to being the most extensive survey, data covers a wide-ranging group of countries regarding their population demography. According to Miller (2009), which brings together the estimates on the prevalence of Muslims within a country, 18 out of 75 ever-participated countries have a Muslim community that makes up more than half the total population of the country. These, in order by their Muslim proportions, are Tunisia, Iran, Morocco, Jordan, Algeria, Turkey, Palestine, Saudi Arabia, Kuwait,

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[12] TIMSS pays particular attention to the data collected from different countries to be comparable to the greatest possible extent; therefore, they develop standardized materials and procedures (Martin and Mullis, 1996). Moreover, constructing an assessment data free from the stereotypes of evaluators stands as one of the top priorities of TIMSS. Regarding securing high standards for data quality, the unit of TIMSS Quality Control Monitors at the International Study Center works rigorously and ensures the production of qualified data through dual-system support to the national centers. For example, since assessment items of TIMSS include the questions in constructed-response format in addition to the multiple-choice questions, regarding the required transformation-procedure of free-response items of questions into numerical data, IEA develops the 'CodingExpert' software, which has an integrated control mechanism that guarantees high-quality coding. Besides, the institution provides intensive training programs for coders, regularly surveils the coders, and stringently assesses the coders' performance.

[13] TIMSS has several advantages over OECD's PISA regarding the use for the empirical investigation. First, PISA started in 2000, and early participating countries are mostly OECD member states, where Muslims constitute the minority. More specifically, the list of Muslim-majority countries that have ever been participating in this survey is as follows: Albania, Azerbaijan, Indonesia, Jordan, Kosovo, Kyrgyzstan, Lebanon, Malaysia, Morocco, Qatar, Saudi Arabia, Tunisia, Turkey, United Arab Emirates, and Uzbekistan. However, only two countries, i.e., Albania and Indonesia, constitute the countries conducting the surveys since the starting year of PISA. Besides, Tunisia and Turkey had conducted their PISA survey since 2003, and a quarter of the group joined in 2015. On the other hand, every survey year, PISA focuses on one theme among literacy, mathematics, and sciences, asking more questions related to this field. But, TIMSS attributes equal importance to mathematics and sciences, which subjects are the main interest of this study. Last but not least, PISA does not collect students' examination dates, which provides the main variation exploited in this study.

Egypt, Syria, Indonesia, Oman, Bahrain, Qatar, United Arab Emirates, Malaysia, and Lebanon. In the rest of this paper, I refer to these listed countries as Muslim-majority countries.

A closer looking into countries' average performance reveals that this group predominantly remains as low-performing countries. In other words, they place in the first or second bottom quartiles in the distribution of aggregate performance levels of countries. However, the countries with the lowest shares of Muslims are more diversified in this sense. To attain the main coefficients of interest so that they do not capture the measurement error due to the heterogeneity across countries, I exclude the high-performers within this group of countries from the additional analysis of this study. I refer to the countries whose average test scores are higher than the global level as high-performers (See Table 1.11 for the average test scores of each participating country. See Table 1.12 and Table 1.14 in Data Appendix for the summary statistics of the two groups of countries.). Hence, I conduct the placebo test by using the data of 15 countries out of 48 Muslim-minority countries, which are namely Botswana, Chile, Colombia, Denmark, El Salvador, Georgia, Honduras, Iceland, Moldova, Philippines, Portugal, Romania, South Africa, Spain, and Thailand. For each group of countries, I drop first- and second-generation immigrants detected through the information on the country of origin for students and the parents. Following Campante and Yanagizawa-Drott (2015), I mapped the historical dates of Ramadan month to the Gregorian calendar through Islamic Philosophy Online, and then I integrated them into TIMSS.

The examinations that date coincide with the three months following the end of Ramadan constitute 12 percent of the total number of student tests.[14] The treated group is composed of some students from Bahrain, Indonesia, Kuwait, Malaysia, or Tunisia. (Figure 1.6a).[15] Besides, Ramadan examinations have taken place in different years. More importantly, 1999 rounds of Indonesia and Tunisia surveys allow a variation within the wave, thereby, to estimate the effect of Ramadan within the same cohort. Since Ramadan dates within the two last decades are more frequently intersecting with Southern countries' schedules, the treated students mostly come from this hemisphere (Figure 1.6). The Muslim-majority sample has an equal distribution by gender. The majority of students in this sample are at the ages of 13 or 14, speaking the testing language at home often, and having parents with an education level lower

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[14] I use Ramadan term in the rest of this paper to refer to the first three months after Ramadan.

[15] 90-day window used to estimate the effect in the main results is changed from 70 days up to 120 days of windows, and the results obtained from different threshold values remained similar with the main results.

than secondary school (Table 1.12). Students in Muslim-minority countries are similar in terms of such characteristics (Table 1.14).

Gender Norms: Arab Barometer is the survey used to assess the effect of Ramadan on gender norms and religiosity of Muslim people. It rigorously conducts nationally representative public opinion surveys for the MENA region since 2006, providing insight into the social, political, and economic attitudes and values. The countries covered by this survey are namely Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Saudi Arabia, Sudan, Tunisia, Qatar, and Yemen.[16] One of the common characteristics of Arab Barometer countries is that Muslims comprise the majority. Given that the primary empirical variation is the time distance of interview dates to Ramadan, I integrate the data collection periods from the national technical reports into the dataset, specifically for the second and third rounds. Besides, I exclude the refugees detected through the place of interview, i.e., refugee camps. The interviews fall into the first three-month period after Ramadan, constitute 14 percent of the total sample. Males are slightly more dominant in the sample, with a 49 percent share for women. Almost half of the individuals hold an educational degree less than secondary, whereas one-third respond to a tertiary degree. One-sixth of the sample does not speak Arabic as its first language, and roughly speaking, half of the respondents are married.

1.4 Identification

Previous studies on the nexus of religion and education-related outcomes, e.g., Evans and Schwab (1995); Loury (2004); Lehrer (2006); Brown and Taylor (2007), have neglected the confounding factors such that they fail to identify the social environments that are appropriate for human capital acquisition. Differently than those, this study exploits the Islamic holy month, which engenders an exogenous

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[16] I exclude Bahrain from my empirical investigation, for two following reasons: Bahrain has been participating only in 2006, of which round does not contain information on some controllers to be mentioned in the empirical analysis, such as province, and type of residential area. Most importantly, this country's data collection period is not a month-year basis, but the national technical reports provide information on the field-work year.

increase of religiosity at the extensive and intensive margins (Figure 1.5a).[17] More specifically, given that the daily duration allocated to spiritual activities in the holy month has an equivalence to at least half of the day, besides that religious fasting is a different form of practice than praying five times a day or reading the Quran, in Ramadan month, the number of participants to religious activities increases with the ones who perform prayer irregularly but observe fast, while the time devoted to religion extensively increases at the aggregate level.

While Ramadan dates follow the lunar calendar, TIMSS mainly determines the examination season of a participating country by the country's hemisphere. Therefore, the distance between testing dates of TIMSS from the last Ramadan is assumed to induce as good as random variation in religiosity, which ultimately affects students' academic performance. I thus use the following equation that allows estimating the effect of Ramadan to differ for boys and girls:

$$\text{Score}_{ict} = \beta_0 + \beta_1 Ramadan_{ct} + \beta_2 Female_i + \beta_3 Ramadan_{ct} * Female_i + X_i'\delta + \lambda_t + \mu_c + \varepsilon_i$$

$$(1.1)$$

where Score denotes STEM performances of student i, who has taken part in the survey for country c at time t. *Female* refers to the gender of student i. *Ramadan* is the dummy switching on when the examination date at time t carried out among

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[17] The economics literature extensively exploits Ramadan in natural experimental settings to address research questions related to plenty of subfields, such as economic growth, health, education, labor, and political economy. A broad summary of the extant literature is as the following. The seminal paper of Campante and Yanagizawa-Drott (2015) studies the impact of religiosity on economic growth and subjective well-being, using the fasting durations as an exogenous variation in active religiosity. Colussi et al. (2021) uses Ramadan dates as a proxy for a higher salience of minorities in Germany and studies the effect of the minority salience on voting outcomes in Germany. Van Ewijk (2011); Schultz-Nielsen et al. (2016); Greve et al. (2017) uses Ramadan month as an exogenous shock to fetal malnutrition and studies its impacts on educational, health, and labor outcomes of the infant. The most relevant previous studies to this study examine the impact of Ramadan on Muslims' academic performances (Afifi, 1997; Oosterbeek and van der Klaauw, 2013) and (Hornung et al., 2018). Oosterbeek and van der Klaauw (2013) examines its implications for the Muslim students' academic performance at VU University Amsterdam, using a differences-in-differences framework. Oosterbeek and van der Klaauw (2013) finds that the university students in Amsterdam with an origin from Muslim-dominant countries lower their grades for the courses taught in Ramadan month compared to the same courses taught in other periods and the other students. However, they find quantitatively similar effects on female and male students. Hornung et al. (2018), on the other hand, uses the exogenous variation in fasting hours over time and across countries and estimates its effects on students' achievements, using TIMSS as well as PISA. Contrary to Oosterbeek and van der Klaauw (2013), their estimates point to positive effects on the students' performance. Besides, an identification based on fasting hours may reflect students' participation rates in certain religious activities. Therefore, the causes behind a lower gap among the students with and without Muslim-majority country origin may remain uncertain. Moreover, Hornung et al. (2018) does not consider its differential impacts for female and male students, which is the main interest of this study.

students of country c falls into the first three subsequent months of the last Ramadan. X is a vector of covariates consisting of background characteristics of student i and finally, λ and μ capture year- and country-fixed effects, respectively. *Female$_i$* controls for the pre-existing gender gap in STEM rather than Ramadan. Country-fixed effects absorb all time-invariant differences across countries, such as cultural factors or other country characteristics, which do not vary over time. Year-fixed effects, in turn, capture to what extent the average achievement level of country c in time t has been differing compared to the reference year of country c.

β_1 reveals the estimated effect of Ramadan, and β_3 estimates any additional impact of Ramadan for girls after controlling for these factors. Therefore, they reflect the average performance differences among students with the same observable characteristics but differing in the sense of religiosity. Given that the measures for participation in religious fasting and the religious denomination are not detectable, the coefficients reveal reduced-form estimates, which are unbiased and reliable under the strict exogeneity assumption. To support evidence on strict exogeneity of Ramadan with the characteristics of female and male students, Table 1.1 reports balance test results and reveals that the observables are statistically the same for male and female students who performed in Ramadan and non-Ramadan periods, except the language spoken at home. On average, male and female students with non-native families are 1.1 and 1.3% points more likely to be tested in Ramadan rather than other periods at 95% of confidence level (Column 3 of Table 1.1). This issue is going to be addressed in Section 1.5. Including or excluding non-native speakers from the estimated samples or inclusion as controls do not change the estimated effects.

1.5   Empirical Findings

In this section, I start by reporting how religiosity affects male and female students' STEM performances. After that, I test the robustness of the previous results when I assume the students who perform on dates with a distance to Ramadan no far than 70-120 days are the treated group. In addition to that, I report the implications when I estimate the marginal effects of the distance of exam dates to Ramadan. Then, I use students in Muslim-minority countries as a placebo test since religiosity captured by Ramadan is expected to be resilient among this group of students. Finally, I allocate the final stage of this section to the heterogeneous effects on test scores.

1.5.1 The Effects of Ramadan on STEM Performances

Column 1 of Panel A and Panel B in Table 1.2 report the estimates on Ramadan's effect on female and male students' STEM test scores after controlling for country and the time fixed effects. The estimated Mathematics and Sciences gender gaps in the non-Ramadan period are 1.5 points in favor of females and 1.2 points in favor of males, respectively. The gender gaps are statistically insignificant, reflecting comparable average STEM scores of female and male students before the treatment, as in line with the unconditional means for female and male students, reported in Table 1.13. It reveals that in both Muslim-majority and -minority countries, females are performing better in Mathematics and worse in Sciences, despite the statistically insignificant gender gap for each group of countries. As these groups of countries are low-income countries, proxied by the cross-country STEM performance rankings, the selection of higher-performing girls may be taking place by the income effect. As such, the female coefficients for STEM performances turn negative when I control for the background characteristics of students (Column 2, Table 1.2).

Point estimates of Ramadan on STEM performances of male students are statistically insignificant than zero. Among female students, Mathematics performances tend to be lower in the Ramadan examinations by 14.1 score points. The estimated effect is sizeable; it reflects 17% of a standard deviation. The estimate on Sciences scores is even more substantial: female students examined in Ramadan underperform in Sciences by 20.2 test points, equivalent to 25% of a standard deviation. Therefore, the estimates suggest that STEM gender gaps in Muslim-majority countries stem from female students' underperformance by the effect of Ramadan.

Non-Native Speakers in Ramadan

Overrepresentation of male and female students who speak the testing language less frequently in the treated group by 1.2 and 1.4% points compared to the other students may lead the previous estimates to reflect the effects of language difficulties experienced at school. Yet, this concern is insufficient to explain the sizeable impact presented in Column 1. Therefore, I re-estimate the Ramadan effect after additionally controlling for students' background characteristics, including their age, maternal and paternal education levels, and frequency of speaking the testing language with family members (reported in Column 2, Table 1.2).

These covariates' inclusion increases the estimated effect on boys' performances

to 4.8 points in Mathematics and 6.5 points in Sciences, but these estimates remain statistically insignificant, despite lowering standard errors. On the other hand, for females, the estimated effects of Ramadan stay the same in relative terms: Girls lose 25% of a standard deviation in Sciences and 17.8% of a standard deviation in Mathematics. Considering that the unobservable characteristics of students with different language backgrounds are likely to differ, I run the previous exercises separately for native and non-native speakers. Nevertheless, I still find robust females' underperformance to different language skills and even more significant effect among daughters of native-speaking families (Table 1.8). As the non-native group of students is highly likely to contain non-Muslims, I find a lower estimate for girls within this group of students. On the other hand, the previously estimated effects for the students who speak the testing language at home in different frequencies are not statistically different at 95% confidence level. Briefly, Ramadan has no impact on the performances of boys. In contrast, it causes girls to underperform in STEM by 17% and 25% of one standard deviation.

Contributions of Student Characteristics

Variations in STEM test scores across students that arise from country-specific components but uncaptured by country-specific time-fixed effects may cause biased estimates if Ramadan coefficients incorporate this residual variation. In this regard, although the interested countries are relatively similar in terms of economic development, I interact the student characteristics with country identifiers to consider the differential contribution of each background characteristics by country (the results in Column 3 of Panel A and B in Table 1.2). A more cautious way to subtract the effect of student characteristics from the interested effect results in slight increases in the standard errors of Ramadan coefficients, but subtle diminishes in the ones for the gender gap in the non-Ramadan period. Besides, Ramadan effects for male and female students remain similar to the ones reported in Column 2, Table 1.2 and this evidence is even valid for the two fields of study. Therefore, the main findings are robust to this alternative specification.

The baseline model presented in Equation 1.1 also assumes parental educational attainment levels affect girls' and boys' performance in STEM similarly. However, it may not be the case in practice. Therefore, I ensure the unbiased Ramadan coefficients by introducing a term interacting the students' characteristics with their gender because parents' education levels may contribute to female and male students' performances differentially (the results in Column 4 of Panel A and B in Table

1.2). As expected, the multiple interactions of gender penalize the estimated gap in the control group; the point estimates and standard errors of female coefficients consequently change to an excessive extent. In turn, the estimated effect of Ramadan for female math performance reduces to 13.3 points, an equivalent to 14.3% of a standard deviation. Similarly, the estimated impact for females on Sciences scores reduces to 18.7 points, corresponding to 21% of one standard deviation. After all, even in a cautious specification, the insignificant effects on boys' STEM performances and the undermining impacts on girls remain robust.

1.5.2 Robustness Checks

Timing of Examinations

The previous analysis considers the treated students as the ones' exam dates coincide to three month-interval after Ramadan month. Now, I use different threshold values than 90 days to estimate the effect. The simple intuition of this exercise is that if what the Ramadan identification captured pertains to the religiosity itself, the estimates are expected to remain stable, no matter how one defines the treated examinations.

Figure 1.2 illustrates estimated coefficients from separate regressions in which the threshold varies from 70 days to 120 days since the end of Ramadan. I rely on the specification presented in Equation 1.1; therefore, all regressions include the same set of controls as in Column 2 of Table 1.2. Insignificant effects on boys' outcomes and female STEM underperformances remain robust to the change of threshold value. The inclusion of a larger number of students into the treated group only reduces the standard errors. Besides, point estimates on the boys' achievements in two fields converge to zero at the end of the fourth month after Ramadan month. Interestingly, the adverse effects on females' achievements are slightly downscaling over time, but it can remain its salience even in the fourth month following the end of Ramadan.

Treatment Definition

The current exercise considers an alternative definition of treatment, which estimates the marginal effects of exam dates' distance to Ramadan(the results in Table 1.3). This method also allows for evaluating how the gender gap in test scores evolves after a Ramadan shock. To this end, Column 1 reports the results when I assume the marginal effect of distances on test scores to be constant in every distance level

of examinations. Column 2 reports the results when considering the potential non-linear effects of exam dates' distances on the performances. Also, given the concerns over this variable's distributional feature, Column 3 reveals the results after taking logarithm of the variable of interest.

Boys' performances do not significantly alter by the distance of exam dates to Ramadan (Table 1.3). Besides, the findings on the detrimental effect of Ramadan on females' academic performance are still robust. More specifically, girls underperform in Mathematics by 20.3 points, and the math gender gap vanishes away on the 215th day after the end of Ramadan month (Column 1, Table 1.3). On the other hand, in Sciences, females underperform by 30.3 points just after Ramadan, and the date when the gender gap disappears corresponds to the 206th day after the end of Ramadan. Consequently, on the 334th day, which refers to one day before Ramadan starts, females overperform in STEM by 11.2 and 18.7 points, respectively. Therefore, even though girls overperform boys before the start of Ramadan, the students then receive the same shock of Ramadan, and it ends up girls falling again behind the boys by the end of Ramadan. These results then imply that the negative contribution of Ramadan in later years to the gender gaps becomes limited because of female over-performance before the treatment, potentially through mechanisms of female dropouts of school or the females' resilience to Ramadan effect.

These results are qualitatively similar when distance in log-form; log-transformation makes the gender gap due to Ramadan shock relatively overestimated (Column 3, Table 1.3). When considered that the marginal effect of Ramadan shock on students' performances is likely to change over time, the results again remain similar: The impact on boys' is again statistically insignificant; females respectively underperform by 28.3 and 39.4 points in STEM (Column 2, Table 1.3). However, girls recover quicker, and the respective gender gaps disappear in the 143 and 150. Furthermore, despite the statistical insignificance of β_1 that indicates the effect common to boys and girls, the point estimates reported in Column 2 of Table 1.3 are in line with the findings in the medical literature, such as Toda and Morimoto (2004); Rouhani and Azadbakht (2014); Kul et al. (2014), on the non-persistent effects of Ramadan fasting. The students recover from the adverse impact of Ramadan fasting on STEM in the 40th and 20th days after Ramadan; furthermore, the adverse effects for boys disappear entirely in the 80th and 40th days after Ramadan.

The Effect on Students in Muslim-minority Countries

Ramadan should not reveal any effect on the students in the countries where Islamic culture is not dominant unless the identification does not capture factors other than religiosity. Hence, an exercise on the students in Muslim-minority countries provides supportive evidence that the previous estimates are unbiased and reliable. In this respect, I use a group of countries comparable to the prior ones in terms of performances as a fake-treated group to test if their STEM performances are affected by Ramadan. They include Botswana, Chile, Colombia, Denmark, El Salvador, Georgia, Honduras, Iceland, Moldova, Philippines, Portugal, Romania, South Africa, Spain, and Thailand.

Figure 1.3 presents the estimated coefficients from separate regressions in which the threshold used for the sample selection varies from 0 to 10 percentages. In addition, varying definitions of Muslim-minority countries depending on the Muslim shares in a country are applied to reveal the extent of its robustness. As expected, the implications for both boys and girls are statistically insignificant. Also, point estimates for girls and boys are always around zero and positive, suggesting increased religiosity impairs girls' performance.

1.6 Potential Mechanisms behind Female Underperformance

Ramadan fasting or the gender-related factors that bring with Ramadan may be the potential explanations for the previous findings. Most scholars acknowledge that fasting may worsen students' performance by impairing their learning process (Afifi, 1997; Oosterbeek and van der Klaauw, 2013). Toda and Morimoto (2004); Rouhani and Azadbakht (2014); Kul et al. (2014) are some of the studies that review clinical findings on the effects of religious fasting on health outcomes for Muslims. They report some positive and adverse effects, such as weight loss, dehydration, increases in serum uric acid, and improvements in lipid parameters. Besides, these effects are found as unlikely to persist after Ramadan (Toda and Morimoto, 2004). More importantly, this literature interprets the differential effects of fasting between females and males, depending on their social status. For example, the heterogeneous impacts on weight loss are attributed to the women's tendency to be less likely to work outside the home than men. Or, they explain it through the smoking behaviors of men and

women or alike. Therefore, when considering students' context, biological differences are insufficient to explain the impacts on the gender gap in student performances, unless female and male students are equally likely to fast, on average.

1.6.1   Religious Fasting at Extensive Margin

Families may tend to girls to raise more religiously than boys. Therefore, a higher likelihood for female students to fast due to parental traits may explain why Ramadan leads females to underperform, whereas no effect on male students' performances. To control for this potential issue, I use World Values Survey and focus on Muslims in the countries where they are the majority. Table 1.4 reports whether being raised religiously differs by gender, after the usual controls, such as age, ethnicity, and the country-fixed effects. As the main interest is to understand if it differs among the eighth-graders, and given that pious parents are less willing to send their daughters to school, Column 2 reports the results for a group of individuals who are either a graduate of or have attended secondary school. It reveals that 80% of the individuals with comparable educational levels to the students have been raised religiously. However, I don't find significant differences in reports between females and males. Therefore, as fasting is one of the Islamic pillars, it is most likely that background characteristics account for students' fasting behaviors.

According to the tradition, ill, elderly, menstruating, or pregnant believers can be exempt from observing ritual fasting. Otherwise, every adult Muslim ought to sacrifice as a sign of faith.[18] Considering the association between being an adult and puberty, the differing puberty ages of girls and boys may be causing girls performance impaired while the ones for boys are unaffected. Experts' opinion on the mean age of menarche and delayed age is 12 and 13 for girls. Similarly, puberty age for boys is assumed to be 13, and the delayed age corresponds to around 14 (Marshall and Tanner, 1969, 1970; Palmert and Boepple, 2001).[19] Despite the potential that puberty

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[18] It is worth emphasizing that there is no specific rule indicating at which age a person should start fasting. Instead, the Quran states that it becomes compulsory when someone reaches an age where one can understand what has been doing and who can be responsible for one's actions. As such, the consensus among Muslims is that families should be starting to encourage children around age 7. The interview of BBC News on Muslim children's fasting adverts to this subject, in particular, interviewing with Muslim families and children along with religious officials.

[19] Marshall and Tanner (1969, 1970) present mixed longitudinal data on the physical changes of boys and girls at puberty. For boys, the genitalia begins to develop between 9.5 years and 13.5 years, with a mean equivalent to 11.6 ± 0.09. Boys reach maturity at ages varying between 13 and 17 (mean = 14.9 $\pm$ 1.10). The first sign of puberty for girls, such as breast or pubic hair development, appears between 8.5 years and 13 years, and the breasts reached the mature stage between 11.8 and 18.9 years.

ages lower the likelihood for male students to fast in Ramadan, the students aged 13 or lower constitute 2% of the sample.

In any case, I drop the female students aged below 12 and male ones aged below 13, and Table 1.5 reports the results on STEM scores for the group eligible to fast. Still, the estimates are pretty similar to the one in Column 2 of Table 1.2. As an alternative to the previous evidence, the Ramadan effects are estimated within the subgroup of students in the same age centile. The basic intuition is that if puberty is the primary driver of the differential effects found, boys at the top centiles are expected to be negatively affected in Ramadan. However, for boys in every age group, the impacts remain statistically insignificant (Table 1.9). Also, the pattern of point estimates over the age distribution does not support the last-mentioned hypothesis. Hence, the argument of puberty age as a driver of the results is unlikely to be well-founded. Females during the menstruation period are not allowed to fast but ought to make up for the missing days. Another concern is that female student observe religious fasting on the date they perform for TIMSS. Even though the participants are supposed to be informed about testing beforehand, such an outcome is extreme.[20]

1.6.2 Heterogeneous Effects

This part addresses whether Ramadan fasting is the underlying mechanism by looking at the estimated effects for female and male students are differential to maternal education. Given the negative association between religiosity and education, one can consider that the lower educated mothers are more religious compared to the higher educated mothers.[21] Then, we expect that male and female students whose mothers are lower educated are more likely to be religiously fasting, and vice versa. Therefore, one would expect that Ramadan lowers the test scores of the less-educated mothers' sons. To reveal the heterogeneous impact, I subgroup the students concerning the education level of mothers. For the two student groups, we can describe the following: Lower educated mothers are sizeable in the sample, and the students whose mother has an educational degree less than secondary school constitute almost half of them (Table 1.12). Furthermore, given that the students are in the eighth grade, the daughters are more likely to be among the first generations that pursue the eighth

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[20] Specifically, for the case of pop-up testing or missing out of student on an announcement, the probability for a girl who ought to cover 3-7 days to fast in a given day ranges between 0.8 percent(=3/335) and 2 percent(=7/335). So, the chance of a fasting day for a girl to coincide with the testing date is less than one percent, i.e., it lies within the interval of (0.4% - 1%). Consequently, this argument does not help explain such a substantial effect, as well.

[21] Considering a higher likelihood of assortative mating, I only focus on the maternal background.

grade at school. Yet, the unconditional estimates reveal that the girls and boys with the same maternal background perform similarly, despite the statistically different average test scores among students with different maternal characteristics.

Figure 1.4 illustrates the estimated effects on the students with mothers having an education level below secondary and higher than secondary school. First of all, the results for male students with different family backgrounds remain the same: the coefficients for the two groups of male students are around zero and are still statistically insignificant. Therefore, if highly-educated mothers had been non-Muslim or higher likely to be detached from religion, one would expect the sons and daughters of less-educated mothers to be adversely affected due to the fasting, irrespectively to their gender. Yet, the findings regarding boys and even their point estimates do not support this argument.

Interestingly, the estimated effects for female students are differential to maternal education. Figure 1.4 points that the negative impact of Ramadan is more pronounced among female students if their mother has acquired less education. On average, daughters of mothers having less than a secondary education underperform in Mathematics by 15.8 points, an equivalent of one-sixth the standard deviation, and in Science by 21.9 points equal to one-fourth of the standard deviation (Figure 1.4). Among the daughters of mothers with higher education levels, I find the effect of Ramadan on Mathematics scores is not statistically different from zero. However, the female underperformance in Sciences is more pronounced compared to the girls with better maternal characteristics. Girls with a mother who is a graduate of at least secondary school are estimated to lose 14.1% of a standard deviation in Sciences by Ramadan, whereas the average Science scores of girls in the other group decrease by 26.3% of a standard deviation. In short, the daughters of lower educated parents mainly induce adverse effects on Mathematics. As for Science performances, the detrimental effects slightly diminish if the girl has a mother who has a better educational level (Figure 1.4).

1.6.3 Gender Norms

After providing a discussion on the physical consequences of Ramadan fasting as a potential driver for female underperformance, in this part, I examine whether increased religiosity leads girls to underperform in STEM through the higher salience of traditional gender norms using the Arab Barometer from 2009-2017. To measure the degree of religiosity, I employ the following: Performing prayer, reading or listening

Quran, wearing a headscarf, and how religious the individual identifies oneself.[22] To elicit the gender ideology of individuals, I use their agreements to the following statements: "A woman can work outside if she wishes", "University education is more important for males than females", "A woman can become a president or prime minister of a Muslim country". The first two prescriptions reveal the first-order beliefs of individuals. In contrast, the views on women's ability to become a political leader of a Muslim country are more likely to be dominated through second-order beliefs, considering the nature of political elections. Unconditional means of the gender-related outcomes are in line with Bursztyn et al. (2020), the views on gender are progressive in the MENA region (Table 1.15).

The identification strategy relies on that the distance of interview dates from the most recent Ramadan is orthogonal to any characteristics that may affect adults' opinions. Balance test results presented in Table 1.10 support this assumption largely. Although females with the most frequent characteristics are slightly less interviewed near Ramadan by 1.3-1.6% in Ramadan, the slight underrepresentation of females in the interviews near and far from Ramadan is one of the main characteristics. (Table 1.15). I estimate the effects relying on Equation 1.1. It reflects the average outcome differences between the interviews in Ramadan and non-Ramadan periods, after controlling for some personal characteristics, year-specific-country fixed effects, provincial fixed effects, and type of the residential area.

Table 1.6 reports the effect of Ramadan on religiosity and gender norms of male and female adults in Arab countries. As expected, females are more likely to be religious and more progressive toward gender norms in the pre-treatment period: In standard deviation terms, compared to men, women are more likely to pray by 20.4%; more likely to read or listen Quran always or most of the time by 10.7%; and more likely to identify oneself as religious by 10.9%, on average. Also, in standard deviation terms, compared to male counterparts, females are more likely to support women working outside the home by 16.1%; less likely to be gender-bias in the sense of importance on university education by 33.4%, and more likely to believe that a woman can become a high-ranking politician in a Muslim country by 48.3% in the pre-treatment period.

It appears Ramadan's effects on values and religious practices differ by gender. Males' religiosity remains unaffected by Ramadan, whereas women report they devote a more substantial amount of time to religious activities. Women praying most

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[22] Performing five times a day is one of the five pillars of Islam, and the other religious behaviors, including reading Quran and wearing a headscarf, are primarily interpreted as nonobligatory, but *sunna*.

of the time or always increase by 22.4% of a standard deviation. Similarly, women who report they engage in Quran reading increase by 8.4% of a standard deviation. Also, women who identify themselves as religious increase by 7.6% of a standard deviation. Likewise to religiosity, the gender values of males are not affected by Ramadan. However, it appears that females report they curb their progressiveness toward women's rights: In standard deviation terms, Ramadan affects females to restrain their support on working women outside by 16.1%; their support to the equal importance of university education for women and men by 12.8%, on average. According to the preference-falsification argument of Kuran (1997), the social acceptability of opinion plays a substantial role in reflecting preferences, particularly if personal beliefs do not conform to public opinion. Despite the progressiveness of women, increased religiosity leads women to conform to the majority's opinion. Since women are expected to be more religious at the same time, I find females' self-reported religiosity increases in the subsequent periods of the holy month. In line with the preference falsification argument, social pressures result in such an equilibrium that women, who are more supportive of women's rights, commit to the tradition.

1.6.4 Norms Really Salient among Students?

Going back to the students' achievement data, I address how the traditional values appear in the school environment such that they affect girls' performance in STEM if the conservative values are the underlying mechanism. Hence, it aims to endeavor a better understanding of the multi-dimensional effects of gender norms. Also, it allows to re-consider plausibility of the channel suggested. More importantly, a thorough investigation on the mediators can help facilitate public policy targeting if traditional gender norms due to the increased religiosity are in effect. To do so, I focus on some concepts in the literature closely related to gender norms, such as self-confidence and peers' attitudes toward the importance of females' success at school.

Self-confidence

A recent laboratory experiment, Bordalo et al. (2019), shows that stereotypes contribute to gender gaps in self-confidence in achieving a task attributed to a particular gender. Consistently with the previous findings and the theoretical framework of Bordalo et al. (2019), Jouini et al. (2018) incorporates psychological components into

consumption utility, showing that any stereotype of lower ability leads to gaps in confidence as well as in performances. In light of such findings, one can argue that it is expected to observe self-confidence problems among girls if Ramadan poses more rigid gender stereotypes. Besides, self-confidence measures are unlikely to be associated with any harm due to religious fasting.

TIMSS involves some measures of Rosenberg (1965) self-esteem, adopting them in a school context.[23] Table 1.7 reports the estimated effects of Ramadan on some indicators of self-esteem in Mathematics and Sciences for both female and male students. Pre-existing gender differences in perceived abilities in STEM are statistically insignificant. Yet, female and male students interviewed near Ramadan are more likely to be optimistic about their typical capabilities (Column 1 of Panel A and B in Table 1.7).

Ramadan does not change male students' perceived abilities in the two fields compared to their classmates. In contrast, females considerably adjust their perceived self-abilities. Specifically, on a scale of confidence levels from 0 to 1, females' average self-confidence level towards Mathematics decreases by 2% points (Panel A, Table 1.7). The effect on self-confidence in Sciences is even more substantial, reducing by 4.1% points (Panel B, Table 1.7). In relative terms, Ramadan lowers the compared abilities with their classmates about STEM by 6.3% and 12.5% of the standard deviations, respectively (Panel A and B of Table 1.7).

The last measure related to self-confidence is about the extent of students' self-reported aptitudes for the two fields. Neither for boys nor girls, Ramadan has any effect on the perceived talents in Mathematics. Yet, the extent to boys' agreement about finding Sciences as one of this strength increases by 6.3% of a standard deviation, whereas this decreases among girls by 5.7% of a standard deviation (Panel B of Table 1.7). Consequently, the evidence of differential impacts on self-confidence by gender supports the argument of the substantial effects on females' academic performances through the reinforcement of rigid gender stereotypes.

Peer pressure

Although most people are concerned about social image and what others think about them, adolescents may care deeply about establishing an image or identity. Consequently, a desire to shape how their peers view them may influence their

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[23] More detailed information, such as the way of asking, the rounds that contain such questions, and the summary statistics are allocated in Data Appendix.

behaviors to a greater extent. Literature on the behavioral economics of education, such as Austen-Smith and Fryer Jr (2005); Fryer Jr and Torelli (2010); Bursztyn et al. (2018), pays particular attention to social interactions and peer pressure in explaining many stylized facts that emerged among the group members that are prone to be vulnerable. One of the concepts, i.e., the Acting White hypothesis, suggests that minority students may face punishment from peers for exerting effort because such behaviors signal that they are weakly attached to in-group identity. Given a trade-off between the returns of educational activities in the labor market and group membership, some students may decide that signaling group loyalty is more critical when choosing educational effort. Therefore, by adhering to traditional values, Ramadan is expected to shape school-girls' social image in the same manner.

Panel C of Table 1.7 reports to what extent Ramadan has affected friends' expectations in the sense of one's success at school.[24] By the effect of Ramadan, friends of boys believe that his success in Mathematics, Sciences, and Languages becomes more important; however, this effect on beliefs is not statistically significant at a 95% confidence level. On the other hand, a substantial amount of pressure is prevalent among girls' peers: Ramadan increases the degree of peers' perception about her success in Sciences and Languages by 12.7% and 10.9% of their one standard deviation (Panel C of Table 1.7).

Differences in the estimated effects on peers' perceived opinions on Mathematics and Sciences may explain slight changes in the impact on self-confidence about these fields, hence a more considerable underperformance of girls in Sciences. Lastly, the exercise on sports acts as a kind of placebo test. The intuition behind this is that non-academic and the strictly male-dominant field is expected to be unaffected by Ramadan. The results confirm that the peers' attitudes on the importance of sport do not change by the effect of Ramadan (Panel C, Table 1.7).

Interestingly, peer pressure does not target a single field, such as the stereotyped fields, but the school subjects, including languages. Then, her peers' signal is that her school performance does not matter in her prospects. Consequently, the results shed light on the fact that students become aware of traditional norms' higher salience, at least through friends. In line with the Acting White hypothesis, the higher the salience is, the lower is the return of educational activities in the labor market over the return to group membership (Bursztyn et al., 2017, 2018). Accordingly, female

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[24] Gender-based selection into educational attainment poses a higher expectation in the non-treated period towards girls' success in Mathematics, Sciences, and Language courses. Sports are already regarded as less necessary for female students, mainly due to the male-dominant audience for sportive activities and the substantial attention given to males, such as in soccers, basketball.

students act as Muslim women and underperform in the exams by lowering their educational efforts.

1.7   Concluding Remarks

This study sheds light on the causal links between religiosity, gender norms, and the gender gap in STEM performances. It exploits Ramadan as a quasi-natural experiment for increased active religiosity in Muslim-majority countries. Ramadan increases religious practicing at both extensive and intensive margins because non-regular and regular prayers increase the time for religious activities, at least through fasting. More importantly, TIMSS mainly determines the examination season by the hemisphere of countries. Therefore, the distance between testing and Ramadan dates induces as good as random variation in religiosity at the testing date.

Through exploiting the idiosyncratic variation in Ramadan and assessment dates of TIMSS from 1995 to 2015, it estimates that Mathematics and Sciences performances of female eighth-graders in Muslim countries worsen during the three months following Ramadan by 17 and 25 percent of their one standard deviation, respectively. However, Ramadan does not affect male students' academic performances. Such gender-based effects are unlikely due to the rules on religious fasting and gender differences in Ramadan fasting. Instead, the adverse effects mainly arise from the daughters of lower-educated parents. On the other hand, daughters of highly-educated parents are either unaffected or even overperform in assessments near Ramadan. Such heterogeneity in the impact on performances is consistent with the Ramadan effect on the gender norms of adults.

Findings using the Arab Barometer suggest a tendency of women toward traditional norms. Such differences are prevalent in educational subjects and the power of women in politics and household-decision making. Increased religiosity leads women, significantly lower educated groups, to conform to public opinion. It may be through the participation in religious practices carried out in gender-segregated ways. Or, in line with the preference falsification argument, social pressures may result in equilibrium for the women they commit to the tradition.

Further analysis reveals that gender stereotypes are salient in the school environment. Ramadan leads to self-confidence problems among girls. Friends of girls attribute lower importance to female students' success in school subjects, including languages. Acting White hypothesis emphasizes the significance of negative peer

pressure, especially on minority groups in academic performances and the career choices (Austen-Smith and Fryer Jr, 2005; Fryer Jr and Torelli, 2010; Bursztyn et al., 2017, 2018). Similar to the Acting White hypothesis, the higher the salience is, the lower is the return of educational activities in the labor market over the return to group membership (Bursztyn et al., 2017, 2018). Therefore, female students act as Muslim women and underperform in the exams by lowering their educational efforts. Lower self-confidence and negative pressures on females from school peers support the rigid gender stereotypes as the underlying mechanism. Such findings are consistent with imperfect empathy through which parents transmit their preferences to their offspring at the expense of lowering their expected economic outcomes (Bisin and Verdier, 2001; Algan et al., 2013).

The analysis points to multidimensional effects of religiosity on female adolescents, ultimately lowering their achievement scores in STEM by one-forth and one-fifth standard deviations. Perpetuation of the intensified religious practices in Islam compels policy-makers to develop multidimensional policies for the sake of female academic success and its substantial consequences in their adult life. Otherwise, religious culture reproduces social norms far from progressive and becomes the ground for lower female social mobility and larger inequalities among females. Considering poor outcomes of women that can last for generations and its spill-over effects, the pieces of evidence are an alert to leave from having a boomerang effect on the historical development process of women empowerment.

In light of this evidence, breaking the channel involves an urgent evaluation of the school environment and the genuine supports of religious leaders. Acknowledgment by the authorities of female Muslim scientists, such as Maryam Mirzakhani in Mathematics, Anousheh Ansari in Astronomy, Hayat Al Sindi in Medicine, could be a starting point. Furthermore, study materials and school environment could emphasize their excellent contributions to Sciences, thereby helping to create authentic female role models within Islamic culture. Lastly, religious leaders must stand with girls, as now happening in South Sudan.

1.8 Figures and Tables

FIGURE 1.1: Global Gender Gap Rankings, 2020
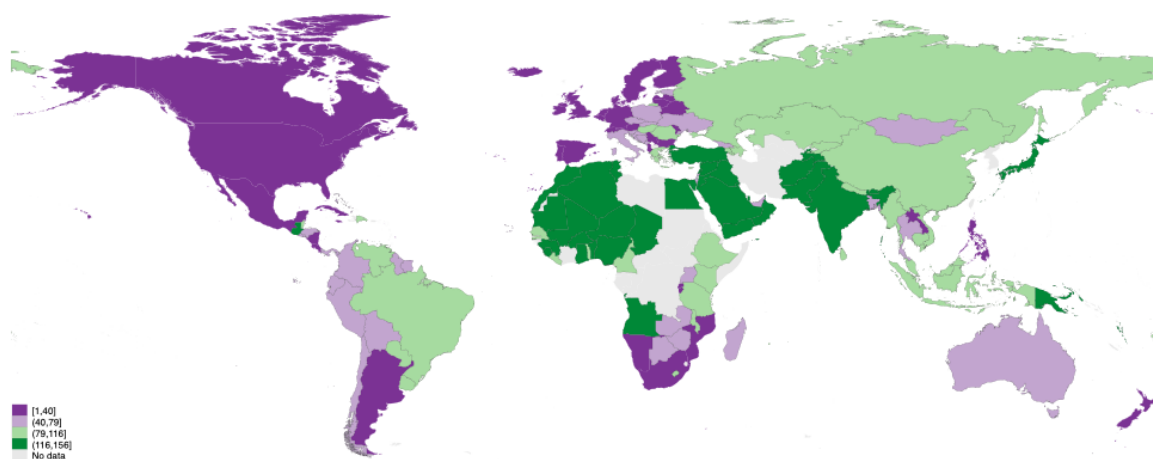
Source: 2020 Global Gender Gap Report of World Economic Forum. Notes: Global Gap Index of World Economic Forum measures gender-based gaps in access to resources and opportunities in countries in order to isolate the actual differences across countries due to the varying degree of economic development. Economic participation and opportunity, educational attainment, health and survival, and political empowerment constitute the main dimensions of this index.

FIGURE 1.2: Exams' Distance to Ramadan and STEM Achievements

(A) Mathematics

(B) Sciences
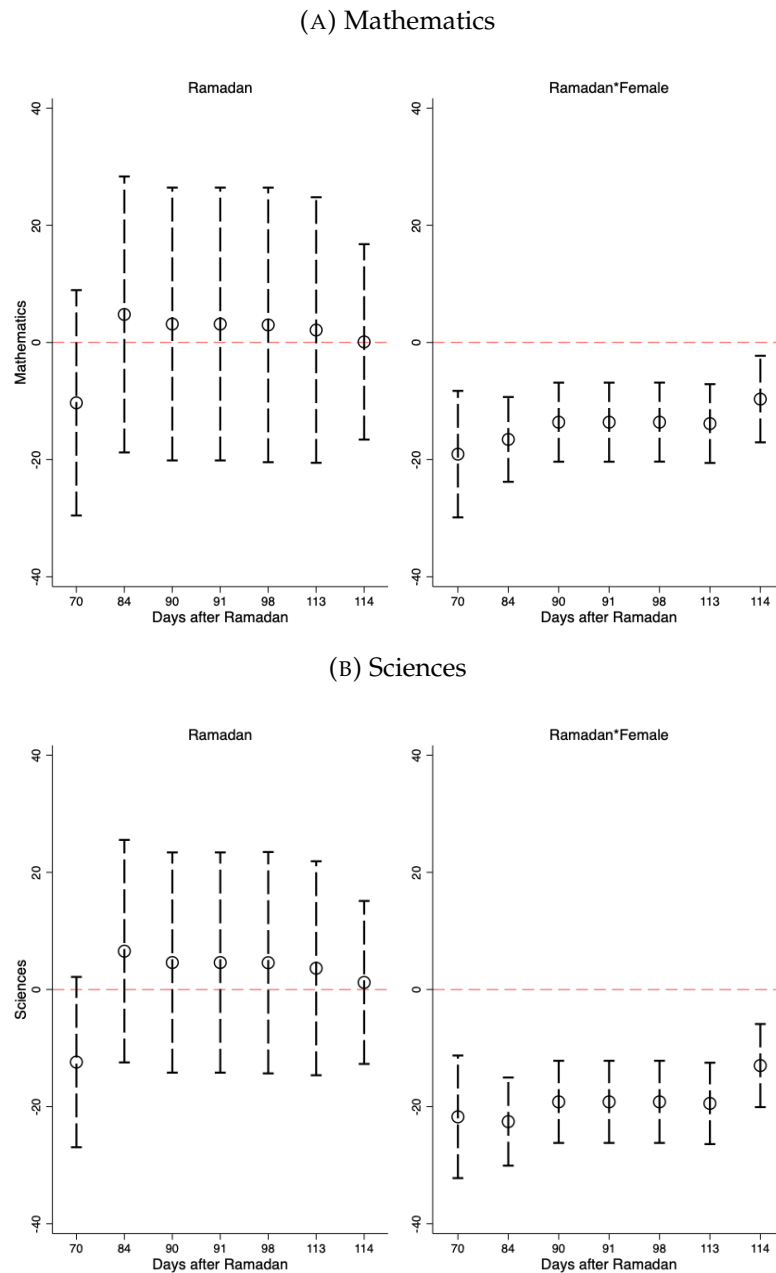
Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: It illustrates estimated coefficients from separate regressions in which the definition of treated examinations varies from 70 days to 120 days since the end of Ramadan. All regressions include the same set of controls, as in Table 1.2, Column 2. The point estimates of each regression are represented with hallow circles and the vertical dashed lines denote the point estimates within 95% confidence level. The estimated gender gaps in non-Ramadan, which also vary by the definition, are statistically insignificant, and they are not presented here due to the space constraints.

FIGURE 1.3: Ramadan, Gender, and Muslim-Minority Countries
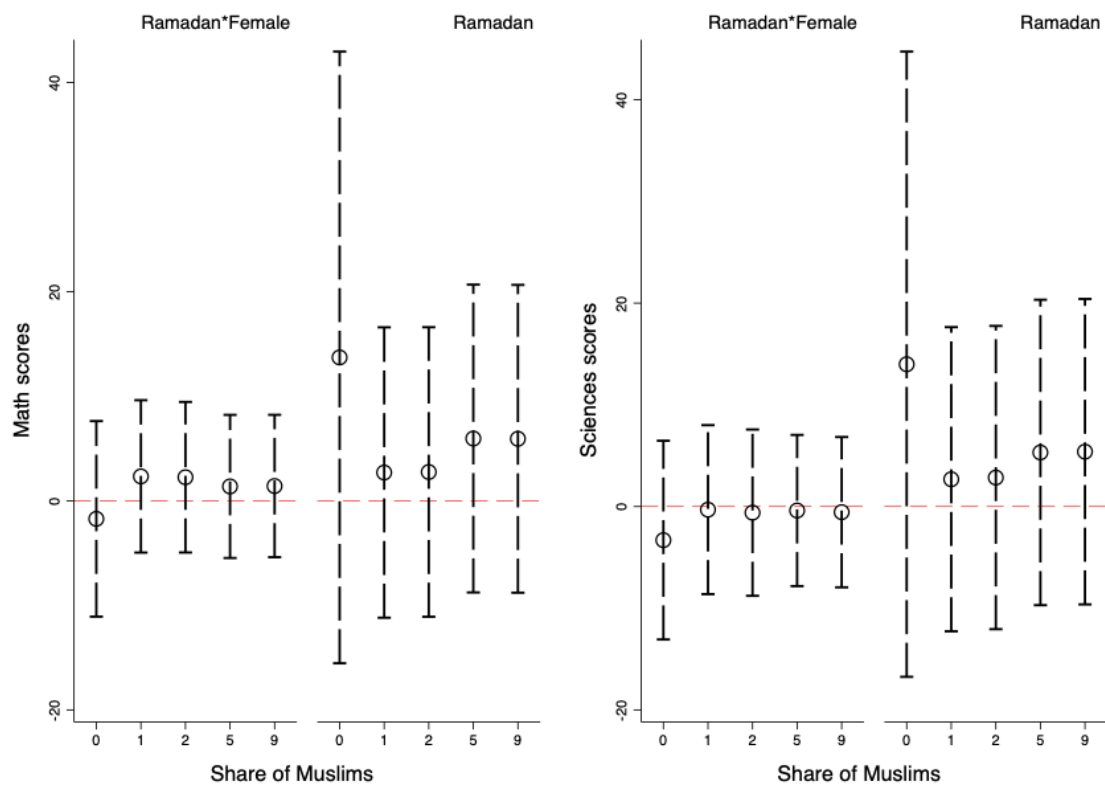
Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: This analysis acts as a placebo test and examines whether STEM performances of the students in Muslim-minority countries are affected by Ramadan. To illustrate these results are robust to how one defines Muslim-minority countries, the figure shows the estimated coefficients from separate regressions in which the threshold value to define whether the country is a Muslim-minority or not vary from 0 to 10 percents. Therefore, x-axis shows the threshold used for the definition and the respective dashed lines show the estimated effects for each group of countries within 95% confidence level. All regressions include the same set of controls, as in Table 1.2, Column 2. Bulgaria, Botswana, Chile, Colombia, Denmark, El Salvador, Georgia, Greece, Honduras, Iceland, Moldova, Mongolia, Philippines, Portugal, Russia, Romania, Singapore, South Africa, Spain are the list of countries examined in this exercise.

FIGURE 1.4: Ramadan, Maternal Education, and Gender Gap in STEM Performances
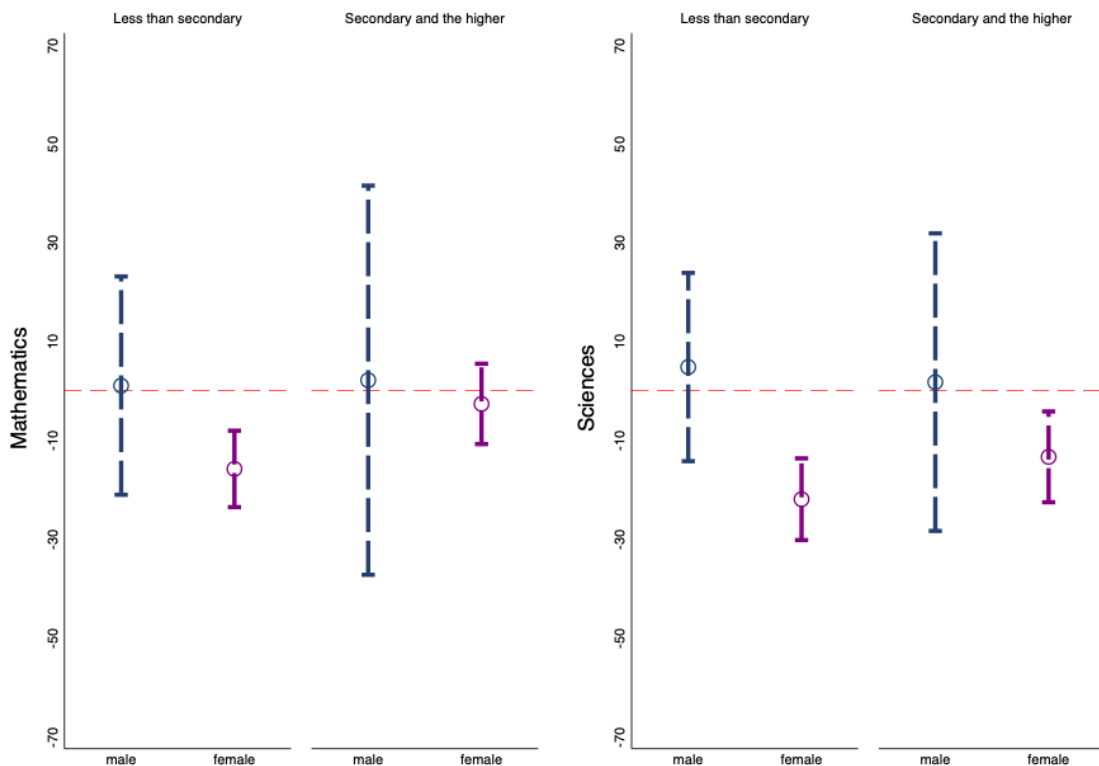
Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Figure illustrates the heterogeneous effects of Ramadan on STEM scores with respect to the education level of mothers. Therefore, students whose mothers are graduated below secondary (secondary or the higher) constitute the lower (higher) educated mothers. Students with lower and higher level of maternal education constitute 44.9 and 48.1 percent of the total, and the estimates for those with unreported maternal education are not presented here. Average mathematics and sciences scores of students with worse backgrounds in order are 407.7 and 435.7, while their standard deviations correspond to 87.1 and 83.4. Average mathematics and sciences scores of the students with better maternal background are respectively 441.6 and 459.6 whereas the respective standard deviations are 98.9, and 95.2. Blue and purple dashed vertical lines denote the estimated causal effects within 95% confidence level and reflect the impact for boys and girls with different backgrounds in the sense of maternal education, respectively. The estimations account for the age- and language-effects along with country-specific time fixed effects. Standard errors are robust and clustered at time-specific country level. Each maternal group remains having the same number of clusters, i.e. 67 clusters.

TABLE 1.1: Balance Test of Ramadan for Muslim-majority countries

	(1) Ramadan	(2) Ramadan	(3) Ramadan	(4) Ramadan	(5) Ramadan	(6) Ramadan
Female	0.000644	0.00152	-0.000412	0.00116	0.00156	0.00138
	(0.000915)	(0.00115)	(0.000828)	(0.00131)	(0.00162)	(0.00166)
Age less than 12		-0.000259				-0.00103
		(0.00111)				(0.00131)
Age at 12		-0.000153				-0.000322
		(0.00352)				(0.00353)
Age at 14		-0.00168				-0.00247
		(0.00176)				(0.00167)
Age at 15		0.000597				-0.00142
		(0.00401)				(0.00362)
Age greater than 15		-0.00187				-0.00425
		(0.00517)				(0.00486)
Female*Age less than 12		0.00106				0.000568
		(0.00253)				(0.00279)
Female*Age at 12		0.00164				0.00259
		(0.00409)				(0.00407)
Female*Age at 14		-0.000919				-0.00120
		(0.00153)				(0.00152)
Female*Age at 15		-0.00465				-0.00573*
		(0.00327)				(0.00324)
Female*Age greater than 15		-0.00263				-0.00316
		(0.00636)				(0.00634)
Non-native speaking family			0.0113**			0.0107**
			(0.00459)			(0.00468)
Female*Non-native speaking family			0.00343**			0.00376**
			(0.00171)			(0.00170)
Mother: Secondary school				-0.00411		-0.00104
				(0.00428)		(0.00375)
Mother: Tertiary or higher				-0.00214		-0.00202
				(0.00251)		(0.00211)
Female*Mother: Secondary school				-0.00136		-0.00127
				(0.00264)		(0.00276)
Female*Mother: Tertiary or higher				-0.000311		0.000309
				(0.00139)		(0.00170)
Father: Secondary school					-0.00620*	-0.00460*
					(0.00345)	(0.00262)
Father: Tertiary or higher					-0.000831	0.00132
					(0.00260)	(0.00173)
Female*Father: Secondary school					-0.000503	-2.69e-05
					(0.00259)	(0.00268)
Female*Father: Tertiary or higher					-0.00154	-0.00189
					(0.00177)	(0.00219)
Observations	274,651	274,651	274,651	274,651	274,651	274,651
R-squared	0.858	0.858	0.858	0.858	0.858	0.858

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Unit of observation is student i of country c performed in time t. The sample consists of the students in the Muslim-majority countries, where the prevalence of Muslims within a country constitutes at least half of the population, according to the estimates in Miller (2009). The countries of interest are namely Algeria, Bahrain, Egypt, Palestine, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Morocco, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Tunisia, and Turkey. Ramadan is a dummy switching on when the testing date within 3 months since the end of Ramadan. The results are conditional on country-specific time fixed effects, and the columns from (1) to (5) report the results where each kind of the background characteristics are regressed on Ramadan individually in order to sort out potential collinearity problem. Reference groups for each type of student characteristics are the ones with the highest prevalence among the students, and it refers to a male student who is at 13 –the age of target population–, whose family speaks the language of testing at home either always or almost always, as well as, whose parents have an education level less than secondary school. Students with lack of information on the covariates remain in the sample but their coefficients are unreported for the space purposes. Nonetheless, male and female students with such characteristics are statistically in equal proportions across Ramadan and non-Ramadan subsamples. Following the recommendations of Martin (2005), PV module of Macdonald (2019) is executed for the regressions and sampling weighting method is applied to adjust the size of population across countries, as well as, the sample properties into country-population characteristics. Standard errors, in parenthesis, are robust and clustered at year-specific country level. Total number of cluster is 67. *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.2: Ramadan, Gender, and STEM Performances in Muslim Countries

Panel A : Mathematics

	(1)	(2)	(3)	(4)
Ramadan	-0.332	4.783	2.051	3.053
	(14.18)	(12.02)	(12.08)	(11.92)
Female	1.489	-1.371	-2.039*	-11.99
	(1.236)	(1.159)	(1.131)	(15.26)
Ramadan*Female	-14.12***	-16.55***	-16.19***	-13.27***
	(4.191)	(3.693)	(3.708)	(3.481)
Country FE	Yes	Yes	Yes	Yes
Country*Year FE	Yes	Yes	Yes	Yes
Background Characteristics	No	Yes	Yes	Yes
Country*Background Characteristics	No	No	Yes	No
Gender*Background characteristics	No	No	No	Yes
Observations	274,651	274,651	274,649	274,651
R-squared	0.112	0.194	0.214	0.196

Panel B : Sciences

	(1)	(2)	(3)	(4)
Ramadan	0.840	6.541	3.242	4.536
	(11.46)	(9.694)	(9.912)	(9.660)
Female	1.469	-1.189	-1.856*	-7.947
	(1.122)	(1.047)	(1.013)	(15.12)
Ramadan*Female	-20.15***	-22.56***	-22.01***	-18.70***
	(4.286)	(3.839)	(3.889)	(3.706)
Country FE	Yes	Yes	Yes	Yes
Country*Year FE	Yes	Yes	Yes	Yes
Background Characteristics	No	Yes	Yes	Yes
Country*Background Characteristics	No	No	Yes	No
Gender*Background characteristics	No	No	No	Yes
Observations	274,651	274,651	274,649	274,651
R-squared	0.123	0.197	0.219	0.199

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Unit of observation is student *i* of country *c* performed in time *t*. The sample consists of student in the Muslim-majority countries, where Muslims constitute at least half of the population, according to the estimates in Miller (2009). The countries of interest are namely Algeria, Bahrain, Egypt, Palestine, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Morocco, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Tunisia, and Turkey. Outcome variables are the five plausible values of the *Mathematics* and *Sciences* scores for the student *i*. The standard deviations of *Mathematics* and *Sciences* scores correspond to *93* and *89*, respectively. Ramadan is a dummy switching on when the testing date within 3 months since the end of Ramadan. Background characteristics include the age intervals, language spoken at home, and parents' education levels of student *i*. Country-specific time fixed effects are included in all regressions. Following the recommendations of Martin (2005), PV module of Macdonald (2019) is executed for the regressions and sampling weighting method is applied to adjust the size of population across countries, as well as, the sample properties into country-population characteristics. Standard errors in parenthesis are robust and clustered at year-specific country level. Total number of cluster is 67. *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.3: Measuring Treatment as Distance to Ramadan, and Gender Gap in Test Scores

	(1)	(2)	(3)	(1)	(2)	(3)
	Math test scores			Science test scores		
	distance in days	distance in days	distance in log	distance in days	distance in days	distance in log
Distance	0.153	-0.0467	15.04	0.125	-0.0158	12.96
	(0.141)	(0.434)	(22.31)	(0.130)	(0.376)	(19.79)
Distance^2		0.000584			0.000405	
		(0.00105)			(0.000917)	
Female	-20.32***	-28.32***	-73.02***	-30.32***	-39.40***	-109.7***
	(3.121)	(7.533)	(13.47)	(3.482)	(7.375)	(13.64)
Female*Distance	0.0944***	0.196**	13.64***	0.147***	0.262***	20.71***
	(0.0162)	(0.0794)	(2.631)	(0.0163)	(0.0736)	(2.589)
Female*Distance^2		-0.000278			-0.000316*	
		(0.000186)			(0.000173)	
Observations	274,651	274,651	274,651	274,651	274,651	274,651
R-squared	0.195	0.195	0.195	0.199	0.199	0.199

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Unit of observation is student i of country c performed in time t. The sample consists of student in the Muslim-majority countries, where Muslims constitute at least half of the population, according to the estimates in Miller (2009). The countries of interest are namely Algeria, Bahrain, Egypt, Palestine, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Morocco, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Tunisia, and Turkey. Outcome variables are the five plausible values of the *Mathematics* and *Sciences* scores for the student i. The standard deviations of *Mathematics* and *Sciences* scores correspond to 93 and 89, respectively. Distance refers to the daily distances of examinations to the most recent Ramadan, and linear and log forms of distance are employed in this exercise. All regressions include the same set of controls, as in Table 1.2, Column 2. Standard errors in parenthesis are robust and clustered at year-specific country level. Total number of cluster is 67. *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.4: Raising Religiously by Gender

	(1) Raised religiously Unrestricted sample	(2) Raised religiously Incomplete secondary or the higher
Female	0.0260**	0.0175
	(0.0109)	(0.0133)
Constant	0.765***	0.799***
	(0.0918)	(0.115)
Observations	5,234	3,815
R-squared	0.143	0.159

Source: World Values Survey Longitudinal [1981-2016] Notes: It assesses if raising religiously among Muslims differs by gender. Muslim-majority countries are included, such as Azerbaijan, Bangladesh, Nigeria, and Turkey. Sample is restricted to people who reports the religious denomination is Islam. The first column is the results for the unrestricted sample after controlling for country-fixed effects, age in cubic form, and mother tongue. As the main interest is on secondary school students, Column 2 reports the results only for whose highest education level is incomplete secondary or the higher. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE 1.5: Ramadan, Puberty, and Student Achievements

	(1) Mathematics	(2) Sciences
Ramadan	5.482	7.202
	(12.71)	(10.29)
Female	1.173	0.936
	(1.159)	(1.047)
Ramadan*Female	-15.05***	-21.76***
	(3.749)	(3.985)
Background Characteristics	Yes	Yes
Country FE	Yes	Yes
Country-Specific Year FE	Yes	Yes
Observations	269,895	269,895
R-squared	0.168	0.175

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: This exercise examines if gender differences in test scores by Ramadan effect are due to varying puberty ages of girls and boys. Considering the sex differences in age to reach puberty, it is assumed that girls at age 12 or higher are in puberty whereas it corresponds to 13-year-old or the older for boys. Hence, this subsample of students is allowed to observe religious fasting. The standard deviations of *Mathematics* and *Sciences* scores correspond to *93* and *89*, respectively. Ramadan is a dummy switching on when the testing date is within 3 months since the end of Ramadan. All regressions include the same set of controls, as in Table 1.2, Column 2. Standard errors, in parenthesis, are robust and clustered at year-specific country level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE 1.6: Ramadan, Religiosity, and Gender Norms

Panel A: Gender norms	(1) Working	(2) University	(3) Political leader
Ramadan	0.0513*	-0.109*	0.00472
	(0.0273)	(0.0567)	(0.0361)
Female	0.144***	-0.106***	0.174***
	(0.00801)	(0.00787)	(0.0133)
Ramadan*Female	-0.0596***	0.0400***	-0.0491**
	(0.0129)	(0.0139)	(0.0199)
Observations	33,105	32,890	20,435
R-squared	0.081	0.096	0.167
Mean	0.84	0.30	0.54
SD	0.37	0.32	0.36

Panel B: Religiosity	(1) Pray	(2) Quran	(3) Religious
Ramadan	-0.0525	-0.00854	-0.0350
	(0.0380)	(0.0529)	(0.0282)
Female	0.0690***	0.0515***	0.0530***
	(0.00679)	(0.00739)	(0.00712)
Ramadan*Female	0.0766***	0.0407***	0.0354***
	(0.0141)	(0.0148)	(0.0128)
Observations	32,799	32,677	33,326
R-squared	0.139	0.116	0.110
Mean	0.87	0.64	0.37
SD	0.34	0.48	0.48

Source: Arab Barometer [2009-2017]. Notes: Unit of observation is the adult *i* living in country *c* and interviewed at time *t*. The countries include Algeria, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Saudi Arabia, Sudan, Tunisia, and Yemen. Outcome variables on gender ideology measured at extensive margin, and they are elicited through the following statements: *"A woman can work outside if she wishes"*, *"University education is more important for males than females"*, and *"A woman can become a president or prime minister of a Muslim country"*. Religiosity indicators are praying, reading or listening Quran, and religious identification of the self, and they are taking the value of 1 if the individual *i* practices the respective from of religious activities either always or most of the time, or the individual *i* identifies oneself as religious rather than somewhat religious or not religious. Ramadan refers to the interviews conducted in the first three month after the end of the most recent Ramadan. All estimates in this table are calculated after controlling for personal characteristics, year-specific country FEs, province FEs, and type of the residential area. Country-specific time trends in non-linear formation are controlled for, as well. Personal characteristics refer to marital status, education level, mother tongue, and age in cubic formation. Linear models with many levels of fixed effects are applied and the standard errors are clustered at province level. Number of cluster is 228 for all regressions.*** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE 1.7: Ramadan, Self-Confidence, and Peer-Pressure

Panel A: Self-confidence in Mathematics

	Usually do well	Difficult than classmates	Not my strength
Ramadan	0.0280*	0.00264	0.00801
	(0.0163)	(0.0101)	(0.00902)
Female	-0.0207***	0.000183	0.0127***
	(0.00267)	(0.00300)	(0.00308)
Ramadan*Female	0.00562	0.0202**	0.00371
	(0.00706)	(0.00847)	(0.00957)
Observations	212,189	203,875	202,364
R-squared	0.104	0.024	0.048
Mean	0.68	0.50	0.50
SD	0.27	0.32	0.33

Panel B: Self-confidence in Sciences

	Usually do well	Difficult than classmates	Not my strength
Ramadan	0.0438***	-0.00232	-0.0227**
	(0.0139)	(0.0112)	(0.0110)
Female	0.00124	-0.0418***	-0.0403***
	(0.00295)	(0.00378)	(0.00364)
Ramadan*Female	-0.00687	0.0385***	0.0452***
	(0.00737)	(0.00727)	(0.00932)
Observations	161,288	153,555	152,310
R-squared	0.118	0.029	0.057
Mean	0.75	0.42	0.42
SD	0.26	0.33	0.35

Panel C: Peer pressure

	Mathematics	Sciences	Language	Sports
Ramadan	0.0213**	0.0242**	0.0201*	0.00631
	(0.0104)	(0.0105)	(0.0105)	(0.0118)
Female	0.0311***	0.0394***	0.0399***	-0.0654***
	(0.00612)	(0.00614)	(0.00685)	(0.00566)
Ramadan*Female	-0.0123	-0.0283***	-0.0243***	0.00498
	(0.00936)	(0.00910)	(0.00880)	(0.0119)
Observations	30,833	30,985	30,322	30,407
R-squared	0.020	0.020	0.015	0.034
Mean	0.80	0.82	0.81	0.78
SD	0.22	0.21	0.22	0.22

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Self-confidences of students regarding STEM fields are elicited through the following statements in the student survey: *"I usually do well in Sciences."*, *"Although I do my best, I find Sciences is harder for me than my classmates."*, and *''Sciences is not one of my strengths."*. Peer pressure are detected through the survey questions and to what extent students agree to following statements: *"My friends think it is important for me to do well in Mathematics/Sciences/Languages/Sports"*. Therefore, they reflect the second order beliefs of male and female students regarding their success in several school subjects. Responses to these statements were in four-point scale and they are standardized into [0,1] where higher values reflect greater level of agrees. The specifications follow the one in Table 1.2, Column 2. Standard errors are in parenthesis and clustered at year-specific country level. *** p<0.01, ** p<0.05, * p<0.1

Appendix A

FIGURE 1.5: Islamic Culture and Religiosity

(A) Ramadan and Allah in Google Search Trends
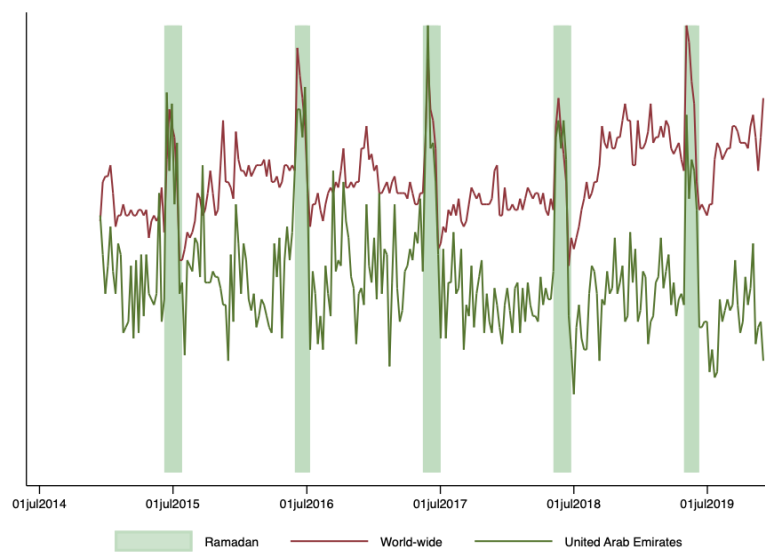
Source: Google Trends, weekly data from 14/12/2014 to 01/12/2019. Notes: Green grid line indicates the weekly search trend of Allah–*the God of Islam*– as a search term. Green line presents the world-wide trend of *Allah* and orange dashed line shows it for a Muslim country, such as United Arab Emirates. Green vertical lines indicate the weeks of the holy month.

(B) Coordination in Mosques

FIGURE 1.6: Sample Distribution with respect to Ramadan

(A) Muslim-majority countries
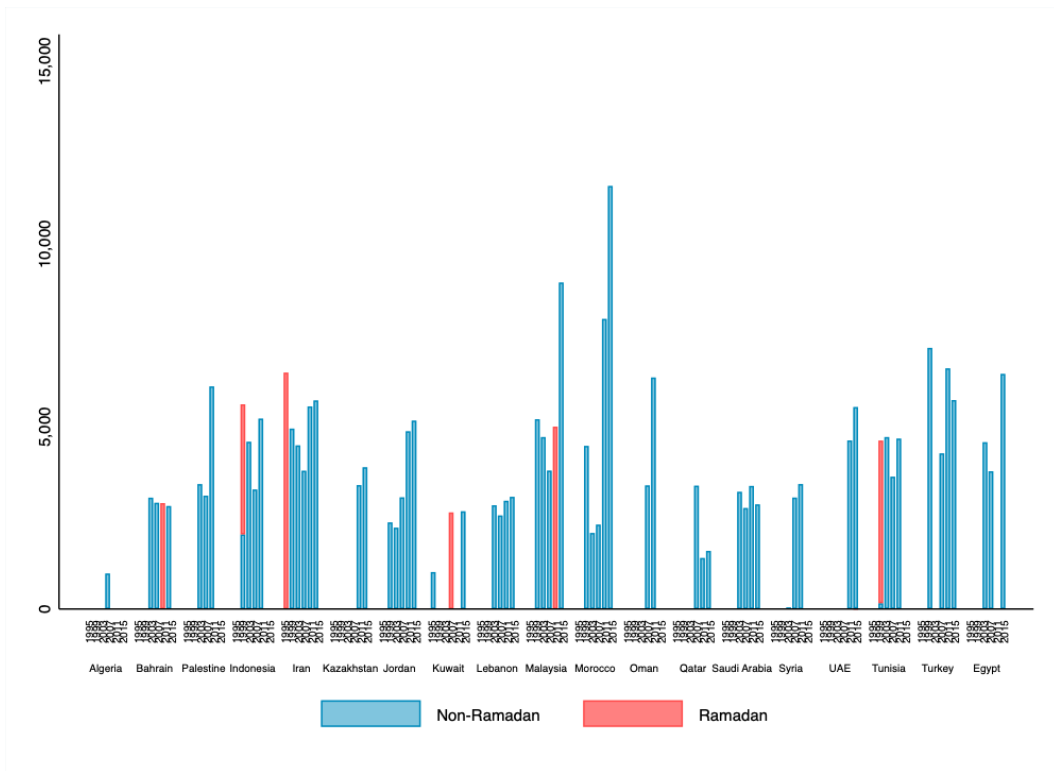
(B) Muslim-minority countries
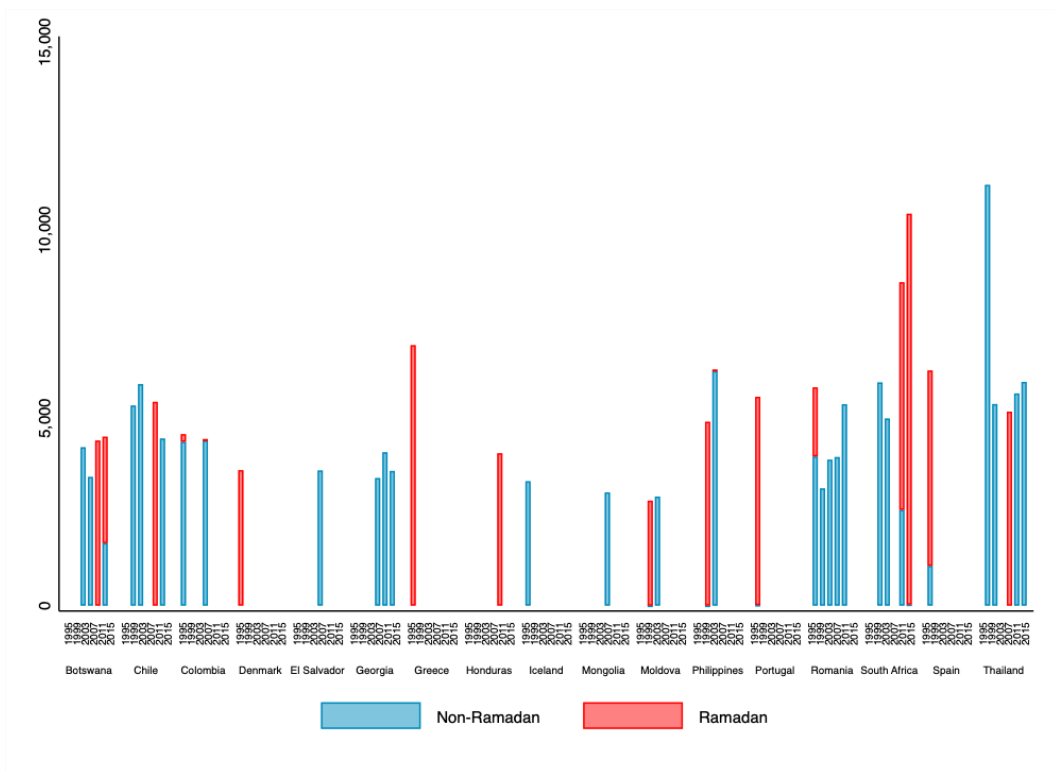
Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: Ramadan refers to the examinations carried out in the first three month after the end of most recent Ramadan while Non-Ramadan refers to the examinations in the other periods.

TABLE 1.8: Ramadan and Performance of Muslim Students by Language Skills

Panel A: Mathematics

	Native	Non-native	Native	Non-native
Ramadan	21.70	-8.798	21.67*	-6.597
	(17.50)	(16.97)	(12.67)	(14.80)
Female	-0.634	1.097	-2.119	-2.050
	(1.424)	(1.538)	(1.298)	(1.477)
Ramadan*Female	-16.89***	-12.86***	-17.67***	-15.08***
	(6.372)	(4.217)	(5.355)	(4.078)
Background Characteristics	No	No	Yes	Yes
Observations	178,351	94,391	178,351	94,391
R-squared	0.124	0.120	0.215	0.179
Chi-square for Ramadan	chi2(1)= 2.25		chi2(1)= 3.04	
P-value for Ramadan	Prob>chi2 = 0.13		Prob>chi2= 0.08	
Chi-square for Ramadan*Female	chi2(1)=0.34		chi2(1)=0.19	
P-value for Ramadan*Female	Prob>chi2=0.56		Prob>chi2=0.67	

Panel B: Sciences

	Native	Non-native	Native	Non-native
Ramadan	17.39	-7.496	17.92	-5.596
	(16.20)	(12.99)	(11.86)	(11.20)
Female	1.348	-1.975	0.0453	-4.830***
	(1.387)	(1.268)	(1.259)	(1.282)
Ramadan*Female	-23.49***	-16.86***	-24.35***	-18.78***
	(6.022)	(4.889)	(5.081)	(4.818)
Background Characteristics	No	No	Yes	Yes
Observations	178,351	94,391	178,351	94,391
R-squared	0.150	0.090	0.227	0.144
Chi-square for Ramadan	chi2(1)= 2.25		chi2(1)=1.94	
P-value for Ramadan	Prob>chi2 =0.13		Prob>chi2=0.16	
Chi-square for Ramadan*Female	chi2(1)=0.34		chi2(1)=0.90	
P-value for Ramadan*Female	Prob>chi2=0.56		Prob>chi2=0.34	

Source: TIMSS - Grade 8 ; IEA [1995-2015]. Notes: Unit of observation is student i of country c performed in time t. The sample consists of student in the Muslim-majority countries, where Muslims constitute at least half of the population, according to the estimates in Miller (2009). The countries of interest are namely Algeria, Bahrain, Egypt, Palestine, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Morocco, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Tunisia, and Turkey. *Native* columns report the estimates for the students whose family speaks language of the test at home either always or almost always, whereas *Non-native* columns are the one for the students whose family speaks language of the test either sometimes or never. The students with missing information on language skills consist of 0.62% of the overall Muslim sample ($N = 1711$), and their results are not reported for interpretation concerns. Outcome variables are the five plausible values of the *Mathematics* and *Sciences* scores for the student i. Ramadan is a dummy switching on when the testing date within 3 months since the end of Ramadan. Background characteristics include the age intervals and parents' education levels. Country-specific time fixed effects are included in all regressions. Following the recommendations of Martin (2005), PV module of Macdonald (2019) is executed for the regressions and sampling weighting method is applied to adjust the size of population across countries, as well as, the sample properties into country-population characteristics. Standard errors in parenthesis are robust and clustered at year-specific country level. Total number of cluster is 67 for all regressions. *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.9: Ramadan, Age of Students, and the Performances

Panel A: Mathematics

Age centiles	(1st)	(2nd)	(3rd)	(4th)	(5th)	(6th)	(7th)	(8th)	(9th)	(10th)
Ramadan	-3.267	7.596	23.74	10.79	1.286	-25.44	-11.69	-7.553	4.158	9.907
	(14.08)	(18.85)	(17.61)	(16.37)	(16.76)	(21.00)	(19.77)	(16.55)	(12.66)	(10.35)
Female	-0.306	-0.785	-5.343**	1.155	-0.997	-3.176	-2.053	1.665	-3.405	-8.557***
	(2.586)	(1.898)	(2.369)	(2.281)	(2.309)	(2.324)	(2.397)	(2.118)	(2.093)	(2.368)
Ramadan*Female	-29.99***	-16.90	-19.08**	-21.34**	-8.512	-1.066	-6.666	0.947	-11.08	-18.27**
	(9.201)	(11.37)	(8.454)	(8.610)	(9.327)	(7.374)	(6.172)	(7.610)	(7.402)	(7.567)
Observations	31,264	28,181	23,201	33,462	26,753	21,779	26,502	30,333	26,085	25,115
R-squared	0.132	0.151	0.143	0.169	0.175	0.171	0.181	0.207	0.187	0.138
Mean of age	13.2	13.6	13.7	13.9	14.0	14.1	14.3	14.5	15.0	16.2
[Min,Max]	[9.3, 13.4]	[13.5, 13.6]	[13.7, 13.8]	[13.8, 13.9]	[14.0, 14.1]	[14.1, 14.2]	[14.2, 14.3]	[14.4, 14.7]	[14.7, 15.3]	[15.3, 23.3]

Panel B: Sciences

Age centiles	(1st)	(2nd)	(3rd)	(4th)	(5th)	(6th)	(7th)	(8th)	(9th)	(10th)
Ramadan	-2.170	3.712	15.44	16.23	5.077	-8.922	0.224	-6.331	5.195	7.446
	(13.48)	(14.34)	(16.09)	(15.15)	(14.59)	(17.28)	(14.57)	(13.34)	(12.25)	(10.42)
Female	0.818	1.321	-2.062	3.197*	0.598	-3.938	-1.637	-1.500	-4.968**	-9.938***
	(2.332)	(2.299)	(2.305)	(1.938)	(2.039)	(2.400)	(1.840)	(2.148)	(2.295)	(2.259)
Ramadan*Female	-33.71***	-24.72**	-19.42**	-26.01***	-22.96***	-9.216	-17.93***	-0.878	-15.47**	-22.08**
	(8.080)	(11.70)	(7.935)	(7.827)	(8.458)	(6.495)	(6.648)	(7.327)	(6.808)	(8.982)
Observations	31,264	28,181	23,201	33,462	26,753	21,779	26,502	30,333	26,085	25,115
R-squared	0.153	0.183	0.183	0.172	0.182	0.183	0.184	0.185	0.169	0.149
Mean of age	13.2	13.6	13.7	13.9	14.0	14.1	14.3	14.5	15.0	16.2
[Min,Max]	[9.3, 13.4]	[13.5, 13.6]	[13.7, 13.8]	[13.8, 13.9]	[14.0, 14.1]	[14.1, 14.2]	[14.2, 14.3]	[14.4, 14.7]	[14.7, 15.3]	[15.3, 23.3]

Source: TIMSS - Grade 8 ; IEA [1995-2015] Notes: To estimate the effect of Ramadan for different age of students, a non-parametric approach is applied here. Columns from (1) to (10) show the effects of Ramadan for girls and boys at the same age decile. The usual Muslim-majority countries of the study constitute the sample, and Algeria, Bahrain, Egypt, Palestine, Indonesia, Iran, Jordan, Kazakhstan, Kuwait, Lebanon, Malaysia, Morocco, Oman, Qatar, Saudi Arabia, Syria, United Arab Emirates, Tunisia, and Turkey are the countries of interest. Outcome variables are the five plausible values of the *Mathematics* and *Sciences* scores for the student *i*. Ramadan is a dummy switching on when the testing date within 3 months since the end of Ramadan. The specification relies on the one presented in Table 1.2, Column 2; but disregards the age effects for obvious reasons. Standard errors, in parenthesis, are robust and clustered at year-specific country level. Total number of cluster is 67 for all regressions. *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.10: Balance Test for Arab Barometer

	(1) Ramadan	(2) Ramadan	(3) Ramadan	(4) Ramadan	(5) Ramadan	(6) Ramadan
Female	-0.0133**	-0.0156**	-0.00791	-0.0151**	-0.0123**	0.00182
	(0.00528)	(0.00615)	(0.0288)	(0.00657)	(0.00517)	(0.0295)
Age			-0.000252			0.000100
			(0.000930)			(0.000975)
Female*Age			-0.000486			-0.00127
			(0.00229)			(0.00244)
Age squared			3.42e-07			-6.24e-06
			(2.04e-05)			(2.09e-05)
Female*Age squared			1.48e-05			3.00e-05
			(5.17e-05)			(5.43e-05)
Age cubed			3.79e-08			7.59e-08
			(1.35e-07)			(1.38e-07)
Female*Age cubed			-1.39e-07			-2.27e-07
			(3.65e-07)			(3.79e-07)
Non-Arab		-0.00294				-0.00257
		(0.00308)				(0.00301)
Female*Non-Arab		0.0137**				0.0131**
		(0.00580)				(0.00538)
Secondary or the higher				-0.00162		-0.00118
				(0.00142)		(0.00132)
Female*Secondary or the higher				0.00325		0.00220
				(0.00380)		(0.00327)
Single					0.00173	0.00133
					(0.00197)	(0.00264)
Female*Single					-0.00295	-0.00380
					(0.00240)	(0.00317)
Observations	33,362	33,362	33,362	33,362	33,362	33,362
R-squared	0.920	0.920	0.920	0.920	0.920	0.920
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Specific Year	Yes	Yes	Yes	Yes	Yes	Yes
Provincial FEs	Yes	Yes	Yes	Yes	Yes	Yes
Urban-Rural	Yes	Yes	Yes	Yes	Yes	Yes

Source: Arab Barometer [2009-2017] Notes: Unit of observation is the adult i living in country c and interviewed at time t. Countries include Algeria, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Saudi Arabia, Sudan, Tunisia, and Yemen. Ramadan refers to the interviews conducted in the first three month after the most recent Ramadan. Reference groups for each type of individual characteristics are the ones with the highest prevalence among the sample, and it refers single, male, and working adults whose first language is Arabic and education level is less than secondary. Spatial fixed effects which consist of country, province, and residential area are taken into account in all regressions. Country-specific time trends are controlled for, as well. Standard errors are clustered at province level. Number of cluster is 228 for all regressions. Standard errors are clustered at province level. *** $p<0.01$, **$p<0.05$, * $p<0.1$

Data Appendix

Trends in International Mathematics and Sciences

Trends in International Mathematics and Sciences (TIMSS) is a global education survey that quadrennially measures the student achievements of the participating countries all around the world (Figure 1.7). Starting the first study in 1995, TIMSS has been the longest-ever data on student achievements. So far, 96 countries from 6 continents in total have participated in this survey, and thus it measures the achievement levels of fourth- and eighth-grade students who pursue their education around the world. TIMSS provides insights into the human capital quality of the next generations, which presents a significant component of future economies. Given such a purpose, its research design and implementation are rigorous and uneasy task; and the appropriate methodology to apply for this is sophisticated, as well.

FIGURE 1.7: Prevalence of Muslims in TIMSS Countries
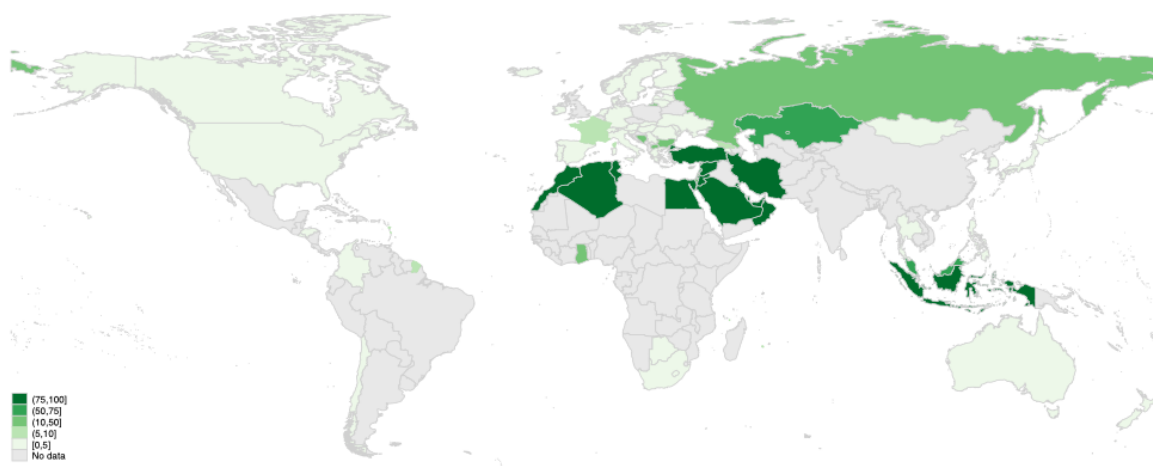
Source: Trends in International Mathematics and Science Study - Grade 8 ; IEA [1995-2015] & Miller (2009) Note: Students in Hong Kong and Chinese Tapai actually have performed for China. For the UK, England and Scotland have participated separately. The data on Muslim shares is assumed to be the same within a sovereign country.

To provide nationally-representative measures of the target population, TIMSS applies a unique way of data collection. More specifically, they follow a two-stage

sampling design (Joncas, 2008). Then, at the first place, to sustain the sample's representativeness in a different class of schools, they classify all the schools in an entire country by using several measures, such as region or type of schools. Then, they determine how many schools should be drawn for each stratification-class from the population of schools and choose which some schools from the same type of stratification are randomly selected to participate in TIMSS. While stratifying schools, Statistics of Canada and IEA take the leading role in rigorous consultation to NRCs and monitor this process. In the second stage of the sampling procedure, they randomly choose the participating students from each randomly selected school, with rigid IEA directions. IEA's primary roles in executing TIMSS are not limited to the sampling-step: Their responsibilities start at the beginning steps, such as scheduling and the sampling-design stage; also, they prepare the questionnaires, and their involvements do not end until the data become ready for an evaluation.

TIMSS applies a peculiar assessment design, hence suggesting a specific methodology to be used while making analysis. It arises from their method of measuring performances due to the fact that participating students do not answer to the entire assessment, but a single booklet of it. Regarding this issue, TIMSS relies on item response theory scaling methods. As for assessing the difficulty of questions and each item's discriminating power, IRT scaling methods suggest taking a weighted average of all students' responses for each item while mapping these responses with students' background characteristics. They then construct an estimate of student achievement distribution, considering the item characteristics, student responses, and background characteristics. From the estimated distribution, they impute values for the achievement level of all students. Due to the sampling error generated by the imputation process, TIMSS draws five plausible values that could best reflect the student performances. After all, the estimation considering all of these values is required while analyzing the student achievements (Martin, 2005).

Besides these technical issues, accounting for the sampling weightings is required due to the stratified nature of TIMSS dataset (Martin, 2005). The sampling weighting considers the following six factors that enable nationally-representative information and population size differences across countries: three weighting factors associated with the stages of the sampling design (i.e., school, class, and student), and adjustment factors for non-participation at each of these stage. Also, IEA recommends a re-sampling technique, i.e., jackknife repeated replication, to estimate sampling variances correctly (Martin, 2005). *PV*, *PVTEST*, and *PVSUM* modules of

Stata allow taking into account all the abovementioned sample properties[25]. Hence, I have preferred these modules for every statistical calculation from this dataset.

TIMSS does not collect information on the religious affiliation of students. However, using the report of Miller (2009), one can identify the size of the Muslim population. Thanks to being the most extensive survey, demographic characteristics of the participating countries have been diversified. According to Table 1.11 presenting the religion-based diversity and average STEM performance levels of countries, in 18 out of 75 ever-participated countries, Muslims constitutes more than half of the total population. These, in order by the Muslim shares, are Tunisia, Iran, Morocco, Jordan, Algeria, Turkey, Palestine, Saudi Arabia, Kuwait, Egypt, Syria, Indonesia, Oman, Bahrain, Qatar, United Arab Emirates, Malaysia, and Lebanon. While only 8 countries have Muslim shares between 10 and 50 percent, the rest of the sample (48 countries) is Muslim-minority countries, i.e., those with Muslim shares lower than 10 percent.

A closer look into countries' average performance reveals that the vast majority of this group remain as low-performers, i.e., placing in the first or second quartiles. On the other hand, Muslim-minority countries are more dispersed in the sense of student achievements. Considering that the marginal effects of the student characteristics on their STEM performances are very likely to differ among such a divergent group of countries, I exclude the high-performing countries from the interested countries (Table 1.12 for the average test scores). In the end, 15 out of 48 countries that Muslims are rarely present provide the data for a placebo test. These Muslim-minority countries are Botswana, Chile, Colombia, Denmark, El Salvador, Georgia, Honduras, Iceland, Moldova, Philippines, Portugal, Romania, South Africa, Spain, and Thailand.

Data clean: I drop pilot TIMSS surveys detected through country identifiers. In case of repeating IDs of students within the same year and the same country, which is rarely observed, I randomly keep one of them in the sample. Besides, I drop first- and second-generation immigrants, which are detected using the information on the country of origin for students and the parents, for measurement error reasons.

Muslim-majority countries of TIMSS: Table 1.12 reports summary statistics for the countries of primary interest. Majority of country-level test scores fall behind 500, the population average. Compared to Mathematics, students outperform in Sciences, for which the standard deviation is also slightly lower.

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[25] *PVTEST* and *PVSUM* are to commands used for chow test and descriptive statistics, respectively. *PVSUM* is not publicly available yet. Thanks to Kevin MacDonald –programmer of the modules–, I could calculate standard deviations of variables.

TABLE 1.11: Some Characteristics of TIMSS-Participating Countries

Country	Muslim share (%)	Science†	Math†	TIMSS‡	Arab Barometer††
Ghana	15.9	298	316	No	
South Africa	1.5	311	330	Yes	
Philippines	5.1	362	364	Yes	
Honduras	0.1	368	337	Yes	
Morocco	99.0	378	374	Yes	Yes
Botswana	0.4	382	383	Yes	
Qatar	77.5	389	377	Yes	No
El Salvador	0.0	393	345	Yes	
Colombia	0.0	398	361	Yes	
Algeria	98.0	407	387	Yes	Yes
Saudi Arabia	97.0	410	358	Yes	Yes
Kuwait	95.0	412	369	Yes	Yes
Lebanon	59.3	412	451	Yes	Yes
Egypt	94.6	414	415	Yes	Yes
Oman	87.7	419	371	Yes	No
Palestine	98.0	423	394	Yes	Yes
Tunisia	99.5	426	425	Yes	Yes
Indonesia	88.2	427	406	Yes	No
Syria	92.2	428	376	Yes	No
Georgia	9.9	428	436	Yes	
Macedonia	33.3	436	434	No	
Cyprus	22.7	442	461	No	
Chile	0.0	445	417	Yes	
Portugal	0.1	446	436	Yes	
Mongolia	5.0	449	433	Yes	
Jordan	98.2	452	410	Yes	Yes
Denmark	2.0	454	480	Yes	
Bahrain	81.2	458	420	Yes	No
Iran	99.4	459	418	Yes	No
Armenia	0.0	461	480	No	
Turkey	98.0	462	442	Yes	No
United Arab Emirates	76.2	463	455	Yes	No
Greece	3.0	465	459	Yes	
Bosnia and Herzegovina	40.0	466	457	No	
Moldova	0.5	467	465	Yes	
Iceland	0.1	467	468	Yes	
France	6.0	469	513	No	
Romania	0.3	469	472	Yes	
Serbia	3.2	470	484	No	
Malta	0.2	470	492	No	
Thailand	5.8	477	464	Yes	
Malaysia	60.4	485	491	Yes	No
Spain	1.0	487	466	Yes	
Latvia	0.0	488	498	No	
Bulgaria	12.2	490	489	No	
Israel	16.7	492	493	No	
Italy	0.0	493	485	No	
Scotland	2.7	494	486	No	
Norway	1.0	496	481	No	
Ukraine	1.0	497	476	No	
Lithuania	0.1	498	494	No	
Germany	5.0	501	491	No	
Canada	2.0	508	514	No	
New Zealand	0.9	509	491	No	
Kazakhstan	56.4	513	508	Yes	No
Switzerland	4.3	513	538	No	
United States	0.8	514	500	No	
Ireland	0.5	514	516	No	
Sweden	2.0	516	497	No	
Australia	1.7	520	507	No	
Russian Federation	11.7	524	521	No	
Slovak Republic	0.0	529	527	No	
Hong Kong	0.0	530	579	No	
Austria	4.2	532	527	No	
Slovenia	2.4	535	509	No	
Hungary	0.2	537	522	No	
Netherlands	5.7	538	535	No	
England	2.7	538	507	No	
Finland	0.5	545	515	No	
Czech Republic	0.0	545	526	No	
South Korea	0.1	551	592	No	
Japan	0.1	551	572	No	
Estonia	0.1	553	532	No	
Singapore	14.9	566	597	No	
Chinese Taipei	1.4	569	596	No	

Notes: Table reports the list of countries ever participated in the eighth-grade module of TIMSS during the period 1995-2015. The second column indicates Muslims' shares within countries according to the estimates in Miller (2009). The list is sorted by their average test scores of countries in Sciences, and the different colors denote the quartiles of the distribution. Subsection 1.8 in Chapter 1.8 at the page 46 is allocated to explain the results here. † The third and fourth columns report the unconditional means test scores of students who performed for their countries within this period. ‡ This column indicates whether the respective country is included in the analysis. For this, I apply two basic criteria to include countries in the study: Firstly, the country-level Muslim share should be either below 10% or above 50 percent to regard them as the minority or majority country. Secondly, for the minority countries, I restrict it to those having comparable scores with Muslim-majority countries because Muslim-minority countries are more dispersed in terms of student achievements. To this end, I exclude the group of countries whose average scores are above the overall score of all participating students worldwide. †† Arab Barometer-column indicates the presence of countries in the nationally-representative Arab Barometer surveys, which allows measuring the religiosity and gender norms of adults in the MENA region. When necessary, I benefit from the technical reports of the Arab Barometer to measure the distance of interviews to Ramadan. Bahrain is a participating country in the Arab Barometer, but this country has been participating only in the 2006 wave, which wave is out of the repeated-cross sectional data. Moreover, Bahrain in 2006 does not provide information on the period for their fieldwork. Besides that, note that Iraq, Libya, Sudan, and Yemen are non-participants of TIMSS within the last twenty years, and they are one of the countries with the highest shares of Muslims. I do not exclude them from the empirical analysis on mechanisms, given that the model controls for country-specific differences by the fixed effects.

Student survey questions: Self-confidence indicators of TIMSS are in line with Rosenberg's self-esteem scale (Rosenberg, 1965). TIMSS has adopted the standard scale into the school context with collaborations of specialists. Before starting to testing, students fill out to what extent that that self-confidence related statements describe themselves. Given a 4 point-Likert scale scheme, I standardize the agreement-disagreement scale into [0,1], where strongly agrees take the value of 1. Besides, for the analysis on self-confidence, I drop students with missing observations for these statements.

The number of observations of self-confidence measurements differ for the following reasons: First, a few countries have preferred asking the self-confidence of students regarding each subfields of Sciences, such as, Physics, Biology, while the vast majority of the countries preferred that they collect data on self-confidence level of students in Sciences. Given the uncomparable measurements due to the different ways of collecting data, the ones for Sciences have relatively lower number of observation than the ones for Mathematics. Secondly, the starting year of including some statements in the survey differ. For example, the statement on usually doing well in subjects has been followed up since the first round of TIMSS, while the other type of self-confidence indicators are incorporated into the survey in the second wave of TIMSS. Nonetheless, self-confidence levels of students are entirely consistent with their test scores, that is the unconditional means for Sciences are higher than the ones for Mathematics (Table 1.12).

1995 and 1999 rounds of TIMSS contain information to what extent students' friends and mother think that doing well in Mathematics, Sciences, Languages, and Sports and have time for fun in spare times are crucial for the student. For the empirical analysis, I transformed students' self-report into [0,1] scale, where the agrees take values of 1. The importance given to different fields is quite similar to each other. (Table 1.12). Expectedly, friends, compared to mothers, are more prone to support allocating time for fun.

TABLE 1.12: Summary Statistics of the Students in Muslim-majority countries

Variable	Mean	Std. Dev.	Min	Max	Obs
Mathematics	418	93	14	902	274,651
Sciences	443	89	5	882	274,651
Self-conf: I usually do well in Mathematics	0.68	0.27	0	1	268,129
Self-conf: Although I do my best, I find Mathematics is harder for me than my classmates	0.50	0.32	0	1	258,809
Self-conf: Mathematics is not one of my strengths	0.50	0.33	0	1	257,094
Self-conf: I usually do well in Sciences	0.75	0.26	0	1	205,073
Self-conf: Although I do my best, I find Sciences is harder for me than my classmates	0.42	0.33	0	1	196,349
Self-conf: Sciences is not one of my strengths	0.42	0.35	0	1	195,005
My friends think it is important for me to do well in Mathematics	0.80	0.22	0	1	39,550
My friends think it is important for me to do well in Sciences	0.82	0.21	0	1	39,709
My friends think it is important for me to do well in Languages	0.81	0.22	0	1	39,002
My friends think it is important for me to do well in Sport	0.78	0.22	0	1	39,101
Ramadan	0.12	0.32	0	1	274,651
Female	0.49	0.50	0	1	274,651
Language at home: Always or almost always	0.58	0.49	0	1	274,651
Language at home: Sometimes or never	0.41	0.49	0	1	274,651
Language at home: Not administered	0.01	0.08	0	1	274,651
Age below 12	0.00	0.04	0	1	274,651
Age at 12	0.02	0.14	0	1	274,651
Age at 13	0.36	0.48	0	1	274,651
Age at 14	0.45	0.50	0	1	274,651
Age at 15	0.11	0.31	0	1	274,651
Age at 16 or higher	0.05	0.21	0	1	274,651
Age: not administered	0.01	0.11	0	1	274,651
Mother's education: Less than secondary	0.57	0.50	0	1	274,651
Mother's education: Secondary	0.18	0.39	0	1	274,651
Mother's education: Higher than secondary	0.17	0.37	0	1	274,651
Mother's education: DK or not administered	0.08	0.27	0	1	274,651
Father's education: Less than secondary	0.48	0.50	0	1	274,651
Father's education: Secondary	0.22	0.42	0	1	274,651
Father's education: Higher than secondary	0.22	0.41	0	1	274,651
Father's education: DK or not administered	0.08	0.27	0	1	274,651

Source: TIMSS - Grade 8 ; IEA [1995-2015]

To measure the examinations regarding their distance from the end of Ramadan, I follow the procedure of Campante and Yanagizawa-Drott (2015), Islamic Philosophy Online and I use it to convert historical dates of Ramadan periods from the Islamic to the Gregorian calendar. The examination dates of students until 2011 are in the month-year format; therefore, I use mid-dates of months to calculate daily distances.

The background characteristics include students' gender, language skills, age, and the educational attainment of their parents. Female and male students are equally likely to be in the sample (Table 1.12). Regarding the frequency of speaking the testing language at home, I combine the students with always and almost-always responses, as their language skills are very likely to be similar. Likewise, I group the students with never and sometimes answers. 58% of the students often speak the testing language at home (Table 1.12).

Since the targetted age of TIMSS for the eighth-grade module corresponds to 13 years, the students at age 13 present the target population; students younger than 12 years represent the ones who reached the eighth-grade quite earlier than their birth cohort. Similarly, 12-year-old students refer to whose school registration is one-year earlier. Expectedly, the bulk of the students is either 13 or 14 years old (Table 1.12).

Most of the parents (57% of mothers and 48% of fathers) have an education level less than secondary school.

Muslim-minority countries of TIMSS: Students' STEM performances in Muslim-minority countries are similar to those in the minority countries in quantitative and qualitative terms. Outperformance and higher self-confidence in Sciences than Mathematics are also prevalent in this group of countries. Table 1.13 reports average STEM performances of students in two groups of countries by gender. Despite more significant differences between Mathematics and Sciences in the minority group, the girls overperform in Mathematics compared to boys. Besides, boys overperform in Sciences than girls. The trend observed by gender is prevalent in two groups of the countries.

TABLE 1.13: Average Test Scores of Female and Male Students by Group of Countries

	Test scores	Female	Male	Gender gap	All Students
Muslim-majority countries	Mathematics	418.1 (93)	418.0 (94)	0.1	418 (93)
	Sciences	441.6 (87)	443.4 (90)	-1.8	443 (89)
Muslim-minority countries	Mathematics	413.2 (104)	411.1 (104)	2.1	412 (105)
	Sciences	419.1 (110)	423.6 (113)	-4.5	421 (112)

Source: TIMSS - Grade 8 ; IEA [1995-2015]

For the reasons mentioned earlier, the number of observations is not the same for all outcome variables of interest (Table 1.14). However, the mean values regarding the peers' attitudes and the shares for the other attitudes are similar to the ones for the students in Muslim-dominant countries. Girls are relatively over-represented in the Muslim-minority countries, with having a 53% share in the sample. 61.6% of the students in this group speak the testing language at home more frequently. Most of the students are either 13 or 14 years old, having parental educational attainment levels less than secondary, and fathers are more educated than mothers.

TABLE 1.14: Summary Statistics of the Students in Muslim-minority countries

Variable	Mean	Std. Dev.	Min	Max	Obs
Mathematics	412	105	5	871	196,186
Sciences	421	112	5	829	196,186
Self-conf: I usually do well in Mathematics	0.655	0.261	0	1	192,262
Self-conf: Although I do my best, I find Mathematics is harder for me than my classmates	0.562	0.318	0	1	144,990
Self-conf: Mathematics is not one of my strengths	0.545	0.336	0	1	144,053
Self-conf: I usually do well in Sciences	0.708	0.246	0	1	132,659
Self-conf: Although I do my best, I find Sciences is harder for me than my classmates	0.503	0.316	0	1	110,058
Self-conf: Sciences is not one of my strengths	0.490	0.326	0	1	109,311
My friends think it is important for me to do well in Mathematics	0.768	0.226	0	1	72,440
My friends think it is important for me to do well in Sciences	0.790	0.222	0	1	72,869
My friends think it is important for me to do well in Languages	0.790	0.216	0	1	72,593
My friends think it is important for me to do well in Sport	0.780	0.232	0	1	72,596
Ramadan	0.32	0.47	0	1	196,186
Female	0.53	0.50	0	1	196,186
Language at home: Always or almost always	0.615	0.487	0	1	196,186
Language at home: Sometimes or never	0.360	0.480	0	1	196,186
Language at home: Not administered	0.025	0.154	0	1	196,186
Age below 12	0.002	0.042	0	1	196,186
Age at 12	0.050	0.217	0	1	196,186
Age at 13	0.250	0.433	0	1	196,186
Age at 14	0.431	0.495	0	1	196,186
Age at 15	0.165	0.371	0	1	196,186
Age at 16 or higher	0.099	0.298	0	1	196,186
Age: not administered	0.004	0.060	0	1	196,186
Mother's education: Less than secondary	0.438	0.496	0	1	196,186
Mother's education: Secondary	0.240	0.427	0	1	196,186
Mother's education: Higher than secondary	0.195	0.396	0	1	196,186
Mother's education: DK or not administered	0.127	0.333	0	1	196,186
Father's education: Less than secondary	0.380	0.486	0	1	196,186
Father's education: Secondary	0.243	0.429	0	1	196,186
Father's education: Higher than secondary	0.227	0.419	0	1	196,186
Father's education: DK or not administered	0.150	0.357	0	1	196,186

Source: TIMSS - Grade 8 ; IEA [1995-2015]

Arab Barometer

Arab Barometer rigorously conducts nationally-representative public-opinion surveys and provides insight into citizens' social, political, and economic attitudes and values in the MENA region since 2006. The countries covered by this survey are Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Palestine, Saudi Arabia, Sudan, Tunisia, Qatar, and Yemen. One of the common characteristics of Arab Barometer countries is that Muslims comprise the majority of the society.

Data clean: Some information associated with individuals' values, including the province that they live or the type of residential area they reside, is not covered in 2006. Therefore, I do not include the first wave. In any case, the results do not substantially change when I change the specification to have this survey year in the analysis. Instead, I employ the second, third, and fourth rounds of the Arab Barometer. For the interview dates, I use each country's technical reports, and then I integrate the ending dates of their field works for the second and third waves into the primary dataset. As the fieldwork last for 1-2 weeks, the measurement error is

ignorable enough. I also exclude refugees detected through the place of interview, i.e., refugee camps.

Religiosity and Gender Norms: Arab Barometer enables to measure religiosity and gender norms of both female and male adults. I use these related variables after transforming them from a 4-point Likert scale into a 2-point since I am interested in if Ramadan causes a change from disagreements to agreements or vice versa. Performing prayer constitutes one of the five pillars of Islam. In the Arab world, the vast majority, with 87%, perform prayer regularly (Table 1.15). 65% of the people read or listen the Quran regularly (Table 1.15). In line with Bursztyn et al. (2020), the beliefs on gender norms are progressive in the MENA region, despite the prevalence of large gender inequalities: Around three fourth of the sample favors gender equality in education. 78% of them disagree that university education is more important for males. Despite a lower share, 57% of the MENA citizens believe that a woman can become a president or prime minister of a Muslim country.

TABLE 1.15: Summary Statistics of Arab Barometer

Variable	Mean	Std. Dev.	Min	Max	Obs
Pray: almost always or always	0.87	0.34	0	1	31336
Read or listen Quran: almost always or always	0.64	0.48	0	1	31249
Religious	0.37	0.48	0	1	30959
A woman can work outside if she wishes	0.84	0.37	0	1	31644
University education is more important for males than females	0.30	0.32	0	1	31498
A woman can become a president or prime minister of a Muslim country	0.54	0.36	0	1	19554
Ramadan	0.15	0.36	0	1	31770
Female	0.49	0.50	0	1	31770
Age	37.94	13.82	18	95	31770
Arab	0.84	0.37	0	1	31770
Less than secondary	0.45	0.50	0	1	31770
Secondary or the higher	0.55	0.50	0	1	31770
Education not administered	0.00	0.05	0	1	31770
Single	0.34	0.48	0	1	31770
Married	0.64	0.48	0	1	31770
Marital Status not administered	0.01	0.11	0	1	31770
Rural	0.33	0.47	0	1	31770
Urban	0.64	0.48	0	1	31770
Residential area: Not administered	0.03	0.17	0	1	31770

Source: Arab Barometer [2009-2017]

The interviews, of which date fall into the first three-month period after Ramadan, constitute 14 percent of the total sample. Males are slightly more dominant in the sample, with a 49 percent share for women. Almost half of the individuals hold an educational degree less than secondary, whereas one-third responds to have a tertiary degree. One-sixth of the sample does not speak Arabic as its first language, and roughly speaking, half of the respondents are married.

Chapter 2

Parental Religiosity and Missing School-Girls in Turkey

2.1   Introduction

Does parental religiosity affect female education and the life-long outcomes of women? Parents are prominent actors in children's future earnings capacity and well-being.[1] In many countries, more than 50% of the variation in years of schooling is attributed to factors shared by siblings (Björklund and Salvanes, 2011). While the culture transmitted through parents to offspring plays an essential role in child development, the parental decisions on educational investment and availability of the family resources have significant consequences for intergenerational mobility. However, the role of parental religiosity has attracted relatively less attention in the literature, especially on females' education. Despite the rising trend of education levels across much of the developing countries, gender inequalities in schooling remain persistent (UNESCO, 2010), and social norms are suggested as important as economic development explaining the prevailing gender inequalities (Jayachandran, 2015). Consistent with the evidence on low female education associated with Islam, e.g., Norton and Tomal (2009); Cooray and Potrafke (2011), most of the Muslim-majority countries, including Turkey, persistently rank at the bottom of the Global Gender Gap Index (Figure 2.1).

I focus on the Turkish Republic, the first secular Muslim-majority country adopting the Swiss Civil Code in the 1920s, and I investigate the extent to which parental religiosity affects the gender gap in completing primary education. Despite the secular constitutional setting, the subjugation of women under Islam is often argued

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[1] Haveman and Wolfe (1995) overviews the literature on the determinants of children's attainments.

to prevent the full implementation of women's rights enshrined in the legal code, including equal access to education (Arat, 1989; Toprak, 1995; Rankin and Aytaç, 2006). Turkish culture is patriarchal with a rigid gender-based division of labor (Kandiyoti, 1977; Ozyegin, 2001). The high share of female NEET rates presented in Figure 2.1b well-pictures the patriarchal culture in Turkey that obstacles the construction of female identity other than wife and mother.[2] In addition to that, Islamic disapproval of working women in paid jobs exacerbates the low participation of women in the labor market (Guner and Uysal, 2014; Dildar, 2015), and hence discouraging female education in line with the Acting Wife hypothesis of Bursztyn et al. (2017). To many religious families in Turkey, schools pose a threat to their daughters' safety and modesty, and thus to family honor (Rankin and Aytaç, 2006). Despite the non-causal evidence on the higher prevalence of the under-education and the low labor-market participation rates for the females born to pious families, disentangling the religious beliefs from the confounding factors had remained the empirical challenge of this literature.

For the empirical investigation, I focus on the first generation of the Turkish Republic, the first secular Muslim-majority country. The individuals born in 1923-1955 constitute the interested group for the empirical analysis because the Turkish education system available for this group of people was predominantly the same for all, regardless of their gender. To clarify the characteristics of this system, five months after the proclamation of the Turkish Republic, the first parliament passed a law now considered one of the Kemalist revolutionary laws, and it made the education system unified, centralized, national, and secular. The law enacted in 1921 terminated all institutions that provided religious education and prescribed that every child at 6 shall get 5-year primary education, regardless of their gender. Then, the 1961 Constitutional Law made the non-compliance of kids to compulsory education more deterred by introducing fines to parents. Besides that, it brought a straightforward process to monitor parents of the children at schooling age by clearly defining the duties and authorities of every state unit regarding the registration process of kids and their attendance to schools. Since the new constitutional law affects the parental decision mechanism on enrollment and brings the public officials an additional actor in school registrations, I investigate the effects of parental religiosity on missing school-girls and its consequences for their labor market outcomes among the group of individuals whose enrollment process is the same. I obtain their educational and labor market outcomes through the censuses conducted in 1985, 1990, and 2000 in which all subgroups are representative.

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[2] Sexism in Turkey through the quotes from pro-Islamist political elites are elaborated in this article.

To analyze the effect of parental religiosity during the registration period on females' access to education, I use Ramadan as an exogenous shock to religiosity, as Ramadan increases religious practicing at both extensive and intensive margins: non-regular and regular prayers increase the time for religious activities, at least through fasting. I then combine the occurrence of Ramadan with the school enrollment rules: school starting age is fixed at 6, and the registrations are only possible in a fixed period of the summer season. Using these pieces of information, I employ two alternative empirical strategies: the first one defines treated females if they belong to birth-cohorts for which school registrations occurred in Ramadan and the following two months (distance to Ramadan as in Colussi et al. (2021)). The second strategy exploits the variation of fasting hours in the school registration year, which exogenously vary over time and the latitude (varying daylight hours across or within a country as in Campante and Yanagizawa-Drott (2015); Hornung et al. (2018); Aksoy and Gambetta (2020); Mehmood and Seror (2020)). I thus estimate the causal effect of parental religiosity on female education by interacting the treatment variables with a female indicator and controlling for the birth-place-specific birth-cohort fixed effects and province-specific time trend in the gender gap in education.

Results reveal that parental religiosity constitutes an impediment to girls' educational attainment in Turkey. Girls' chance to complete their compulsory education decreases by 4.3 percentage points when the registration date to primary school is in Ramadan or shortly after Ramadan. The effect of increased parental religiosity is economically significant: it corresponds to 8.8 percent of a standard deviation; therefore, parental religious beliefs explain one-seventh of the prevailing gender difference in holding a formal degree. The hindering effect of parental religiosity on females' enrollment in schooling is still evident when I estimate the impact on different educational outcomes: women's chance to read and write in Turkish during their adulthood decreases by 2.7 percentage points when their enrollment dates to primary education coincide with the three months following the start of Ramadan. In addition, Ramadan does not affect males' educational outcomes. Such results are qualitatively robust to alternative specifications.

To identify the mechanisms that derive lower female education due to the increased parental religiosity, I employ the Turkish Demographic and Health Survey database over the 2008-2013 period and analyze the relationship between religiosity and gender norms. Identification relies on the arguably exogenous variation of interview dates from the end of the most recent Ramadan, and therefore, it induces as good as random variation in religiosity. The daily distances of interview dates to Ramadan are unlikely to be associated with women's demographic characteristics.

Results reveal that the number of women that report performing prayer regularly or irregularly decreases with the distance to the last Ramadan. At the same time, women's egalitarian voices over family decisions, female education, and political participation raise with interviews' time distance to the previous Ramadan. Consequently, the increased religiosity leads families to undervalue females' educational returns, hence lowering girls' enrollments rates and the chance of females to complete primary education.

Parents' religious belief is not a negligible element for the education of females. Policymakers should reckon with the long-term aspects of their policies that enhance the religiosity of their citizens and should be well-acknowledged that the increased religiosity causes families to acquire more traditional gender norms, which unfortunately leads them to underestimate females' educational returns, hence lowering girls' enrollments in schools. I find that it contributes to the gender gap in Turkey in average completed years of schooling by 1.15 years. Furthermore, I observe significantly lower educational attainment levels for the girls whose starting dates to a new school year had coincided with Ramadan more frequently, especially when their parental religious beliefs were more strengthened during their first three grades.

The increased parental religiosity at age 6 causes considerable gender inequalities in the labor market and exerts significant inefficiencies in the Turkish economy. I find that the labor force participation of women in Turkey is not only lowering, parents' religious beliefs also reduce the shares of female income-earners and female professionals in Turkey. One standard deviation increase of fasting hours in the significant year of schooling results in the rise in the number of children given birth by 2.7 children. Given that increased number of children gives much more burden on the shoulders of women in the presence of traditional household division of labor, I find that the same amount of increase in fasting hours causes the probability of females to be out of the labor force due to the household responsibilities to increase by 1.5 of one standard deviation, equivalent to 73.6 percentage points.

This study relates to a broader literature analyzing the role of religion in the development and accumulation of human capital.[3] Becker and Woessmann (2009); Botticini and Eckstein (2012) argue that Protestants and Jews, compared to Catholics,

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[3] Iannaccone (1998); Iyer (2016) overview of the literature on the economics of religion. Basedau et al. (2018) also reviews the studies on the causal effects of religion on socioeconomic outcomes. Kuran (2004) discusses the role of Islam in the underdevelopment of the Middle East and Kuran (2018) reviews and discusses the recent findings on Islam with the methodological strains of them and aspects of future research.

have better economic outcomes due to the investment in literacy. Becker and Woessmann (2008) shows that Protestantism had a positive influence on gender equality in primary education. Squicciarini (2020) shows more religious locations had lower economic development after Catholicism in France during the Second Industrial Revolution. Distinctively than this literature, I find male education and literacy are not affected by Muslim religiosity. However, it undervalues female education due to the relationship between religion and gender in Islam.

This study also contributes to the role of religion in gender equality and the origins of gender norms. Guiso et al. (2003) shows that religion is an essential determinant of the preferences significant for economic development. Alesina et al. (2013) shows that in societies where plough had been used more intensely for agricultural production, traditional gender norms are more salient, and female labor force participation rates are lower today. Gay et al. (2018) shows that women who speak a language that marks gender more intensively are less likely to supply labor. I add this literature that religious beliefs engender favorable preferences toward males on attaining an advanced level of education and unfavorable preferences regarding women's working outside the home.

This paper is also closely related to the literature on the importance of family ties in attitudes and beliefs that promote or hamper women's agency.[4] Fernández et al. (2004); Farré and Vella (2013) show that mothers transmit their attitudes regarding labor force participation to their children. Alesina and Giuliano (2010) finds that families having stronger ties have lower labor force participation of women. I show that parental religiosity ultimately leads Muslim women to depend on their families, even when they become adults. Women who could not attend school by increased religiosity become less likely to participate in the labor market, less likely to be income-earners, and less likely to work in professional jobs. Instead, increased religiosity at the starting year of schooling increases the probability of women being married and out of the labor force due to household responsibilities and the increased number of children.

The remainder of this paper proceeds as follows: Section 2.2 outlooks the primary education system in the Ottoman Empire and the educational and gender policies enacted during the Republic period of Turkey. To follow up on the historically important policies for education and women or both, I provide a timeline in Appendix. Section 2.3 explains the data used in this study. Section 2.4 elaborates the identification strategies of this study. Then, Section 2.5 reports the main results on

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[4] Guiso et al. (2006) elaborates the economics of culture.

educational outcomes, including robustness checks and the mechanism, in addition to the results on life-long outcomes. Finally, Section 2.5 includes concluding remarks.

2.2 Turkish Education System and Religion in Turkey

The system of education in the late Ottoman period was paving for pursuing primary education in liberal (*iptidaî*) and religious schools (*mahalle/sübyan mektebi)*. It was compulsory for all kids from different religions; however, every religious community provided education for their own people. In addition, the schools in the entire period of the Ottomans had been gender-segregated, despite a few exceptional cases. In *mahalle* mektebi, which accepts children younger than 7, girls were able to pursue their education with boys only if a *mahalle* (neighborhood) incorporated one school.[5] Before the *Tanzimat* Edict, girls were only able to attend courses in *mahalle mektebi* and hiring private teachers for girls from wealthier families was the single option for their further education (Akyüz, 1982; Gelisli, 2004). Over time, female schools higher than the primary level were opened.[6] Indeed, the Empire had implemented some policies to enhance civil education contemporaneously with most European countries. But, the Ottomans ended up being far behind them in terms of primary schooling.[7] For instance, according to Central Statistics Office of Turkey (1927), the literacy rate of Muslims remained at 8 percent.

Educational and Secularization Reforms in Republic of Turkey: The founder of the Turkish Republic, Mustafa Kemal Atatürk, and the political elites of the time reached a consensus on the decentralized system of education as one of the devastating reasons for the Ottomans becoming a failed state (Lewis, 1961; Alkan, 2000; Çiçek, 2012). According to them, the system where Muslims and non-Muslims had been allowed to attend schools – either religious or not– of their community had escalated the propagation of separatist movements and led non-Muslim groups to build their

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[5] The other exception is that co-education was started in *Darülfünun* in 1921 after female students boycotted the courses at *Inas Darülfünun* (the university for females).

[6] The first female lower-middle school *İnas Ruşdiye* was opened in 1859 (Somel, 2001). Upper-middle schools (*İnas İdadî*) and high schools (*İnas Sultanîye*) and a university for females (*Inas Darülfunun*) were opened in 1911, 1913, and 1915, respectively (Akyüz, 1982).

[7] Alkan (2000) evaluates Ottomans' timing of imposing compulsory education policies, comparing the Empire with the other advanced economies. Alkan (2000) concludes that the Ottoman Empire was indeed one of the pioneer countries in terms of the timing of introducing them. However, based on the estimated statistics of Barro and Lee (2013), the shares of individuals in Turkey who enrolled in primary education corresponds to 6.7 in 1910, while the ratios in the same year for France, Germany, Japan, Italy, Sweden, and the UK are equivalent to at least three-quarters of their total population.

national identities. Besides, the cultural divide between schooled and non-schooled generations among Muslims was another concern over the education policies of the national state.[8] On the other hand, an organized campaign of mass execution and deportation of non-Muslim populations in the 1910s resulted in the absence of a large number of merchants and craftspeople of the Ottomans. Therefore, the transformation of the remained population from pre-modern society to the modern one was believed to be only possible through education and statism in the economic policies (Pamuk, 2018). Given these circumstances, education became an integral part of Atatürk's nation-building policies.

After abolishing the Sultanate, many top-down policies, including education, were implemented. As such, five months after the Turkish Republic's proclamation, the education system of the Republic took its conventional form, i.e., unified, centralized, national, and secular (Unal, 2015; Gazette, 1924). The law *Tevhid-i Tedrisat Kanunu* gave the managerial authority of schools to the Ministry of National Education *(Maarif Vekaleti)* and terminated all *medrese* institutions. According to the law, every girl and boy at 6 has become obliged to get 5-year primary education. [9] Therefore, co-education at the primary school level was guaranteed. Furthermore, in 1927, the Kemalist government established gender-mixed classrooms in all the secondary schools (Başgöz, 2005).

In the following years of the proclamation, the Islamic elements in every state institution were erased: in addition to the closure of *medrese,* religious convents and dervish lodges were abolished. Secularization was also salient in law; Sharia courts were abolished, and the civil marriage law was introduced. Adopting a new civil code allowed women in Turkey to be liberated from the restrictions that traditional Islamist interpretations had imposed on them (Arat, 2010). The new civil code prohibited polygamy, subjected marriage to secular law, outlawed unilateral divorce, and recognized gender equality in children's inheritance and guardianship.

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[8] The former Minister of General Education, Hüseyin Vasıf Çınar, gives a declamation in Ankara Parliament, 1924 on the new education system of the Republic. During his speech, he extensively argues in favor of the unified and state-controlled system while emphasizing the futility of *medrese* education. According to him, a nation shall get one type of education because educating people with different methods causes to raise different kinds of people in a country. Still, he promises to add religious schools to lower secondary levels called as *Imam Hatip Orta Okulları*. To get more information on Hüseyin Vasıf Çınar and his historically significant declamation in the parliament, please visit the following website: https://portreler.fisek.org.tr/laik-egitimin-mimari-vasif-cinar/

[9] In following years, the village schools become able to track *at least three years of schooling*, although the other schools remained following a 5-year tracking program. Yet, the law re-regulated quickly, and the school year of every kind became equalized at five-year. As the focus of this study is enrollment decisions of parents in compulsory education and given that village schools could last for five years, according to the prior law, I assume that primary school education in these years is for five years.

In 1934, women's political emancipation was completed by a law entitling them to vote and be elected in deputies. A series of language reforms were also implemented (Assouad, 2020). So, the numbering system and the alphabet were converted from Arabic to Latin in 1928.[10] Regarding the curriculum content for primary education, religion was taught entirely until 1933, when religious instruction was abolished from village primary schools (Özdalga, 2018). From 1938 to 1950, it was out of the regular program. After the end of this period, the religious courses in primary school became voluntary, but then, the 1982 Constitution introduced it as compulsory for all Muslim children.

Despite the strenuous efforts to build a modern Turkish nation, before the constitutional change in 1961, the law on compulsory education lacked a monitoring and punishment mechanism. Nevertheless, the Education Section number 222 of the 1961- Basic Law adopted on 5 January 1961 has appointed the roles of monitoring to elected neighborhood representatives, provincial directorates of education, and school principals.[11] While keeping school starting age as the same at 6, by introducing this law of the new constitution, the elected representatives and the provincial directorates of education have become responsible for making sure that the parents of kids at the school-starting age enrolled them to schools. Besides, every year, the elected representatives have become liable to prepare a list of children living in the neighborhood at the respective period. According to the enrollment section of this law, they have been obliged to present them to the provincial directorates of education before 15 days of school openings. Furthermore, in non-registrations of kids, school principals had owned the right to register the kids and inform the parents on compulsory attendance of students by the law. Besides, the law allowed to launch legal action against parents in the case of non-attendance to the courses. According to the Constitution Law, the fines could be up to 2 TL $\approx$ 2 $ per non-attended day.

Although gender-egalitarian laws for many areas, including education, have been enacted, the gender disparity in education remains a problem in Turkey. Despite a more gender-egalitarian environment provided by the Republic than the Empire, most Turkish families still acquire traditional values (Gelisli, 2004). It is often argued that the subjugation of women under Islam has prevented the full implementation of women's rights enshrined in the legal code, including equal access to education (Arat, 1989; Toprak, 1995; Rankin and Aytaç, 2006). (Gelisli, 2004) anecdotally points

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[10] As Assouad (2020) pointed out, Arabic and Persian accounted for up to more than 80 % of the Ottoman's vocabulary, and Turkification of the language was another aspect of these reforms.

[11] See this https://www.mevzuat.gov.tr/MevzuatMetin/1.4.222.pdf and this to reach out to the original version of the Law on Primary Education and Education. The related article is on the page from 12 to 17. https://www.resmigazete.gov.tr/arsiv/10705.pdf

out that the parents with strong religious beliefs and traditional structure resisted educational reforms. As such Sakalli (2020) finds that after the secularization, residents of provinces with higher pre-secularization levels of religiosity were less likely to send their children to secular schools relative to others. To many families in Turkey, schools pose a threat to their daughters' safety and modesty, and thus to family honor (Rankin and Aytaç, 2006). They prefer her early marriage rather than her school enrollment. Likewise, Erten and Keskin (2019) finds that girls in more religiously conservative regions constitute the largest group of compliers to Turkish Compulsory Schooling Law enacted in 2012, which increased compulsory year of schooling from eight to twelve. As this group of girls was neither in school nor employment before the law, their inclusion in education reduced female NEET rates in these regions.

Several studies also point to the incompatibility of the secular environment in units of state institutions, such as schools, with parents' religious beliefs. The regulations led female civil servants and students to adapt to the Western dress code, including uncovering their hair (Arat, 2010). Due to the pure secular environment, more impoverished parents were less willing to send their daughters to school without a headscarf (Çarkoğlu and Toprak, 2007).[12] Likewise, Meyersson (2014) finds Islamic rule increased female secular high school education in poor areas, where Islamic values are salient to a large extent. It also reduced adolescent marriages and increased female political participation. Meyersson (2014) also finds, due to the more extended period of exposure to secular education, a reduction in religious preferences, as in Gulesci and Meyersson (2015); Mocan and Pogorelova (2017); Cesur and Mocan (2018).[13]

2.3 Data

I mainly employ two different data sources: For the educational and other outcomes, I use Turkey's Census from 1985 to 2000. Regarding the relationship of Ramadan with religiosity and gender norms, I exploit the Turkish Demographic and Health Survey (T-DHS) for the years 2008 and 2013. The section describes these databases.

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[12] Veiling as a strategical choice of women enabling them to take up outside economic opportunities while preserving their reputation within the community is shown both theoretically (Carvalho, 2013) and empirically (Aksoy and Gambetta, 2016; Shofia, 2021).

[13] In this direction, the current public controversies are on a growing number of deist and higher educated women, who keep on wearing headscarves due to the pressure of families and religiously conservative society. See the interview posted on BBC-Turkish: bbc.com/turkce/haberler-turkiye-43832877

Turkish Census: I use the samples of 1985, 1990, and 2000 censuses of Turkey. Each census sample I employ involves 5 percent of the population randomly selected by province of residence, and it provides a representative sample for all subgroups.[14] The censuses were collected by imposing a one-day curfew at the country level on 20 October 1985, 21 October 1990, 22 October 2000. It includes all the face-to-face interviews conducted through the visits to all existing places serving as households or non-households, including dormitories, hospitals, prisons, and the military districts.

The survey instruments include some universally asked questions, including the birth information, e.g., the age at the census date, province of birth, the highest completed educational degree, the status showing that one can read and write in Turkish. Therefore, I can observe when and where the individual was born. In addition, the data enables me to observe whether the individual is a complier of a 5-year compulsory primary school or not.[15] To analyze whether parental religiosity has resulted in gender disparities in economic participation and opportunities of individuals, the participation status of individuals in the labor market, whether the individual is an income-earner or not, and whether the one works in professional or technical jobs are the other outcomes of interest.[16] To better understand the effect of educational choices on labor market decisions, I focus on the marital status of the individuals, the number of children that the woman has given birth until the census year, and housewife status, which is detected through that the main reason for her to be out of the labor force is being busy with the household chores. Besides,

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[14] The number of provinces in Turkey had increased from 67 to 81 in the years between 1985 and 2000. Indeed, I had no change in the coding of provinces at birth. So the number of observations for the province of birth varies by the census year. However, my main findings are similar qualitatively when I use the census data individually (See Table 2.8). So, my results are unlikely to be driven by the measurement error of province at birth.

[15] Considering the 5+3+3 pre-tertiary tracking system in Turkey, I first measured the year of completed schooling. Then, I log-transformed them in $ln(\text{year of schooling} + 1)$ method to get a smoother distribution of the outcome variable.

[16] I rely on the definitions and indicators of the Global Gender Gap Index, although there are a few exceptions. The index uses the estimated gender gap in income and wage; however, I use the status showing that the individual earns an income or not. For the advancement gap between women and men, they use the ratio of women to men among legislators, senior officials and managers, and the ratio of women to men among technical and professional workers; however, I only focus on the professional and technical jobs. The index relies on the ILO's standard classifications on occupations. Since the index uses the ISCO-08 classification despite the classification of the census on occupations in the essential job in ISCO-68, I used the respective correspondence tables. Professional and technical jobs refer to the following occupations: physicians, chemist or other related occupations; architects, engineers or other-related technicians; pilots, warrant officers, maritime engineer; biologists, agnoroms or related technicians; medicine-related occupations; statisticians, mathematics, system analysts, or related technicians; economists; financial advisor and accountants; teaching-related occupations, religious clerics or related; writer or literature-related occupations; sculptor, painter, photographer or other fine-artists; sportspersons or other related occupations; unclassified scientific or technical occupations.

I use the historical national and provincial income data that are retrieved from
2010 Maddison Project and Asik et al. (2020) to capture the local and country-level
economic conditions when the individuals will start their education. [17]

Demographic Health Survey of Turkey: The Demographic and Health Survey
Program of Turkey measures gender norms and the religiosity of women, in particular
after 2008. Therefore, I use the 2008 and 2013 waves of Turkish DHS in this study to
examine the causal effect of Ramadan on religiosity and gender norms. The data is
representative at the NUTS-2 level. Therefore, it allows for a greater span of the same
cohort. Also, it collects extensive information on the demographic characteristics
of women. Due to the heavy workload of interviewers by collecting a large piece
of information through both women and children, the field work's usual practice
is that the Turkish authorities complete the survey within three months. More
importantly, they carry out the fieldwork in Falls. Consequently, using DHS for the
analysis of this study has several advantages, for example, enabling a large number of
interviews to vary considerably by the distance to Ramadan and allowing controlling
for observable characteristics that are closely related to religiosity and gender norms.

Before 2013, the national survey's target population had been ever-married
women aged between 15 and 49. Since then, they have included single women as well.
So, I drop this new subgroup from the analyzed data to balance the waves' sample
characteristics.[18] Also, I drop women born abroad to minimize the measurement
error of covariates.[19]

2.4 Identification

The role of religions and religiosity on economic preferences, including the ideal
roles defined to women and men, has been debated in the literature.[20] However, the
literature has some challenges in revealing a causal effect of religiosity on women
empowerment. This problem arises from the fact that the extent to which individuals
participate in religious activities is an outcome where they allocate their limited time

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[17] The descriptive statistics of the dataset is reported in Table 2.6.

[18] The inclusion of the singles does not change the results.

[19] Note that they are in total 262 number of observations, hence constituting 1.8% of the raw data.

[20] Holm and Bowker (1994) examines the gender perspective of most of the religions prevalent around
the world. Iyer (2016); Basedau et al. (2018); Iyer (2019) review the literature on the effects of religion
on economic development and demography. Kuran (2018) focuses on the same literature specific to
Islam.

among religious and secular activities to maximize their lifetime and afterlife utility (Azzi and Ehrenberg, 1975).[21] Therefore, an analysis on the impact of religiosity requires an exogenous instrument that increases religiosity. In this aspect, Ramadan constitutes a relevant natural experiment.

The economics literature has extensively exploited Ramadan in natural experimental settings to address many research questions, from economic growth, health, and education, to political economy. When methodologically classified, one can group them into two: the studies using the rotating property of the Islamic calendar, hence varying Ramadan dates over time, and the ones using fasting hours, which change over time and the latitude. The first group of these studies exploits Ramadan months as a treatment to minority salience in Germany (Colussi et al., 2021); as exposure to prenatal malnutrition (Van Ewijk, 2011; Schultz-Nielsen et al., 2016; Greve et al., 2017). Besides, Oosterbeek and van der Klaauw (2013) estimates the effect of Ramadan fasting on student performance using the diff-in-diff framework. Studies in the latter group use the fasting hour to evaluate its impact on economic growth & subjective well-being (Campante and Yanagizawa-Drott, 2015), on student performances (Hornung et al., 2018), on the support for Islamist parties in Turkey (Aksoy and Gambetta, 2020), and finally on judicial behavior in Pakistan (Mehmood and Seror, 2020).

Exogenous source of variation in parental religiosity: In this study, I use Ramadan as an exogenous source of variation in parental religiosity. As depicted in Figure 2.2, Google search trends of some terms closely related to religiosity sharply increase in Ramadan month. Figure 2.2a displays that people search on Quran more extensively in Ramadan weeks, meaning that religious practices carried out through digital means intensify in Ramadan. Figure 2.2b shows that individuals raise questions on the spiritual implications of their daily-life actions more frequently during Ramadan month.

To estimate the effect of parental religiosity on females' enrollment in primary schools, I measure the time distance of the enrollment dates to the starting date of last Ramadan. Relying on the current educational regulations applied in the past, I choose the mid-day of the enrollment period to minimize the measurement error in calculating its distance to the most recent Ramadan's starting date. Per the current regulation, the registration of kids starts on the first official day of July. Even though

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[21] Bentzen (2019) discusses why some societies are more religious than others, presenting the existing approach on religiosity in theoretical frameworks. She demonstrates the demand- and supply-side factors that cause differences in religiosity across societies.

the ending period is not certain in the regulation, the schools usually begin in the second week of September. Therefore, I use 5 August as the mid-day of this period to calculate the distance measure.[22] Since children should start school at age 6, I match the distance variable using the birth year information. By doing so, I identify the birth-cohorts whose enrollments fall into the three months following Ramadan's starting date. For fasting hours at each academic year, after retrieving the coordinates of districts from the open-source data, I use *datetime* package of Python and Ramadan dates to calculate the average daily fasting hours of the districts, proxied by average time duration between sunset and sunrise of the date in Ramadan month. To estimate it at the province level, I weighted them with the population size of the districts. Birth-place and -birth-year are the identifiers to match these variables of interest with the census data.

Figure 2.3 displays the exogenous source of variations I am exploiting in this study and the treated groups. In Figure 2.3a, the enrollment dates are presented with blue circles and the first Ramadan day with red circles. As the enrollment dates are fixed to 5 August, and the first day of Ramadan moves backward by around 10 days each year due to its idiosyncratic variation, the distance between the enrollment dates and the starting date of Ramadan induces as good as random variation in families' religiosity. Vertical green lines show that the daily distances change due to varying Ramadan dates over time. The first group of treated birth-cohorts consists of those enrolled in a primary school in Ramadan or the following two months. Given that the registration dates fall just after Ramadan in 1946, the treated birth-cohorts start with individuals born in 1940. As the variation in the length of daily fasting is due to the interaction between the rotating Islamic calendar and a province's latitude, the average daily fasting hours in enrollment place and years of individuals enable an alternative exogenous variation in religiosity. Figure 2.3b presents the average fasting duration in the southernmost and the northernmost provinces of Turkey. Since the summer solstice of the 1951 year comes about the mid of Ramadan month, 1945 birth-cohorts born on Sinop are exposed to the most prolonged fasting hours in their registration year. Similarly, people born in the same place in 1929 are exposed to the least fasting hours, due to the winter solstice of the year 1935 that corresponds to the mid-day of the holy month. Lastly, the variation in fasting hours is higher in the northern provinces, due to the provinces' geolocation.

Empirical Strategy: The following estimating equation captures the causal effect of religiosity during the enrollment period:

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[22] I also provide information on if the results change for alternative enrollment dates in Section 2.5.

$$Y_{i,p,c,t} = \beta_1 \text{Fem}_i * \text{Ramadan}_{t+6} + \theta_{p,t} + \lambda_{c,\text{Fem}} + t * \text{Fem}_{i,p} + \varepsilon_{i,p,t,c} \qquad (2.1)$$

where Y denotes the education and labor-market-related outcomes for individual i that are observed in the census year c and born on province p in year t. Ramadan_{t+6} refers to whether individual i in birth-cohort t has to register to a primary school in Ramadan month or the following two months. I estimate the effect among the individuals born in 1923-1955 because, as explained in Section 2.2, the Turkish education system available for this group of people was predominantly the same for all, regardless of gender. As the new constitutional law is likely to affect the parental decision mechanism on enrollment, it brings the public officials an additional actor in school registrations. Therefore, I focus on the individuals born before this law was enacted.

$\theta_{p,t}$ absorbs provincial fixed effects that capture any local and time-variant characteristics that affect the enrollment decisions for boys and girls in the same manner. Therefore, it captures the socioeconomic conditions of provinces where the kids in the same birth-cohorts are challenging. School resources, economic conditions, land productivity, and attitudes toward educational attainment are the characteristics that I control for by this fixed effect. I also account for any improvements in literacy skills in the years between 1985 and 2000 through the campaigns that aim to eliminate adult women's illiteracy in Turkey and the changing population over time by including gender-specific census-year fixed effects, i.e., $\lambda_{c,\text{Fem}}$, into the estimating equation. Given that the gender gap may vary differently across localities and over time, I include the provincial time trend of the gender gap in the outcome variables, i.e., $t * \text{Fem}_{i,p}$, in the estimation model as a control variable.

Although the inclusion of time-specific fixed effects absorbs the Ramadan effect for individuals, regardless of their gender, it pays off greatly; because it allows capturing the crucial factors in parents' decision on human capital investment of their kids. As I aim to estimate the effect unique to girls, β_1 constitutes the parameter of interest. Hence, I argue that the deviation in the treated years from the gender-gap trend presents the causal effect of religiosity on girls' educational attainment. Since the errors can be correlated within provinces, I cluster the standard errors at the province level (N=81).

The previous estimation does not estimate its effect on males' education. However, the impact of religiosity on males' educational attainment level may be still substantial, given that Sakalli (2020) finds that the secularization in Turkey causes

lower education levels in localities where religiosity was higher before the secularization.[23] To directly investigate the impact of parental religiosity for both males and females, I use an alternative exogenous source of variation, for which parental religiosity varies over time and across provinces, that is, province-specific average daily fasting hours in the year that the respective birth-cohorts are registered for the primary education. By doing so, I can also assess the robustness of my previous results that I use the exogenous timing of Ramadan for the identification. Exploiting the variation of fasting hours within a year, I estimate the effect of religiosity on the probability of boys and girls holding a formal education diploma by the following equation:

$$Y_{i,r,p,c,t} = \beta_1 \text{FastHour}_{p,t+6} + \beta_2 \text{Fem}_i X \text{FastHour}_{p,t+6} + \theta_{r,t} + t * \text{Fem}_{i,p} + \lambda_{c,\text{Fem}} + \varepsilon_{i,r,p,c,t}$$
$$(2.2)$$

where $\text{FastHour}_{p,t+6}$ is log of average fasting hour in the birth-province p in year $t + 6$, when birth cohort t are registered to primary school. I interact the fasting hours with the gender of individuals; therefore, β_1 & β_2 are the coefficients of interest in this estimation strategy. The fixed effects and the controllers are mostly in line with Equation 2.1, despite one exception: As fasting hours given a year only vary across provinces, I instead use regional and regional-specific birth-cohort fixed effects for the sake of not discriminating boys from girls.[24]

2.5 Empirical Findings

This section starts with reporting the main results on the causal effects of parental religiosity on females' and males' education outcomes. Then, after the sensitivity of analysis, I focus on the mechanism that drives the results on education. In the end, I will analyze the long-run impacts of religiosity, particularly its effect on the following outcomes: the probability of being in the labor force, being an income-earner, working in professional and technical jobs, being married, the number of children, and being a house-wife.

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[23] The current version of Sakalli (2020) does not consider the potential heterogeneous effects by gender. Yet, the secularization policies in education target for eliminating the female disadvantage in the Ottoman education system, and the non-compliers of this policy in the regions with different levels of religiosity before the secularization policies may differ by gender.

[24] Regions here refer to 26 statistical sub-regions of Turkey at NUTS-2 level, whereas provinces are the statistical regions of Turkey at NUTS-3 level, according to the Eurostat standards.

2.5.1   Main Results

Table 2.1 displays the estimated causal effects of parental religiosity on the educational attainment of men and women. Column 1 reports the estimate for the conditional mean difference in completing an educational degree between male and female cohorts on province-specific birth-cohort fixed effects and the variation in the outcome due to census-year. Again, the gender gap is significant; the estimated difference for individuals born in 1923-1956 is equivalent to 32.4 percentage points in favor of males, reflecting 66 percent of a standard deviation.

I introduce my benchmark treatment in the second column, and it displays the specification, as in the equation 2.1, including some additional controls, such as the province-specific trend of the gap between female and male cohorts in the outcome and gender-specific census-year fixed effects. It reveals that parental religiosity constitutes an impediment to girls' educational attainment in Turkey. Girls' chance to complete their compulsory education decreases by 4.3 percentage points when the registration date to primary school is within three months since the start of Ramadan. The effect of increased parental religiosity is economically important: it corresponds to 8.8 percent of a standard deviation. By the same token, the estimate reflects one-seventh of the prevailing gender difference in holding a formal degree presented in the first column. The third column shows the estimates for my alternative instrument, which exploits the variation in the average daily number of fasting hours across provinces and over time. As I here control for birth-cohort fixed effects specific to birthplaces at NUTS-2 level and province-specific trends in the gender gap, the estimates exploit the variation in fasting hours of the same year that varies within a region, after taking into account the potential bias due to the province-specific gender gap over the birth cohorts. The effect of the average daily number of fasting hours at the registration year to primary school for males' completion rate is on the average negative, but statistically insignificant ($\beta = -0.267$, $p = 0.568$). However, similar to the results in the second column, the effect for females is negative and statistically and economically significant. One standard deviation increase in fasting hours, reflecting 1.8 additional hours ($\mu = 12.46$, $\sigma = 1.78$) in daily average, lowers girls' probability of completing primary school by one-fifth of a standard deviation.

The hindering effect of parental religiosity on females' inclusion in schooling is again evident when I estimate the impact on different educational outcomes, such as literacy rates and completed years of education. The fourth column of Table 2.1 shows the conditional difference in average literacy rates between males and females

on birthplace and birth-year-specific cohort fixed effects and census-year fixed effects as 32 percentage points. As shown in the fifth column, I find that women's chance to read and write in Turkish during their adulthood decreases by 2.7 percentage points when their enrollment dates to primary education coincide with the three months following the start of Ramadan. The results using fasting hours, presented in the sixth column, show that males' literacy rates are statistically insignificant to increased parental religiosity. However, 1.8 hours of increase in average daily fasting hours lower girls' literacy rates by one-tenth of a standard deviation. The seventh column and the rest in Table 2.1 report the results for the completed year of schooling in log. The seventh column displays that the conditional average completed years of education on the usual fixed effects are lower for females than males by 66.9 percent. Enrollment dates for primary schools to be in three months starting with the first date of Ramadan month lower females' average completed year of schooling by 6.9 percent. On average, I still do not find any significant change in males' completed years of education by the effect of fasting hours. Again, I find that 1.8 hours of an increase in average daily fasting hours at the year that kids will have enrolled in primary school lower females' average completed years of schooling by 29.4 percent of one standard deviation. In other words, parental religiosity contributes to the gender gap in Turkey in average completed years of education by 1.15 years ($\mu = 4.09, \sigma = 3.91$).

The effects estimated on females' literacy rates are smaller than those for the shares of people who completed at least primary school in terms of their magnitude. I basically attribute the difference in the coefficients to what the outcome variables measure. As literacy skills are acquired particularly in the first grade, the estimates reported in the fifth and sixth columns tend to show the effect of Ramadan on females' chance to start and complete the first grade of primary school. By the same token, the estimates on having completed primary school may reflect the aggregated effects of parental religiosity that females have been exposed to during their entire primary schooling age. However, the model cannot capture the impact of mass, effective and women-targeting literacy campaigns that had run before the earliest census year. For instance, a law passed in 1983 addressed literacy courses as mandatory and introduced penal regulations. The campaign also had given priority to some groups, including women (Sayilan and Yildiz, 2009). Therefore, the estimates underestimate the number of missing school-girls due to parents' religious beliefs. Thus, the actual effect captured through the distance of enrollment dates to Ramadan should be between them.

Linearity assumption on gender-gap trend: Given that the treated group for the enrollment by Ramadan corresponds to a particular group born in the same year, the extent of economic strains that families challenge may be different across the birth cohorts. For instance, during World War II, Turkey remained neutral until the final stages and tried to maintain an equal distance between the Axis and the Allies until February 1945. Yet, the subversive effects of the war were salient through the economic distress. As such, by the gendered nature of family decisions about their offspring's education, such budget constraints may lead to an equilibrium where families prefer a higher investment to the ones believed to have the highest educational return among their siblings. Therefore, such hardships, along with son-preference over educational investments, may deepen the gender gap in education, as well as, such economic shocks may lead to considerable deviations from the gender-gap trend. I tackle this issue by including the term interacting gender with per capita income at national and provincial levels in the birth cohorts' enrollment years. The first and second columns of Table 2.2 report the results after controlling for such income effects, and the estimates are still consistent with the previous results. I find that Ramadan lowers girls' chance to pursue their education by 3 percentage points, equivalent to 6.5 percent of one standard deviation. While there is no effect of fasting hours for males, it estimates 1.8 hours of increase in average daily fasting hours lowers girls' likelihood of being degree-holder by 19.7 percentage points.

The other robustness check is again on the linearity assumption on the gender-gap trend. I here consider the potential non-linearities in gender gap differences in education levels over the cohorts. The third columns of Table 2.2 report the estimated effects where I compare within five-year birth cohorts of males and females born in the same statistical region. The characteristics of provinces within the same statistical region are comparable enough in terms of economic development, such as productivity of land, sectoral composition, and culture. Therefore, this type of grouping enables us to estimate the effect of fasting hours within the birth-cohorts for which social and economic conditions remain similar while the variation in fasting hours is large enough within the region. I also consider the gender gap trend of provinces within the five-year cohorts and income-related differences in female education within the new group of birth-cohorts. Consequently, the case where I relax the trend assumption gives qualitatively similar results.

Enrollment Period: I now focus on the treatment definition. I first focus on the relevance of the assumption that the current regulation on school enrollments was the same in the past. In other words, the individuals born in 1923-1955 may be

subjected to slightly different rules than today. So, this uncertainty may cause my definition to regard non-treated in actual as treated, and vice versa. In addition, using the mid-point of a period would give an average effect within the interval, but the estimated results for the two most distant dates may differ in terms of sign and magnitude. In this regard, I employ every possible day within the enrollment period as the enrollment date to re-estimate the effect for all. Figure 2.6 displays the results from separate estimations on all educational outcomes. It shows that the estimates are still negative and statistically significant no matter the date chosen within the enrollment period. Moreover, the findings for each day are not statistically different from those in Table 2.1 at 95 confidence level.

2.5.2   Religiosity during Primary Schooling Age

I next address whether the exposure to parental religiosity at earlier ages matters for females' level of education. To compare the relative effects, I now use starting date of education because school enrollments in Turkey automatically renew every year, and parents make their kids registered only at the first years of the pre-tertiary educational levels. For the estimation, the distance measure to the first day of Ramadan month here considers the 15th of September, given that the second week of this month is the usual starting week. Assuming the potential collinearity, I estimate the effects separately for each grade, relying on the equation 2.1 and present the results on females' average completed years of schooling in Figure 2.4. I find that the effect estimated for the first grade is the largest and the hindering effect slightly diminishes by the fourth grade. After the fourth year, which is the average years of schooling of this birth cohort, the estimates substantially vanish away. The estimated effect of the exposure at the eighth grade turns positive for females, potentially due to the female cohorts that reach eighth grade is selective.

I next examine whether the intensity of parental religiosity during the primary schooling age matters for females to acquire their education. Recall that the variation in average daily fasting hours measures at the intensive margin, but their religiosity in the year that the birth-cohorts become in primary schooling age. This exercise addresses the effect of its intensity that females had encountered during the entire schooling age. I estimate it for the girls on their chance to complete at least primary school and on their completed year of schooling, relying on the equation 2.1 and illustrate them in Figure 2.5a and Figure 2.5b, respectively. The results reveal that a greater religiosity of parents during girls' primary schooling age exacerbates the

risk of females not completing the primary education and lowers the level of female education. Table 2.9 keeps the intensity of females' exposure to Ramadan during their entire primary schooling age and examines at which ages (or grades) females are further vulnerable in the sense of pursuing their primary education. It shows that females are more likely to end up with worse education outcomes if parents are more religious during every new academic year, but it becomes more pronounced if parents' religious beliefs are more strong during their starting dates to the first three grades. These results suggest that the missing school-girls in Turkey, due to their parents' stronger religious beliefs, are less likely to be driven by the secular school dress codes, given that the women in Turkey customarily wear headscarves after they reach puberty.

2.5.3 Mechanism: Religiosity and Gender Norms

Previous results point to lower female education due to the increased religiosity by Ramadan. The evidence using the distance of enrollments and fasting hours as a proxy for religiosity is consistent and shows that religiosity in Turkey causes lower female education levels while there is no effect on males' education access. This part aims to examine the potential mechanism that drives such gender-based outcomes. To do so, I use the sample of Turkish DHS from 2008 to 2013, and I estimate the effect of Ramadan on gender norms and religious practices through the following estimating equation:

$$\text{Culture}_{ipt} = \beta \, \text{Monthly Distance}_{pt} + \theta_p + \mu_u + + \lambda_t + \varepsilon_i \tag{2.3}$$

where Culture is the vector that consists of gender norms as well as the religious practices of the women i living in province p at time t. Figure 2.7 shows that most of the interviews are held shortly after Ramadan because Turkish DHS surveys are usually conducting in autumn, and Ramadan has coincided with September and August in 2008 and 2013, respectively. Given the few variations in distances, I estimate the effect of Ramadan by grouping the individuals whose interviews have an equal monthly distance to the most recent Ramadan. Therefore, identification relies on the arguably exogenous variation of interview dates from the end of the most recent Ramadan, and consequently, it induces as good as random variation in religiosity. Table 2.11 supports this argument and reports whether the daily distance from Ramadan is associated with women's demographic characteristics.

Although some of the estimated coefficients are statistically significant, they remain economically insignificant. Therefore, they are unlikely to affect the interpretation of the results.

I include some personal characteristics as controls because they increase the precision of estimates and absorb the slight differences in demographic characteristics by distance to Ramadan. They consist of age intervals, mother tongue, education level of the women, parental education levels, marital status, and the number of children in categories and spatial characteristics. In the end, I keep the most recent month, i.e., the first month after Ramadan, as the reference group, and β reflects the estimated effect of monthly distances from Ramadan compared to this group.

Women who wear headscarves constitute 70 percent of the total, and three-fourth of individuals observe religious fasting (Çarkoğlu and Toprak, 2007). In this sense, headscarf and fasting questions act as a balancing test and help examine if the prevailing level of religiosity is stable over the distance groups. Table 2.5 shows that the women interviewed in dates with different distances to Ramadan are statistically similar in terms of such religious practices. Hence, it appears the closer the interview date to Ramadan, the closer the interview date to Ramadan, the more conservative and the more religious the response by the women interviewed. The number of reports on whether women perform prayer regularly or irregularly decreases in Ramadan's subsequent months. In return, I find that women's voices over egalitarian family decisions, female education, and women's participation in politics raise.

The previous results are similar when I use the average fasting hours for the exogenous variation in the intensity of religiosity among the women. Table 2.12 shows that the characteristics of the women in provinces with longer fasting hours are similar to the ones with shorter fasting hours. Table 2.13 reveals that the women in provinces where the average daily fasting hours are longer in the interview year are more likely to be religiously fasting, and their responses to the gender norm statements are more traditional compared to the ones in provinces with shorter duration of religious fasting. Consequently, Ramadan is likely to affect the preferences of parents towards women's education.

Increased religiosity likely leads families to underestimate the female educational returns, hence lowering girls' enrollments and the chance of females to complete the primary education. This evidence is also consistent with the notion of imperfect empathy through which parents transmit their preferences to the offspring at the expense of lowering their expected economic outcomes (Bisin and Verdier, 2001; Algan

et al., 2013). Thus, despite the substantial costs brought to girls by deterring their development of cognitive skills, Ramadan's higher degree of conservatism causes a lower female education level. The following section analyzes how females' lack of education due to increased religiosity affects the female labor market outcomes.

2.5.4 Long-term Effects of Parental Religiosity

The previous results constitute conclusive evidence on the missing school-girls in Turkey due to their parents' drastic religious beliefs when these girls should have started their education. I now present the consequences of religious beliefs on women's adult outcomes, with a particular interest in the gender gap in the labor market.

I run equation 2.1 and 2.2, including some other fixed effects as in specification reported in Column 3 Table 2.2. Given that these outcomes are a function of age, labor market characteristics, I added region- and gender-specific five-year birth cohort fixed effects in my model as a control to account for the gender differential age effects and regional factors that are significant for gender differential job opportunities. Also, the variation in per capita income for the year students start their education can capture the quality of education across provinces and birth cohorts. As some of the 1923-1955 born individuals become out of the working-age population after 1985, I estimate the results using the earliest year of the censuses. I report the results using the distance to Ramadan and fasting hours in Table 2.3 and 2.4.[25]

My results indicate that the increased parental religiosity at age 6 does not only cause lower female education levels in Turkey, but it has substantial consequences for women's later life, and it causes considerable gender inequalities in the labor market. For instance, I find that the women with a higher level of parental religiosity in their early ages become less likely to participate in the labor market. The estimated effects using the two instruments for parental religiosity are consistent and statistically significant. Females whose enrollment periods correspond to Ramadan are less likely to be in the labor force by 1.2 percentage points. As parental religiosity did not make boys excluded from schooling, I do not find significant effects on their

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[25] The results on individuals outcomes in 1990 are qualitatively similar to the reported one. However, I observe that the treated group of women is entering into the labor market in 2000 as unpaid family workers due to the severe economic crisis of Turkey starting in the ending years of 1990s. This outcome is not inconsistent with my main findings, given that they enter into the labor market as unpaid and family workers, even when households face a high risk of income loss. As a consequence of their inclusion as unpaid family workers, the effects on their labor market behaviors in 2000 are different. I can provide the results by census if asked.

participation in the labor market. However, a higher degree of parental religiosity, measured by 1.8 hours of increase in average daily fasting hours in the enrollment year to primary school, lowers females' participation rates in their adulthood by 22.1 percentage points. Thus, females' lack of education due to the beliefs of their parents exert significant inefficiencies in the Turkish economy. I find that the labor force participation of women in Turkey is not only lowering, parents' religious beliefs also reduce the shares of female income-earners and female professionals in Turkey.

Given that the coefficients for income-earner rates are considerably higher than those for the labor force participation rates, if these women had had access to education, the opportunity cost of their inactivity would have been much higher, and therefore, they would have been more likely to be in the labor force. More importantly, it is least likely that they would have been unemployed or unpaid family workers in the labor force, but they would have got into jobs that they could have earned an income. Besides, even though the effect on years of schooling seems low, I still find significant results on female professions.

To further analyze the underlying reason for their inactivity in the labor market, I examine the effect on their marital status, as a proxy for the number of children they have, given that the census collects the number of children only from women and enables to observe one individual within a household, besides that marital status is one of the universally asked questions. The results on their marital status using the two instruments are still consistent, and I find that the treated females' probability of being married is significantly higher. The result on the fertility of women is again consistent with the latter one. For the regression result among women, I find those female cohorts with 1.8 hours of higher average daily fasting hours at their school-start year have a higher number of children given birth by 88.1 percent of one standard deviation. The effect of parental religiosity on the female offsprings' fertility is substantial, and the estimate points that 1.8 hours of higher fasting hours in the significant year of schooling result in women having given birth to 2.7 children more, on average. High fertility may arise from their marriages at very early ages, or their lack of education hinders hear about contraceptive methods. Given that increased number of children gives much more burden on the shoulders of women in the presence of traditional household division of labor, I find that the same amount of increase in fasting hours causes the probability of females to be out of the labor force due to the household responsibilities to increase by 1.5 of one standard deviation, equivalent to 73.6 percentage points.

2.6   Concluding Remarks

This study sheds light on the causal effects of parental religiosity on the gender gaps in educational access and labor market outcomes. For the empirical investigation, I focus on the first generation of the Turkish Republic, the first secular Muslim-majority country. The individuals born in 1923-1955 constitute the interested group for the empirical analysis because the education system available for this group of people was predominantly the same for all, regardless of gender. I obtain educational and labor market outcomes of individuals born in 1923-1955 through the censuses conducted in 1985, 1990, and 2000 in which all subgroups are representative.

I exploit Ramadan as a quasi-natural experiment for increased active religiosity in Turkey, where Muslims constitute 99 percent of the total population. Ramadan increases religious practicing at both extensive and intensive margins. More importantly, starting age to school is fixed at 6, and the registrations are only possible in a specified period of summers. Using this information, I detect the treated group to the increased religiosity with two measurements: One of them identifies as the birth-cohorts whose enrollment season occurs in Ramadan and its following two months. The latter captures it through the variation of fasting hours, which exogenously vary over time and latitude. Before estimating the effect of interest, I account for birthplace-specific birth-year fixed effects, the gender gap trend in education level within provinces, and the variation in outcomes due to the census year. Then, I include my instrument interacting with the gender of individuals. Finally, I argue that the variation captured by the instrument with female interaction exerts the causal effect of parental religiosity on female education.

Results reveal that parental religiosity constitutes an impediment to girls' educational attainment in Turkey. Girls' chance to complete their compulsory education decreases by 4.3 percentage points when the registration date to primary school is within three months since the start of Ramadan. The effect of increased parental religiosity is economically important: it corresponds to 8.8 percent of a standard deviation; therefore, parental religious beliefs explain one-seventh of the prevailing gender difference in holding a formal degree. The hindering effect of parental religiosity on females' inclusion in schooling is still evident when I estimate the impact on different educational outcomes: women's chance to read and write in Turkish during their adulthood decreases by 2.7 percentage points when their enrollment dates to primary education coincide with the three months following the start of Ramadan. Exposure to increased fasting hours is not significant to males' literacy

rates. Such results are qualitatively robust to alternative specifications.

Parents' religious belief is not a negligible element for the education of females, and policymakers should reckon with the long-term aspects of their policies that enhance the religiosity of their citizens. The policymakers should be well-acknowledged that the increased religiosity causes families to acquire more traditional gender norms, which unfortunately leads them to underestimate females' educational returns, thus lowering girls' enrollments in schools. I find that it contributes to the gender gap in Turkey in average completed years of schooling by 1.15 years. Furthermore, I observe significantly lower levels of female educational attainment while their starting dates of new school years had coincided with Ramadan more frequently and when their parental religious beliefs were more strengthened during their starts to the first three grades.

The increased parental religiosity at age 6 causes considerable gender inequalities in the labor market and exerts significant inefficiencies in the Turkish economy. I find that the labor force participation of women in Turkey is not only lowering, parents' religious beliefs also reduce the shares of female income-earners and female professionals in Turkey. If these women had had access to education, the opportunity cost of their inactivity would have been much higher, and therefore, they would have been more likely to be in the labor force. More importantly, it is least likely that they would have been unemployed or unpaid family workers in the labor force, but they would have got into jobs that they could have earned an income. Since these women have nothing but being housewives, I find one standard deviation increase of fasting hours in the significant year of schooling results in the rise in the number of children given birth by 2.7 children. Given that increased number of children gives much more burden on the shoulders of women in the presence of traditional household division of labor, I find that the same amount of increase in fasting hours causes the probability of females to be out of the labor force due to the household responsibilities to increase by 1.5 of one standard deviation, equivalent to 73.6 percentage points.

2.7 Figures and Tables

FIGURE 2.1: Global Gender Gap and NEET Rates among OECD-founding Members

(A) Global Gender Gap Rankings, 2020
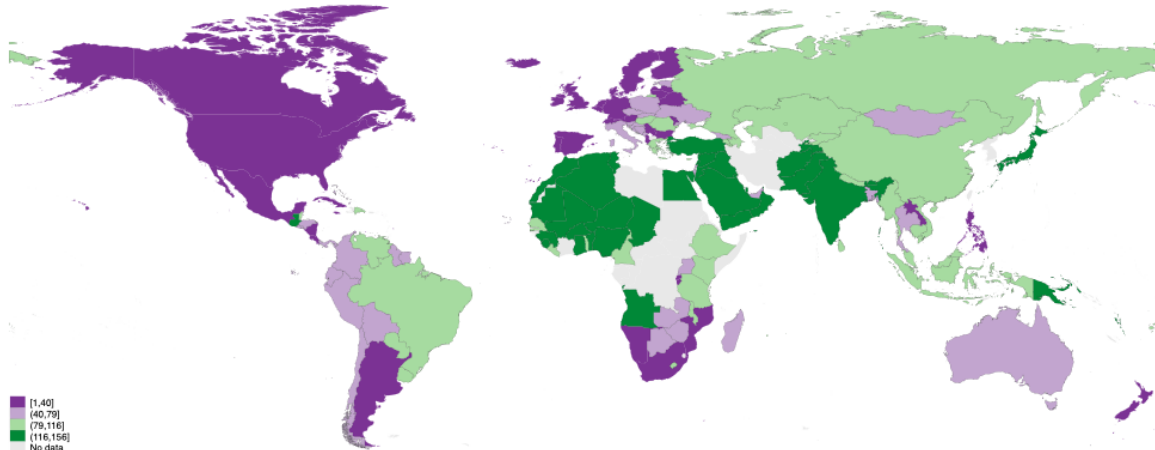
(B) Female and male NEET rates of OECD founding-member countries
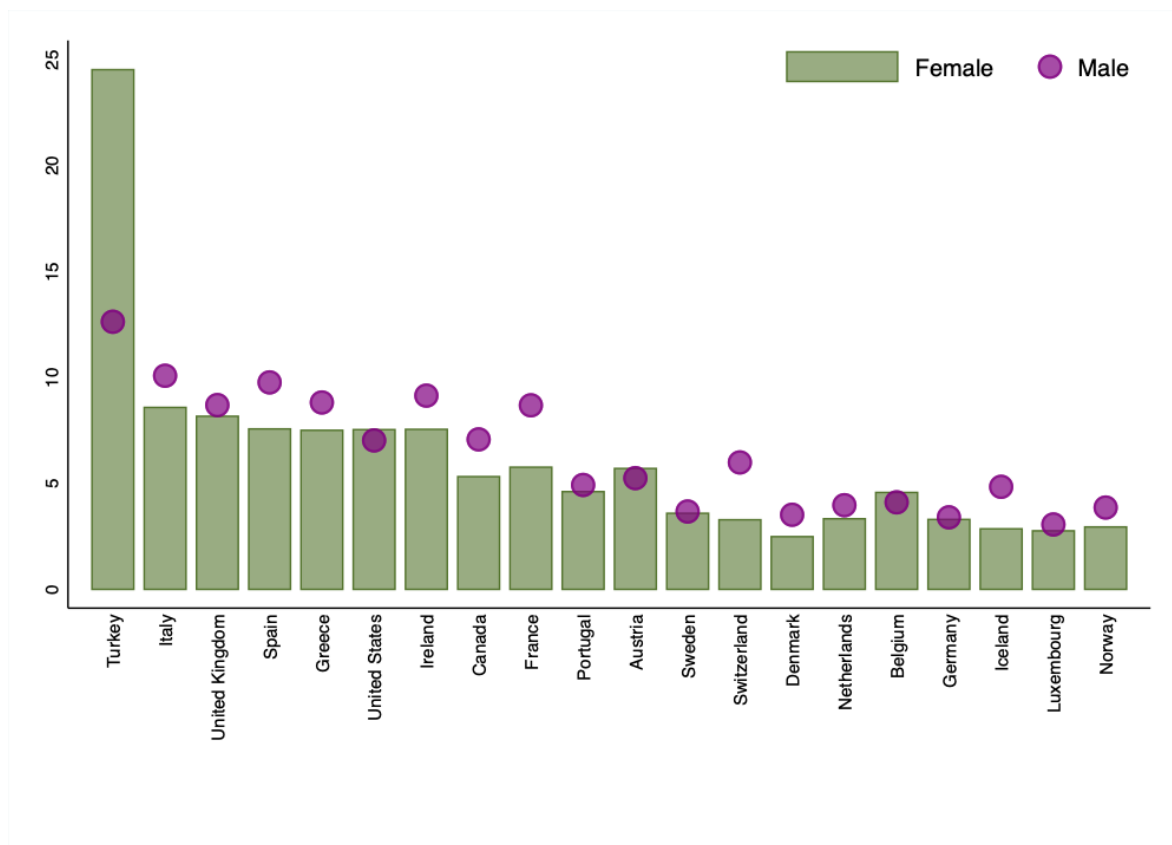
Sources: 2020 Global Gender Gap Report of World Economic Forum & OECD. Notes: Global Gap Index of World Economic Forum measures gender-based gaps in access to resources and opportunities in countries in order to isolate the actual differences across countries due to the varying degree of economic development. Economic participation and opportunity, educational attainment, health and survival, and political empowerment constitute the main dimensions of this index. NEET rates present the share of young people who are not in employment, education or training, as a percentage of the total number of young people in the 15-19 age group, by gender.

FIGURE 2.2: Increased Religiosity on Google Trends

(A) Quran (Holy book) as a search term
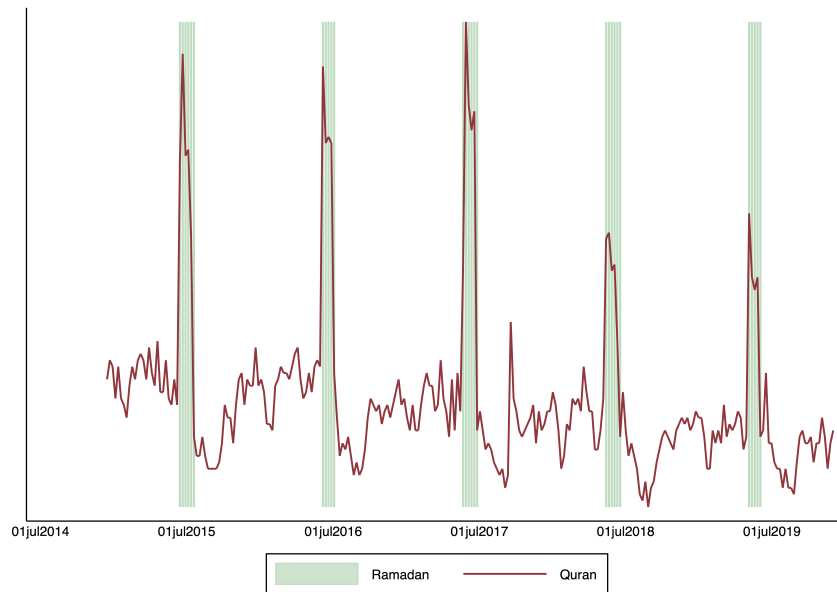
(B) Questions on spiritual implications of acts
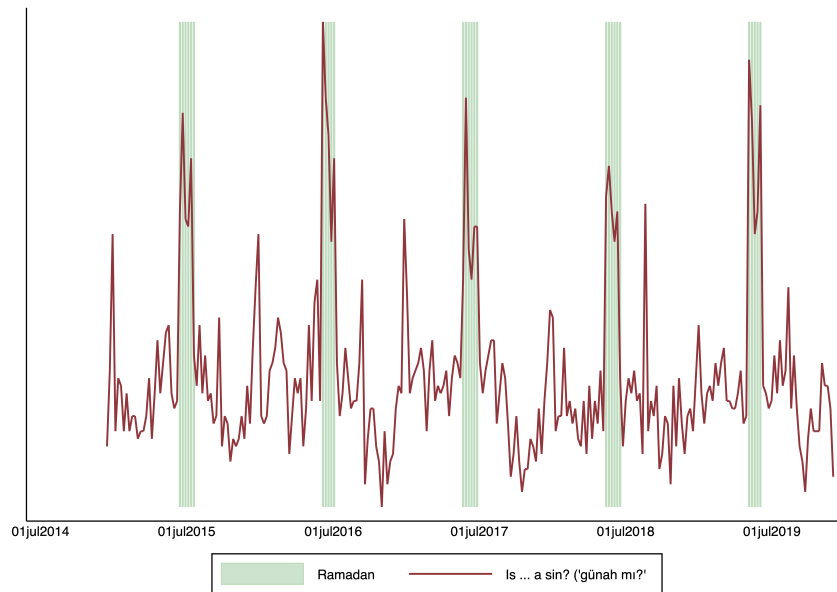
Source: Google Trends of Turkey, weekly data from 14/12/2014 to 01/12/2019. Notes: The data is retrieved from Google Trends in specific to the searches from Turkey. Time interval of the data is chosen considering the pandemic that may lead increased uncertainties, hence potentially affecting the religiosity of individuals. Turkish translations of Quran as well as "Is... a sin", which are "Kuran" and "günah mı", are the search terms that are retrieved for the period from 14/12/2014 to 01/12/2019. Given the data to be weekly, green horizontal lines indicate the weeks of the holy month. Quran searches reflect the religious practices that are carried out through digital means. Questions on the spiritual implications of daily-life actions, on the other hand, are an indicator for to what extent religion becomes an important aspect in decision-making process of individuals.

FIGURE 2.3: Treatment to Ramadan

(A) Identification: Enrollment Periods and Ramadan
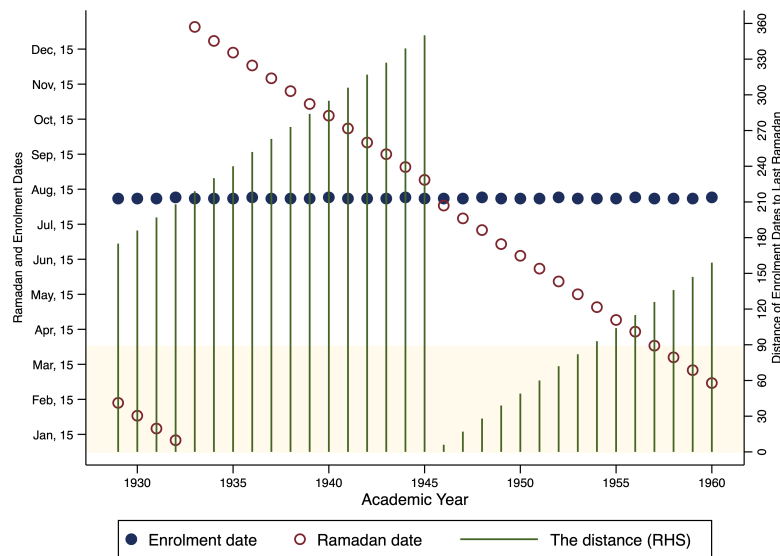
(B) Treated Birth-cohorts and Fasting Durations of the Provinces in Southest and Northest
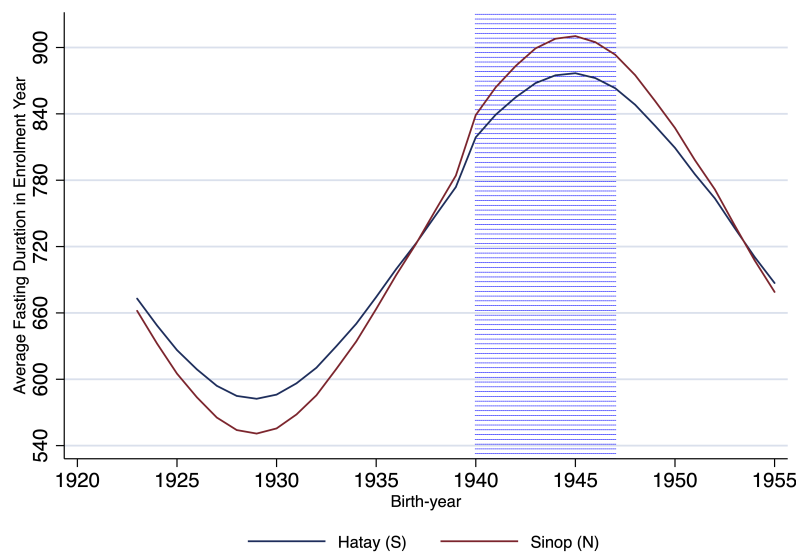
Notes: Figure 2.3a presents the mid-day of enrollment periods,i.e., 5 August of the year, (presented in blue circles) and he first day of the most recent Ramadan months (in red circles) as well as their daily distances in each academic year (in green vertical lines). Yellow vertical lines are included to present the treated academic year when the enrolment dates to primary schools are in three months since the beginning of Ramadan. As the enrollment periods for the school years earlier than 1946 are coinciding to before Ramadan, the treated birth-cohorts start with individuals born in 1940. The treated birth cohorts from this exogenous source of variation are presented in blue rectangle in Figure 2.3b, where I additionally present the average fasting hours of the southernmost and northernmost provinces in the years that the birth cohorts are registered to primary school. The longest average fasting hours correspond to years when the summer solstice of the northern latitude is around the mid of the holy month.

FIGURE 2.4: Distance of Ramadan to Starting Dates to Grades from 1 to 8 and Female Education
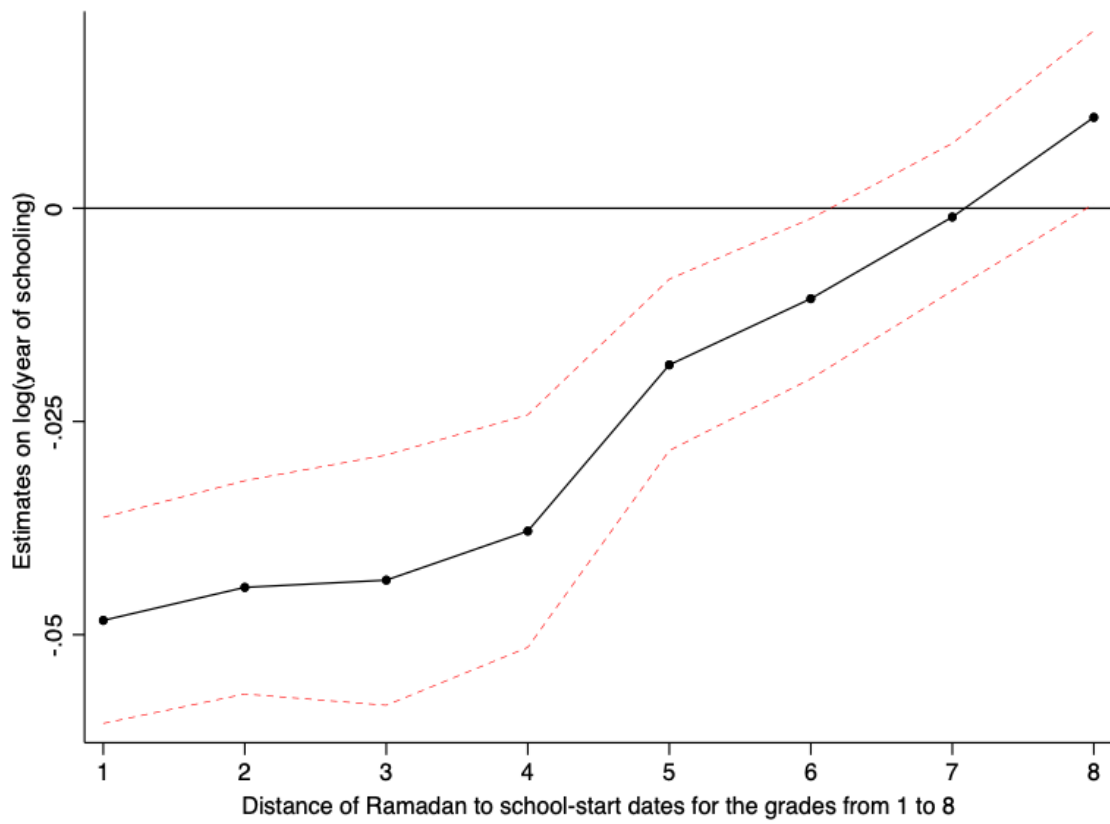
Source: 1985, 1990, 2000 Census of Turkey. Notes: I apply a nonlinear approach by calculating the separate estimates for the effect of Ramadan distances to each school-start dates for the grades from 1 to 8. The estimated effects for the girls on completed year of schooling in percentage changes rely on the specification presented in the equation 2.1. Bullets reflect the point estimates of the distance-effect for each school grade, presented in x-axis. Red dashed lines indicate the coefficient estimates within 95 percent of confidence interval.

(A) The Effect on Girls' Chance to be a Formal Degree Holder
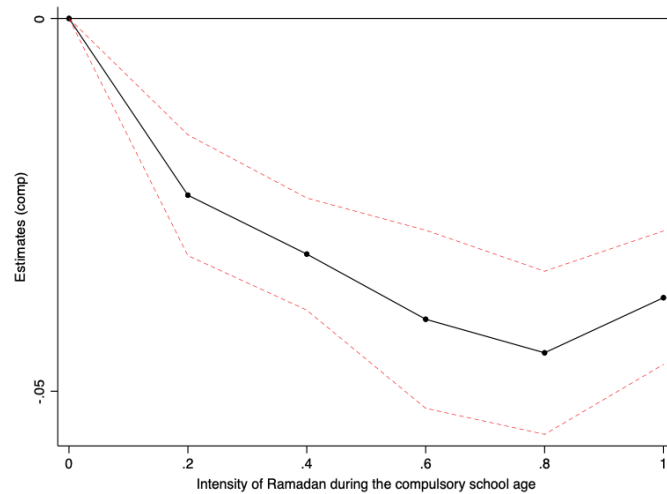
(B) The Effect on Girls' Completed Year of Schooling in Log
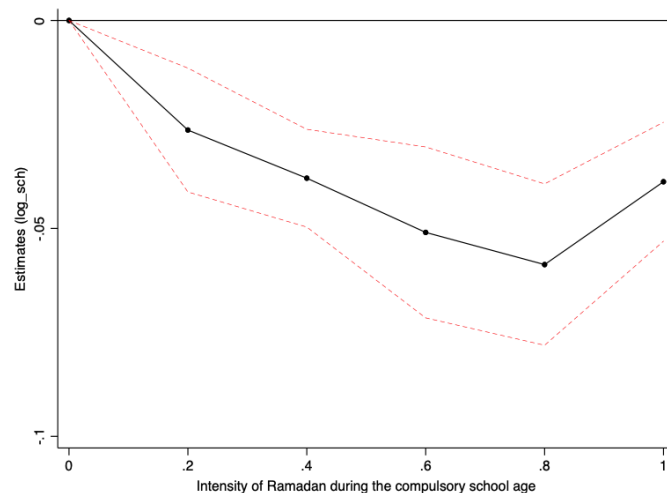
Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: In this exercise, I group the birth-cohorts depending on to what extent they may have been exposed to parental religiosity during their entire compulsory-school age (6-11). To this end, I firstly calculate the distance of starting dates for the grades from 1 to 5 to the first date of the most recent Ramadan month, and then I determine how many times the birth-cohorts' school-start days fall in the 3-month period since the start of Ramadan. The birth-cohorts are grouped according to the amount of exposure. Among the existing 6 alternatives for their degree of exposure to parental religiosity, i.e. never-exposed, the exposure to Ramadan by 0.2, 0.4, 0.6, 0.8 during the compulsory-school age, and full exposure to Ramadan, for the estimation, the never-exposed group– which consists of 1923-1932 and 1944-1955 birth cohorts, hence constituting the largest group– is chosen as the reference group. The estimated effects for the girls on their chance to be a formal degree holder and on their completed year of schooling rely on the specification in the equation 2.1 and they are presented in Figure 2.5a and Figure 2.5b, respectively. Note that 1933 and 1943 borners are exposed by one time in their entire schooling age, hence presenting the treated group in 0.2 of x-axes. 1934(1935; 1936) and 1942(1941; 1940) borners constitute the group whose 0.4 (0.6; 0.8) of the school start days fall in three month following Ramadan month, respectively. Finally, individuals born in years between 1937 and 1939 are exposed to Ramadan during the entire period of compulsory schooling.

TABLE 2.1: Parental Religiosity and Education of Men and Women

	Formal degree holder			Literate			Year of schooling in log		
	(1) Baseline	(2) Treatment (Distance)	(3) Treatment (Duration)	(4) Baseline	(5) Treatment (Distance)	(6) Treatment (Duration)	(7) Baseline	(8) Treatment (Distance)	(9) Treatment (Duration)
Female	-0.323*** (0.0137)			-0.320*** (0.0145)			-0.669*** (0.0267)		
Religiosity			-0.267 (0.473)			-0.110 (0.438)			-0.594 (0.875)
Fem*Religiosity		-0.0432*** (0.00385)	-0.200*** (0.0183)		-0.0272*** (0.00339)	-0.106*** (0.0150)		-0.0692*** (0.00711)	-0.294*** (0.0318)
Provincial Birth-cohort FE	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Region-specific Birth-cohort FE	No	No	Yes	No	No	Yes	No	No	Yes
Census-year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gender-specific census-year FEs	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Trend*Gender*Province	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Observations	2,152,031	2,152,031	2,152,031	2,151,949	2,151,949	2,151,949	2,151,876	2,151,876	2,151,876
R-squared	0.282	0.292	0.291	0.276	0.293	0.291	0.314	0.324	0.323

Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: Share of formal degree holders among this group is 0.49. Literacy rate of the sample is 0.70 and the standard deviation is 0.46. The first columns for each educational outcome reflect the conditional mean differences in the respective educational outcome on province-specific birth cohorts and census-year fixed effects. The estimates in the next columns for each educational outcomes (being a formal degree holder, being able to read and write in Turkish, and the log of completed year of schooling) display my benchmark specifications, as in the equation 2.1 and 2.2.Standard errors are in parenthesis, clustered at province level (N=81). *** p<0.01, ** p<0.05, * p<0.1

TABLE 2.2: The Effect on Holding a Formal Degree with Alternative Specifications

	Distance			Fasting hour in log form		
	(1)	(2)	(3)	(1)	(2)	(3)
Religiosity				-0.269	-0.311	-0.269
				(0.473)	(0.476)	(0.476)
Female*Religiosity	-0.0301***	-0.0302***	-0.00857**	-0.197***	-0.197***	-0.236***
	(0.00283)	(0.00287)	(0.00375)	(0.0187)	(0.0188)	(0.0269)
Provincial Birth-cohort FE	Yes	Yes	Yes	No	No	No
Regional Birth-cohort FE	No	No	No	Yes	Yes	Yes
Gender-specific Year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Trend*Gender*Province	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita*Female	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Income*Female	No	Yes	Yes	No	Yes	Yes
5-year Birth-cohort*NUTS2*Female	No	No	Yes	No	No	Yes
Observations	2,152,031	2,152,031	2,152,031	2,152,031	2,152,031	2,152,031
R-squared	0.292	0.292	0.295	0.291	0.291	0.294

TABLE 2.3: Consequences of Religiosity for Women in Adult Life

	Labor force	Income-earner	Professional jobs	Married
Female*Ramadan	-0.0120**	-0.0282***	-0.00632**	0.0303***
	(0.00510)	(0.00485)	(0.00303)	(0.00370)
Female	Yes	Yes	Yes	Yes
Provincial Birth-cohort FE	Yes	Yes	Yes	Yes
Trend*Gender*Province	Yes	Yes	Yes	Yes
5-year Birth-cohort*Region*Female	Yes	Yes	Yes	Yes
GDP per capita*Female	Yes	Yes	Yes	Yes
Provincial Income*Female	Yes	Yes	Yes	Yes
Observations	752,562	752,562	752,562	752,562
R-squared	0.276	0.545	0.043	0.057

Source: 1985 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: The historical national income data is retrieved from 2010 Maddison Project and provincial real income levels at age 6 of birth-cohorts are retrieved from Asik et al. (2020). Female interaction terms with per capita income levels at the enrollment year are included as a covariate. Standard errors are in parenthesis, clustered at province level (N=81). *** p<0.01, ** p<0.05, * p<0.1

TABLE 2.4: Results on the Consequences of Religiosity for Women in Adult Life Using Fasting Hours

	Labor force	Income-earner	Professional jobs	Married	Nb. children	Housewife
Fasting hour	-0.764*	0.0432	0.193	-0.188	0.881**	1.477**
	(0.457)	(0.476)	(0.197)	(0.174)	(0.423)	(0.590)
Female*Fasting hour	-0.221***	-0.227***	-0.0641***	0.0616***		
	(0.0249)	(0.0195)	(0.0112)	(0.0159)		
Female	Yes	Yes	Yes	Yes	Yes	Yes
Regional Birth-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Trend*Gender*Province	Yes	Yes	Yes	Yes	Yes	Yes
5-year Birth-cohort*Regional*Female	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita*Female	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Income*Female	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752,562	752,562	752,562	752,562	357,169	357,602
R-squared	0.275	0.544	0.041	0.055	0.157	0.037

Source: 1985 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: The historical national income data is retrieved from 2010 Maddison Project and provincial real income levels at age 6 of birth-cohorts are retrieved from Asik et al. (2020). Female interaction terms with per capita income levels at the enrollment year are included as a covariate. Standard errors are in parenthesis, clustered at province level (N=81). *** p<0.01, ** p<0.05, * p<0.1

TABLE 2.5: Ramadan, and Salience of Religiosity and Traditional Gender Norms

Gender norm indicators:	Family decisions	Education preferences	Women in politics
2nd month after Ramadan	-0.0396**	-0.0443***	0.00901
	(0.0153)	(0.0132)	(0.0154)
3rd month after Ramadan	-0.0632***	-0.0734***	0.0221
	(0.0226)	(0.0207)	(0.0267)
4th month after Ramadan	-0.0575**	-0.0737***	0.0705**
	(0.0232)	(0.0221)	(0.0271)
5th month after Ramadan	-0.0763***	-0.0677***	0.0728**
	(0.0285)	(0.0238)	(0.0293)
Observations	14,290	14,326	12,891
R-squared	0.130	0.058	0.031

Religiosity indicators:	Praying	Wearing headscarf	Fasting
2nd month after Ramadan	-0.0273*	0.00506	0.0170
	(0.0142)	(0.0134)	(0.0119)
3rd month after Ramadan	-0.0573**	0.00210	0.0214
	(0.0274)	(0.0332)	(0.0241)
4th month after Ramadan	-0.0432*	0.00438	0.0315
	(0.0227)	(0.0221)	(0.0205)
5th month after Ramadan	-0.0885***	-0.0472*	-0.000818
	(0.0263)	(0.0256)	(0.0221)
Observations	14,349	14,361	14,280
R-squared	0.108	0.315	0.082

Source: Demographic and Health Survey of Turkey; 2008, 2013. Notes: The sample consists of ever-married women aged between 15 and 49 years. Outcome variables refer to gender norms in dummy variable formation if the woman agrees to the following statements "*Important family decisions should be made by husbands.*", "*University education is more important for males than females*", "*Women should be more involved in politics*". Pray, wearing headscarf , and fasting take value of 1 if the respondent carries out the certain religious behavior either regularly or irregularly. Given a lower extent of variation in interview dates with respect to Ramadan, the observations are monthly-grouped by the distance of interview dates to the ending Ramadan. Reference category is the interviews that are held in the subsequent month of Ramadan. In order to increase the precision of estimates, personal characteristics are controlled for. They consist of age intervals, mother tongue, education level of the women, parental education levels, marital status, and number of children in categories. In addition, spatial characteristics which consist of province, and type of the residential area are taken into account. Linear models with many levels of fixed effects are applied and standard errors are clustered at province level. Number of cluster is 81 for all regressions. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix B

TABLE 2.6: Summary Statistics by Census Year

1985					
	Mean	SD	Min	Max	Obs
Ramadan	0.26	0.44	0	1	752,562
Fasting hour	12.41	1.81	9.18	15.17	752,562
Female	0.48	0.50	0	1	752,562
Age	43.01	9.37	30	62	752,562
Degree-holder	0.60	0.49	0	1	752,562
Literate	0.70	0.46	0	1	752,562
Years of schooling	4.01	3.82	0	15.00	752,512
Labor force	0.68	0.47	0	1	752,562
Income-earner	0.47	0.50	0	1	752,562
Professional jobs	0.06	0.23	0	1	752,562
Married	0.92	0.28	0	1	752,562
Number of children	4.90	3.07	0	24.00	357,169
Housewife	0.53	0.50	0	1	357,602
National income per capita	1318.29	288.04	712.11	1814.01	752,562
Provincial income per capita	91.98	49.42	29.40	326.50	752,562
1990					
	Mean	SD	Min	Max	Obs
Ramadan	0.25	0.43	0	1	744,534
Fasting hour	12.44	1.80	9.18	15.17	744,534
Female	0.48	0.50	0	1	744,534
Age	47.76	9.32	35	67	744,534
Degree-holder	0.62	0.49	0	1	744,534
Literate	0.69	0.46	0	1	744,534
Years of schooling	4.12	3.95	0	15	744,429
Labor force	0.65	0.48	0	1	744,534
Income-earner	0.45	0.50	0	1	744,534
Professional jobs	0.06	0.23	0	1	744,534
Married	0.90	0.30	0	1	744,534
Number of children	4.94	2.87	0	40	344,272
Housewife	0.54	0.50	0	1	358,325
National income per capita	1324.86	286.18	712.11	1814.01	744,534
Provincial income per capita	91.79	49.15	29.40	326.50	744,534
2000					
	Mean	SD.	Min	Max	Obs
Ramadan	0.26	0.44	0	1	654,935
Fasting hour	12.57	1.75	9.18	15.17	654,935
Female	0.50	0.50	0	1	654,935
Age	56.83	8.92	45	77	654,935
Degree-holder	0.60	0.49	0	1	654,935
Literate	0.71	0.45	0	1	654,853
Years of schooling	4.15	3.99	0	18	654,935
Labor force	0.52	0.50	0	1	654,935
Income-earner	0.33	0.47	0	1	654,935
Professional jobs	0.06	0.23	0	1	654,935
Married	0.84	0.37	0	1	654,935
Number of children	4.61	2.87	0	26	326,616
Housewife	0.52	0.50	0	1	327,460
National income per capita	1347.37	274.70	712.11	1814.01	654,935
Provincial income per capita	92.19	49.73	29.40	326.50	654,935

Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955.

FIGURE 2.6: Differing Period for Enrolment and The Effect on Female Education
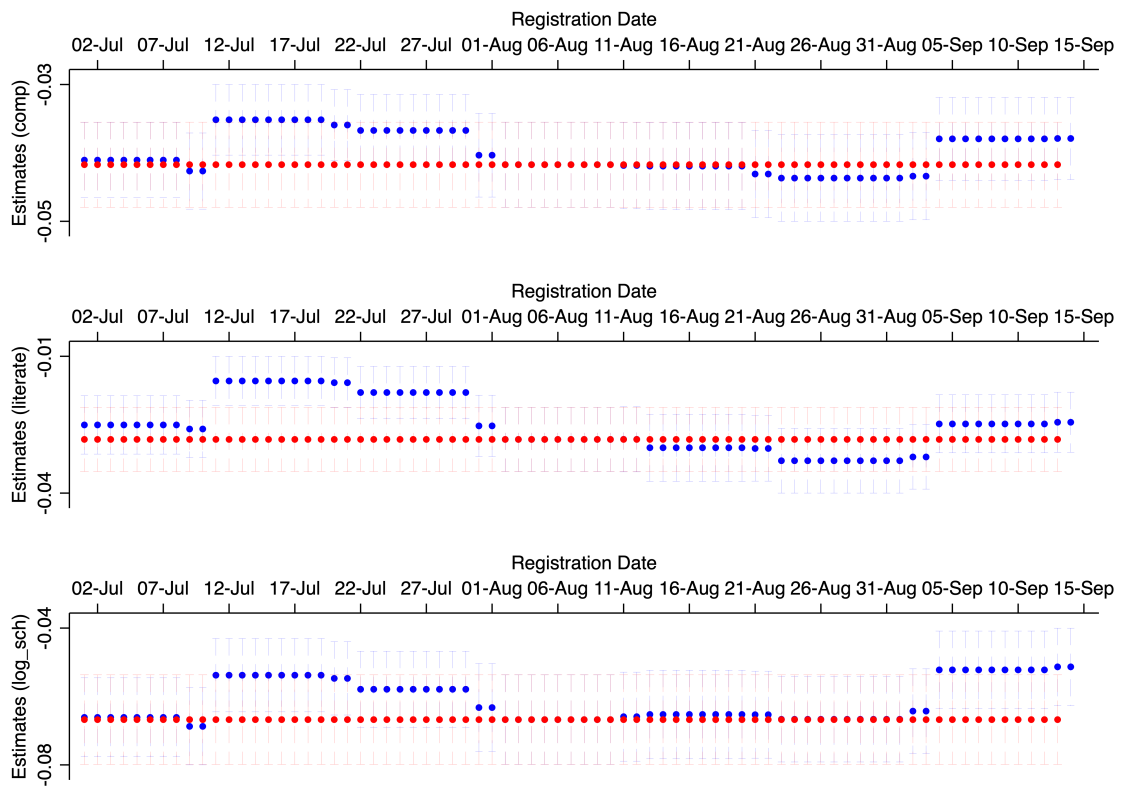
Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: It plots the coefficients for which the enrollment date varies daily from 1st of July to 14th of September. Blue diamond denotes the point estimates that are obtained from separate regressions relying on the equation 2.1. Blue dashed lines present these estimates within 95 percent of confidence interval. I here present the main findings presented in Table 2.1 in red.

TABLE 2.7: Major Events and Reforms from 1921 to 1961

Period	Major reforms	Law Code
November 1, 1922	Abolition of the office of the Ottoman Sultanate (Saltanatın kaldırılması)	308
October 29, 1923	Proclamation of the Republic of Turkey (Cumhuriyetin ilanı)	364
March 3, 1924	The centralization and secularization of education (Tevhid-i Tedrisat Kanunu)	430
March 3, 1924	Abolition of the office of the Ottoman Caliphate (Halifeliğin kaldırılması)	431
April 8, 1924	Abolition of Sharia courts (Şer'iyye mahkemelerinin kapatılması)	
April 20, 1924	Adoption of the new constitution (Teşkilât-ı Esâsiye Kanunu)	491
November 30, 1925	Closure of religious convents and dervish lodges (Tekke ve zâviyelerin kapatılması)	677
February 17, 1926	Introduction of the new civil code (Türk Medeni Kanunu)	743
April 10, 1928	Removal of the article of the 1924 Constitution stating that "Islam is the state religion." ("Türkiye Devletinin dini, Din'i Islâmdır." ibaresinin 1924 anayasasından çıkarılması.)	1222
May 20, 1928	Adoption of the Latin numbers (Beynelmilel Erkamın Kabulü Hakkında Kanun)	1288
1928	Religious courses are removed from primary education	
November 1, 1928	Adoption of the Latin alphabet (Yeni Türk Harflerinin Kabul ve Tatbiki Hakkında Kanun)	1353
April 3, 1930	The rights for women to vote and to be elected in municipal elections (Belediye Kanunu)	1580
1933	Religious courses are removed from primary schools in village	
October 26, 1933	The rights for women to vote and to be elected in village mayorship elections (changes in the Köy Kanunu)	2329
December 5, 1934	The rights for women to vote and be elected in parliamentary elections (changes in the Milletvekili Seçimi Kanunu)	2598
February 5, 1937	The inclusion of the principle of secularism in the constitution ("Türkiye Devleti, Cumhuriyetçi, Milliyetçi, Halkçı, Devletçi, Laik ve Inkılâpçıdır." ibaresinin anayasaya girmesi.)	3115
1938	Removal of religious courses in all education programs	
1948	An option to take religious courses in all education programs on voluntary basis	
1950	Including religious courses in regular education programs	
9 July 1961	1961 Constitution	

Source: Özdalga (2018); Sakalli (2020)

TABLE 2.8: Estimates on Completing Primary School Using 1985, 1990, and 2000 Census Separately

|	1985		1990		2000	
	Distance	FH in log	Distance	FH in log	Distance	FH in log
Religiosity	-	0.128	-	-0.530	-	-0.415
		(0.575)		(0.485)		(0.509)
Female*Religiosity	-0.0387***	-0.175***	-0.0427***	-0.203***	-0.0489***	-0.228***
	(0.00405)	(0.0183)	(0.00460)	(0.0189)	(0.00431)	(0.0209)
Observations	752,562	752,562	744,534	744,534	654,935	654,935
R-squared	0.285	0.283	0.299	0.297	0.298	0.296
Provincial Birth-cohort FE	Yes		Yes		Yes	
Trend*Gender*Province	Yes	Yes	Yes	Yes	Yes	Yes
Regional Birth-cohort FE		Yes		Yes		Yes

Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: Standard errors are in parenthesis, clustered at the province level. Given that the total number of provinces in Turkey was 67, 73, and 81 in the years that censuses had conducted, the number of clusters for each census differ, respectively. *** p<0.01, ** p<0.05, * p<0.1

TABLE 2.9: Timing of the Exposure, and Number of Exposures

	Formal Degree	Log(Year of Schooling)
Female* one-time exposure*1933 (exposure at Grade 5)	-0.00998**	0.00437
	(0.00454)	(0.00821)
Female* one-time exposure*1943 (exposure at Grade 1)	-0.0373***	-0.0567***
	(0.00545)	(0.0101)
F value of Wald test (coef_1933= coef_1943)	*22.25*	*32.95*
	(0.0000)	*(0.0000)*
Female* two-times exposure*1934 (exposure at Grade 4 and 5)	-0.0184***	-0.00786
	(0.00474)	(0.00828)
Female*two-times exposure*1942 (exposure at Grade 1 and 2)	-0.0407***	-0.0587***
	(0.00455)	(0.00745)
F value of Wald test (coef_1934= coef_1942)	*16.87*	*24.00*
	(0.0001)	*(0.0000)*
Female*three-times exposure*1935 (exposure at Grade 3, 4 and 5)	-0.0421***	-0.0505***
	(0.00805)	(0.0142)
Female*three-times exposure*1941 (exposure at Grade 1, 2 and 3)	-0.0363***	-0.0483***
	(0.00542)	(0.00966)
F value of Wald test (coef_1935= coef_1941)	*0.57*	*0.02*
	(0.4500)	*(0.8823)*
Female*four-times exposure*1936 (exposure at Grade 2, 3, 4 and 5)	-0.0308***	-0.0314***
	(0.00574)	(0.0102)
Female*four-times exposure*1940 (exposure at Grade 1, 2, 3, and 4)	-0.0507***	-0.0698***
	(0.00668)	(0.0119)
F value of Wald test (coef_1936= coef_1940)	*7.90*	*8.76*
	(0.0062)	*(0.0040)*
Female*five-times exposure*1937 (exposure at Grades from 1 to 5)	-0.0311***	-0.0252**
	(0.00572)	(0.00957)
Female*five-times exposure*1938 (exposure at Grades from 1 to 5)	-0.0441***	-0.0474***
	(0.00528)	(0.00894)
Female*five-times exposure*1939 (exposure at Grades from 1 to 5)	-0.0344***	-0.0388***
	(0.00543)	(0.00894)
F value of Wald test (coef_1937= coef_1938= coef_1939)	*3.08*	*2.08*
	(0.0510)	*(0.1318)*
Province FE	Yes	Yes
Birth-cohort FE	Yes	Yes
Census-year FEs	No	No
Provincial Birth-cohort FE	Yes	Yes
Gender-specific census-year FEs	Yes	Yes
Trend*Gender*Province	Yes	Yes
Observations	2,152,031	2,151,876
R-squared	0.292	0.324

Source: 1985, 1990, and 2000 Census of Turkey; Sample of birth-cohorts 1923-1955. Notes: This exercise further analyzes the impact of Ramadan-intensity and addresses whether the timing of exposure to Ramadan matters in parents' decision on girls' educational attainment. To this end, the coefficients reflects the average difference in the outcome compared to the never-exposed group, i.e. those born in 1923-1933 and 1944-1955. Linear models with many levels of fixed effects are applied and standard errors are clustered at province level. Number of cluster is 81 for all regressions. *** p<0.01, ** p<0.05, * p<0.1.

FIGURE 2.7: Sample Distribution by monthly distances of interview dates to Ramadan
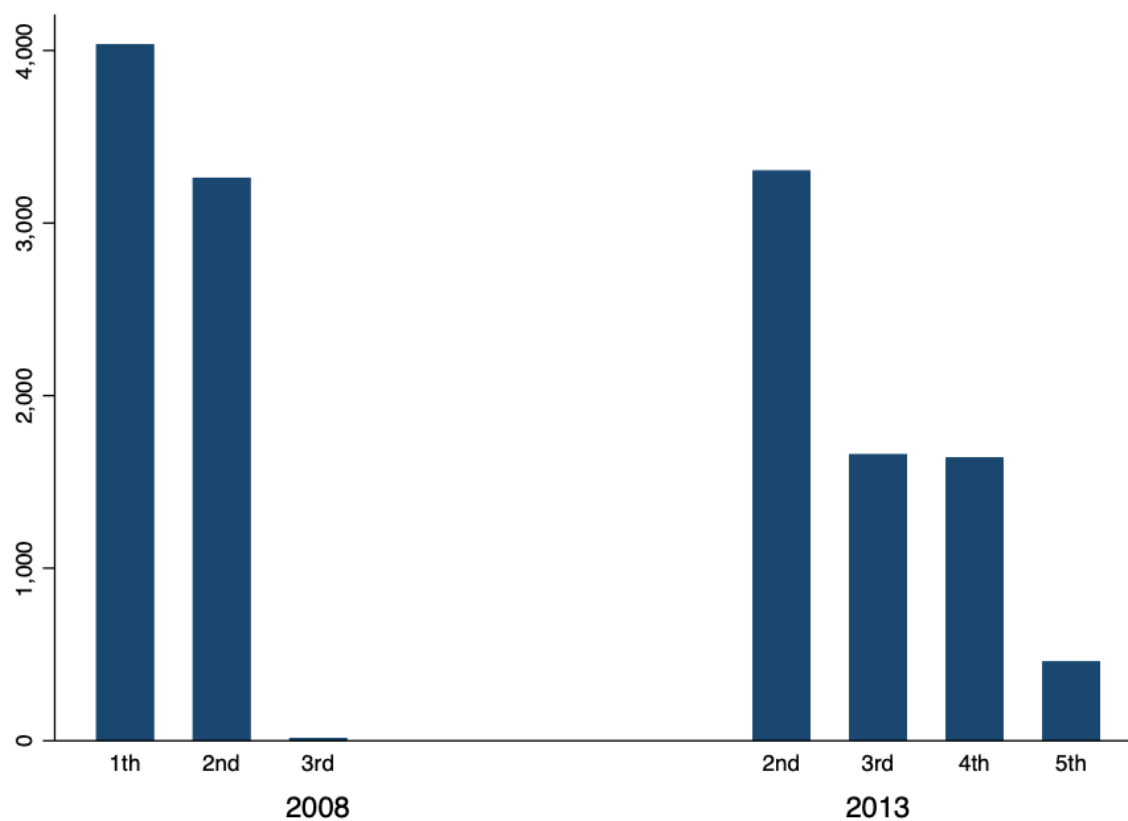
Source: Demographic and Health Survey of Turkey; 2008, 2013. Notes: It reports the number of interviews held in the months far from Ramadan by 1, 2, and 3 months.

TABLE 2.10: Summary statistics of T-DHS

Variable	Mean	Std. Dev.	Min	Max	Obs
Perform prayer	0.794	0.404	0	1	14303
Wearing headscarf	0.760	0.427	0	1	14315
Religious fasting	0.934	0.248	0	1	14234
University education is more important for males than females	0.123	0.328	0	1	14327
Important family decisions should be made by husbands	0.171	0.377	0	1	14258
Women should be more involved in politics	0 .801	0.399	0	1	12868
1st month after Ramadan	0.280	0 .449	0	1	14327
2nd month after Ramadan	0.457	0.498	0	1	14327
3rd month after Ramadan	0.117	0.321	0	1	14327
4th month after Ramadan	0.114	0.318	0	1	14327
5th month after Ramadan	0.032	0.176	0	1	14327
No education	0.156	0.363	0	1	14327
Primary education	0.615	0.487	0	1	14327
Secondary and the higher	0.229	0.420	0	1	14327
Non-Turkish	0.225	0.418	0	1	14327
Turkish	0.774	0.418	0	1	14327
Mother tongue: Not administered	0.000	0.008	0	1	14327
Younger than 30	0.312	0.463	0	1	14327
Age between 30 and 39	0.380	0.485	0	1	14327
Older than 39	0.308	0.462	0	1	14327
Mother: Illiterate	0.555	0.497	0	1	14327
Mother: Literate but no formal education	0.236	0.425	0	1	14327
Mother: Have a formal education	0.178	0.382	0	1	14327
Mother's education: DK	0.030	0.172	0	1	14327
Father: Illiterate	0.177	0.382	0	1	14327
Father: Literate but no formal education	0.375	0.484	0	1	14327
Father: Have a formal education	0.380	0.485	0	1	14327
Father's education: DK	0.068	0.251	0	1	14327
Single	0.050	0.218	0	1	14327
Married	0.950	0.218	0	1	14327
Urban	0.731	0.444	0	1	14327
No children	0.117	0.321	0	1	14327
One children	0.241	0.428	0	1	14327
Two children	0.329	0.470	0	1	14327
More than two children	0.313	0.464	0	1	14327

Source: Demographic and Health Survey of Turkey; 2008, 2013

TABLE 2.11: Balance Test (1)

	(1) Distance	(2) Distance	(3) Distance	(4) Distance	(5) Distance	(6) Distance	(7) Distance	(8) Distance
Age between 30-39	-0.274							-0.170
	(0.363)							(0.386)
40 or more	-0.421							-0.255
	(0.452)							(0.475)
Non-Turkish		1.092						1.052
		(0.976)						(0.934)
Single			0.895					0.821
			(0.639)					(0.631)
Primary education				-1.108				-0.759
				(0.710)				(0.589)
Secondary or higher				-0.830				-1.297
				(0.865)				(0.790)
No children					0.992*			0.651
					(0.501)			(0.503)
One child					0.732**			0.519*
					(0.307)			(0.307)
Three or more children					0.536			0.384
					(0.372)			(0.419)
Literate mother without any diploma						-1.857***		-1.494***
						(0.654)		(0.533)
Mother with a formal education						3.291***		3.431***
						(1.034)		(1.089)
Illiterate father							-0.645	-0.313
							(0.599)	(0.619)
Literate father with a formal education							-1.776*	-0.818
							(0.912)	(0.850)
Observations	14,382	14,382	14,382	14,382	14,382	14,382	14,382	14,382
R-squared	0.686	0.686	0.686	0.686	0.686	0.688	0.686	0.688
F-test	0.465	8.582	1.962	1.408	2.619	4.168	1.313	3.477

Source: Demographic and Health Survey of Turkey; 2008, 2013 Notes: Outcome variable is daily distance of the interviews with respect to the ending date of the most recent Ramadan. Reference category, chosen the one with highest prevalence in the sample, refers to non-educated Turkish women who are younger than 30 years, and having two children, whose mother is illiterate and whose father is literate but does not have a formal education. Year fixed effects and spatial characteristics, which consist of province and the type of residential area, are taken into account in every regression. Standard errors are clustered at province level. Number of cluster is 81 for all regressions. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE 2.12: Balance Test (2)

	(1) Fast.hour	(2) Fast.hour	(3) Fast.hour	(4) Fast.hour	(5) Fast.hour	(6) Fast.hour	(7) Fast.hour	(8) Fast.hour
Age between 30-39	3.65e-05 (8.02e-05)							4.89e-05 (9.78e-05)
40 or more	-5.95e-05 (8.55e-05)							-4.97e-06 (0.000103)
Non-Turkish		0.000265 (0.000281)						0.000285 (0.000282)
Single			-0.000130 (0.000184)					-0.000121 (0.000171)
Primary education				-0.000166 (0.000129)				-6.59e-05 (0.000105)
Secondary or higher				-0.000119 (0.000178)				-0.000156 (0.000178)
No children					-8.14e-05 (8.93e-05)			-0.000113 (0.000108)
One child					-0.000160** (7.58e-05)			-0.000184** (8.14e-05)
Three or more children					-0.000142 (9.47e-05)			-0.000193* (0.000106)
Literate mother without any diploma						-0.000465*** (0.000176)		-0.000376** (0.000149)
Mother with a formal education						0.000675*** (0.000254)		0.000677*** (0.000244)
Illiterate father							-0.000158 (0.000138)	-9.39e-05 (0.000132)
Literate father with a formal education							-0.000483** (0.000242)	-0.000287 (0.000209)
Observations	14,382	14,382	14,382	14,382	14,382	14,382	14,382	14,382
R-squared	0.997	0.997	0.997	0.997	0.997	0.997	0.997	0.997
F-test	0.528	1.026	0.498	0.984	1.935	6.771	1.767	2.632

Source: Demographic and Health Survey of Turkey; 2008, 2013. Notes: Outcome variable is the logarithm of the average daily fasting hours at the province in the interview year. Reference category, chosen the one with highest prevalence in the sample, refers to non-educated Turkish women who are younger than 30 years, and having two children, whose mother is illiterate and whose father is literate but does not have a formal education. Year fixed effects and spatial characteristics, which consist of province and the type of residential area, are taken into account in every regression. Standard errors are clustered at province level. Number of cluster is 81 for all regressions. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

TABLE 2.13: Heterogeneous Effects of Ramadan on Religiosity and Gender Norms

Gender norm indicators:	Family decisions	Education preferences	Women in politics
Fasting hour	2.531***	2.378**	-2.870**
	(0.947)	(1.056)	(1.142)
2nd month after Ramadan*Fasting hour	-0.0156***	-0.0175***	0.00345
	(0.00569)	(0.00494)	(0.00561)
3rd month after Ramadan*Fasting hour	-0.0229***	-0.0269***	0.00673
	(0.00776)	(0.00674)	(0.00976)
4th month after Ramadan*Fasting hour	-0.0203**	-0.0266***	0.0244**
	(0.00826)	(0.00769)	(0.00933)
5th month after Ramadan*Fasting hour	-0.0290***	-0.0259***	0.0270**
	(0.00986)	(0.00803)	(0.0105)
Observations	14,290	14,326	12,891
R-squared	0.130	0.059	0.032
Religiosity indicators:	Praying	Wearing headscarf	Fasting
Fasting hour	1.325	2.001*	2.464***
	(0.994)	(1.175)	(0.924)
2nd month after Ramadan*Fasting hour	-0.0108*	0.00208	0.00683
	(0.00554)	(0.00510)	(0.00432)
3rd month after Ramadan*Fasting hour	-0.0212**	0.00223	0.0100
	(0.0104)	(0.0118)	(0.00883)
4th month after Ramadan*Fasting hour	-0.0157*	0.00341	0.0142*
	(0.00882)	(0.00796)	(0.00747)
5th month after Ramadan*Fasting hour	-0.0335***	-0.0172*	0.000484
	(0.0101)	(0.00921)	(0.00893)
Observations	14,349	14,361	14,280
R-squared	0.108	0.316	0.084

The sample consists of ever-married women aged between 15 and 49 years. Outcome variables refer to gender norms in dummy variable formation if the woman agrees to the following statements "*Important family decisions should be made by husbands.*", "*University education is more important for males than females*", "*Women should be more involved in politics*". Pray, wearing headscarf , and fasting take value of 1 if the respondent carries out the certain religious behavior either regularly or irregularly. Given a lower extent of variation in interview dates with respect to Ramadan, the observations are monthly-grouped by the distance of interview dates to the ending Ramadan. Reference category is the interviews that are held in the subsequent month of Ramadan. In order to increase the precision of estimates, personal characteristics are controlled for. They consist of age intervals, mother tongue, education level of the women, parental education levels, marital status, and number of children in categories. In addition, spatial characteristics which consist of province, and type of the residential area are taken into account. Linear models with many levels of fixed effects are applied and standard errors are clustered at province level. Number of cluster is 81 for all regressions. *** p<0.01, ** p<0.05, * p<0.1.

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