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SIR! I'D RATHER GO TO SCHOOL, SIR!

Mahdi Majbouri

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Abstract

Conscription is a popular method of army recruitment for governments of developing countries that are particularly prone to conflict. This study examines the largely under-researched issues of military service by looking at an unintended consequence of a military service exemption policy and answering a principal question: is there a fear of conscription among the youth? It uses a discontinuity in the military service law in an under-studied country, Iran, and offers causal evidence that fear of conscription entices young men to go to college by 13 percentage points (20%) more. This exogenous increase in college attendance has no impact on labor market outcomes. This further strengthens the argument that it was the fear of conscription motivating demand for attending college.

JEL Classifications: I25, J47, I26, N35

Keywords: Conscription, Coercive labor market, Natural experiment, Regression discontinuity design, Higher-educational attainment

ملخص

التجنيد هو طريقة شائعة تلجأ إليها حكومات البلدان النامية لتكوين جيوشها خاصة إذا كانت معرضة لنشوب نزاعات. تبحث الدراسة في قضايا الخدمة العسكرية التي لم يتم بحثها إلى حد كبير من خلال النظر إلى نتيجة غير مقصودة لسياسة الإعفاء من الخدمة العسكرية ومن ثمة تسعى إلى الإجابة على سؤال رئيسي: هل هناك خوف من التجنيد في صفوف الشباب؟

تستخدم الدراسة فجوة في قانون الخدمة العسكرية في بلد لا يخضع للدراسة بقدر كاف ، هو إيران ، وتقدم أدلة سببية على أن الخوف من التجنيد الإجباري يزيد من دافع الشباب إلى الذهاب إلى الجامعة بمقدار أكثر من 13 نقطة مئوية (20٪). هذه الزيادة في الالتحاق بالجامعة والنتيجة عن أسباب خارجية ، لا تؤثر على مخرجات سوق العمل ، الأمر الذي يعزز كذلك الحجة القائلة بأن الخوف من التجنيد يحفز الطلب على الذهاب إلى الجامعة.

1 Introduction

96 out of 99 countries that experienced internal armed conflict between 1946 and 2014 are developing countries.¹ Moreover, at least one side of all 122 interstate armed conflicts in the same period has been a developing country.² This indicates that in developing countries, having a strong yet relatively inexpensive army is critical for the state. Conscription, which is mandatory in over 60 countries around the world (Chartsbin, 2011), is a relatively inexpensive way governments use to recruit for their armed forces. Yet, its compulsory nature remains controversial.

Despite the prevalence and importance of conscription, its different aspects and consequences, particularly in developing countries and during peace times, have remained largely under-researched.³ As one of the few studies on this topic, this paper uses a novel natural experimental setting to document whether and to what extent (if any) military service is disliked in a developing country at the time of peace. The results draw on some of the fundamental pillars of economic science, including incentives and efficiency, and utilize data from one of the most understudied developing countries, Iran.

Military service for males of age 18 and above is compulsory in Iran, but in some cases exemption is possible. For instance, certain disabilities and chronic conditions make one eligible for permanent exemption. College and graduate students are also exempted (temporarily) from service during their studies. One particular case of exemption is that of a sole son; between 2000 and 2011, a sole son could obtain exemption to take care of his elderly father if his father was of age 59 or older (over 58) when he had reached his 18th birthday

¹The three developed countries are France, Spain and United Kingdom. Source is author's calculation from UCDP/PRIO Armed Conflict Dataset, Version 4-2015. The dataset is provided by Uppsala Conflict Data Program (UCDP) and Center for the Study of Civil Wars, International Peace Research Institute, Oslo (PRIO). See Gleditsch et al. (2002), Pettersson and Wallensteen (2015), and Themner (2015) for the description of the dataset. In this dataset, an armed conflict (internal or interstate) is defined as "a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths." For a more in-depth discussion on definitions, see <http://www.pcr.uu.se/research/ucdp/definitions/>.

²Source is author's calculation from UCDP/PRIO Armed Conflict Dataset, Version 4-2015. For a definition of conflict, as well as information on data, see footnote 1.

³As will be discussed, most of the literature is about developed countries and draft at the time of war.

and became eligible for the military service.⁴ This implies that those sole sons whose fathers are younger than 59 may miss this opportunity. Nevertheless, they also have a means by which they benefit from this exemption; an 18 year-old sole son whose father's age is below but close to 59 can get temporary exemption by attending school (i.e. college) for a few years and, in doing so, postpone his conscription. If throughout the duration of his study, his father reaches or surpasses the age of 59, the son will become eligible for exemption. In effect, 18 year-old sole sons whose fathers' age is above 58 (59 or older) have less incentive to continue their education than those whose father is 58 or younger.

This study establishes that, in Iran, there is a discontinuity in the college attainment rate of sole sons whose fathers' age was over 58 when they were 18 years old relative to the sole sons with slightly younger fathers. The size of this discontinuity is at least about 13 percentage points (20 percent). Because the military exemption law does not apply to any other group except the sole sons, the discontinuity in the educational attainment should only exist for sole sons. As a robustness check, this study demonstrates that there is no discontinuity in college attainment among the sisters of sole sons nor the sons and daughters of multiple-son households. We can, therefore, conclude that fear of conscription motivates sole sons to obtain more education. Thus, if there had not been such an exemption law, sole sons of younger fathers would not have attended college as much. In addition, I show that this exogenous increase in college attendance had no impact on various labor market outcomes such as labor force participation, unemployment, and job status. This further strengthens the argument that sole sons attended college to avoid conscription rather than to gain human capital valued in the labor markets. By showing that individuals are willing to get more education to avoid conscription, this study provides evidence for the inefficiency of conscription and offers a lower bound (minimum) for the size of these inefficiencies.

There have been many studies on the impact of conscription in developed countries,

⁴The required age of father has increased to 65 in 2012 and then to 70 in 2014. Later, the age requirement was abrogated and replaced with a father's disability that impedes him from working. This has remained the law until now when this paper is written.

and almost all of which pertain to war times. Angrist (1990) is a seminal work that uses Vietnam draft lottery as a natural experiment as draft-eligible individuals were conscripted based on randomly chosen birth-days. Most studies that came later (such as those below) utilize the same natural experiment. Angrist (1990) finds that earnings of veterans who were conscripted into the Vietnam war were 15% lower than those of non-veterans in 1970s and 80s. Angrist et al. (2011), however, revisit the question 20 years later and find, notably, that the gap between veterans' and non-veterans' earnings had disappeared by the early 1990s. Angrist and Chen (2011) attribute this to flattening of wages in mid-life and increase in schooling of veterans due to the Vietnam War GI Bill. Autor et al. (2011), on the other hand, find a decline in employment and a rise in disability receipts by Vietnam War Veterans (particularly for Post-Traumatic Stress Disorder) in the 2000s; this is while Angrist et al. (2010) found no evidence of either one in the 1990s. Interestingly, Dobkin and Shabani (2009) find that there is no impact of draft on veteran's health. Similarly, Conley and Heerwig (2012) find no impact of draft on post-war mortality of veterans in the long-run.⁵ Siminski and Ville (2011) find the same results for Australian veterans who were drafted during the Vietnam War. All studies on various impacts of the Vietnam-era draft⁶ inevitably use this draft implemented during a war. Therefore, it is difficult to disentangle the effect of war vs. the effect of conscription in these studies. They remain silent about the effect of conscription during peacetime.

There is little research on the impacts of conscription during peacetime on various outcomes and markets, such as human capital accumulation (cognitive and non-cognitive skills, educational attainment, and health), earnings, hours worked, labor markets, and marriage

⁵The effect of the Vietnam war on Vietnamese has been studied as well. Miguel and Roland (2011) find that the US bombing during the Vietnam war did not have long-term negative effects on local poverty rates, consumption level, infrastructure, literacy, or population density. Singhal (2018), on the other hand, finds that at the individual level, more exposure to bombings in the area where one lived early in life increased the likelihood of severe mental distress in adulthood.

⁶For example, Schmitz and Conley (2016) find that "veterans with a high genetic predisposition for smoking were more likely to have been smokers, smoke heavily, and are at a higher risk of being diagnosed with cancer or hypertension at older ages." They also find that the effect is smaller among those who went to college after the war. Conley and Heerwig (2011) study the impact of the same draft on residential stability, housing tenure, and extended family residence after the War and find mixed results.

markets. Three studies that do examine these impacts are Bauer et al. (2012), Card and Cardoso (2012), and Galiani et al. (2011). Using regression discontinuity, Bauer et al. (2012) compare cohorts who were born before July 1, 1937 in Germany and hence were exempted from service in the 1950s with those who were born immediately after and had to serve in the 1950s. They find no effect of conscription on wages later in life. Similarly, in a different design Card and Cardoso (2012) also find no effect of conscription on Portuguese individuals with more than primary education, despite finding a positive impact on less educated individuals. Galiani et al. (2011) use the draft lottery in Argentina and find that conscription at both war and peace times increased likelihood of developing a criminal record. Like Angrist et al. (2011), they find a negligible long-term impact of conscription on labor force participation and earnings.

If conscription has no effect on earnings (as the above studies suggest) or a positive effect in the case of less educated Portuguese men, one wonders to what extent people are willing to avoid it. This study aims to answer this question. Card and Lemieux (2001) answer a similar question: whether people were willing to go to college to avoid the draft during the Vietnam War. Again, however, they look at a draft during a war, while this paper is about draft during peacetime. It is not very surprising to find that individuals were willing to go to college to avoid serving in war. It is interesting, however, to understand whether individuals behave similarly in the absence of war and in a developing country where supply of college education is limited and entry to college is very competitive and costly. Moreover, as Card and Lemieux (2001) explain, they “find a strong correlation between the risk of induction faced by a cohort and the relative enrollment and completed education of men.” This study, rather, finds a causation.

The rest of the paper is structured as follows: Section 2 explains the military service and its exemption laws in Iran. It also describes the identification strategy. The data are discussed in Section 3 after which the estimation and results are depicted in Section 4. Lastly, the conclusion discusses policy implications not limited to countries with military service.

2 Military Service in Iran

Conscription, in its modern form, was first introduced by the French Republic in the wars after the French Revolution⁷ to protect the country from attacks by other European powers. It later established the French army as one of the most powerful militaries in the early 1800s. With the rise of nationalism in Europe and the rest of the world in the 19th century, this system became popular among governments to create and maintain an army.⁸ In recent decades, however, criticism from various angles (religious, philosophical, economic⁹, political, and human rights grounds¹⁰) has made conscription a controversial method. The end of the cold war and the advances in military technology reduced the need for large armies,¹¹ as a result of which many states abandoned this system and began to rely on professional armies and volunteers.¹²

In Iran, mandatory military service for men was first introduced in 1924 by Reza Shah,

⁷*Britannica Academic*, s.v. “Conscription,” accessed August 13, 2016, <http://academic.eb.com.ezproxy.babson.edu/levels/collegiate/article/25932#>.

⁸Interestingly, the Prussian system of conscription, developed during the Napoleonic wars, became the model for other European nations. France, which abandoned conscription after Napoleon’s defeat in 1815, re-instituted it later with some restrictions. But, it then reverted back to universal conscription after the defeat of the French by the large conscripted German army in the Franco-German War (1870-71). Russia, and later the Soviet Union, have had some form of conscription for most of the last two centuries. The United States and Britain are two Western powers that tried to avoid conscription for most of the 19th and 20th centuries, the exceptions being the US Civil War, and the two World Wars (*Britannica Academic*, s.v. “Conscription,” accessed August 13, 2016, <http://academic.eb.com.ezproxy.babson.edu/levels/collegiate/article/25932#>.) One of the early examples of conscription in developing countries is its introduction by Muhammad Ali (the Ottoman Albanian ruler of Egypt) in early 19th century Egypt.

⁹For a thorough discussion of the economics of conscription vs. all-volunteer force, see Warner and Asch (2001). They also offer empirical evidence that the arguments in favor of an all-volunteer force in the US are substantially stronger in 2001 than they were in 1973, when conscription was abolished.

¹⁰One may challenge military service on other dimensions as well. For instance, using the draft lottery system in Argentina, Galiani et al. (2011) show that conscription increased the chance of development of criminal record.

¹¹There has been a complementarity between capital and labor in the military in all human history even with some modern technologies. For instance, guns need soldiers and tanks need drivers and gunners and vice versa. The advanced military technologies, such as smart drones, make capital more of a substitute for labor rather than a complement. This reduces the need for labor in the armies. Moreover, some military technologies that have considerable destructive capabilities cannot be confronted with armies of regular soldiers. Therefore, return to regular soldiers has been declining over time, which has reduced the need for large standing armies.

¹²For a review of studies on recruitment, retention, military experience and productivity in the All-Volunteer Force (AVF) era in the United States, see Warner and Asch (1995).

the king at the time, to the Parliament and became the law despite some opposition.¹³ After the Islamic Revolution of 1979, the law was modified in 1984 (in the middle of the Iran-Iraq War) to state that conscription consists of 30 years and is divided into four periods. The first of which is an initial two-year period in which every male who has completed his 18th year of life must participate in military training and activities.¹⁴ A period of training lasts for three months followed by a twenty one month period spent in service to the armed forces (military and police). Completion of time in service is followed by three consecutive “reserve” periods: an eight-year period, called “priority reserve,” followed by two ten-year periods, “first reserve” and “second reserve”. During these reserve periods, those who finished the two-year military training and service are on reserve and can be called to service if needs arise (for example, if the country goes to war). Priority would be given to those who are on the priority reserve, and then the first and second reserves respectively.

According to the law, those who are medically unfit for service because of a disability or a chronic illness, are exempted. Tertiary level students are also exempted from military service as long as they are in school. Students cannot stay in school for longer than a certain number of years depending on the degree they pursue (Bachelor, Master, and Ph.D.). Upon leaving the tertiary level institutions, they are required to go to military service. Another form of exemption, which is also a basis of this paper, is given to the only sons whose fathers are at age 59 or older¹⁵ at the time of conscription. The argument is that the elderly father may need his sole son’s assistance in old age.¹⁶

¹³From 1906 to the Islamic Revolution of 1979, Iran was a constitutional monarchy with a parliament.

¹⁴The two-year training and service period has recently changed to 21 months.

¹⁵59 was the threshold for father’s age until 2012. It has changed to 65 in 2012 and then to 70 in 2014.

¹⁶There are other exemptions as well: 1) men who are the sole child of their parents, 2) men who are the sole caregiver of a physically or mentally disabled parent, sibling, or second line family members, 3) doctors, firefighters, and other emergency workers whose military service may jeopardize health and emergency services, 4) employees of important governmental agencies that directly or indirectly assist the military are exempt at the time of war, 5) employees of businesses that work with the military are exempt from service at the time of war, 6) prisoners.

2.1 Exemption and Education

This paper uses a combination of the sole son and student exemptions laws to identify a discontinuity in educational attainment. Consider a male who is 18 years old and is the only son of a father that is 55 to 58 years old. He is just one to four years short of the threshold needed for exemption by the law. Yet, he can take advantage of the student exemption law and attend college for four years to receive (temporary) student exemption for the duration of those years. Once completing his collegiate studies (or even in the middle of it), his father has surpassed the age of 58 and he becomes eligible for the sole son exemption. Compare him with someone who is 18 years old and the only son of a father who is 59 and older. This second man does not need to go to college to qualify for exemption. Therefore, sole sons whose fathers' ages are below the threshold when they are 18 have greater incentive to attend college or grad school than sole sons whose fathers' ages are above the threshold. This may provide a discontinuity in educational attainment for the sole sons whose fathers are younger and older than 58. Thus, the regression discontinuity method can be used to estimate the effect of exemption law on educational attainment.

3 Data

In this study and for the reasons explained below, I use the 2% random and nationally representative sample of the 2011 Census of Iran. The Statistical Center of Iran (SCI) is the main organization in charge of gathering micro datasets in Iran. It has been collecting the national census every ten years starting in 1956 and every five years since 2006. The latest one available is the 2011 census. The military exemption law for age 59 was implemented between 2001 and 2011. The 2011 census includes individuals that were affected throughout the whole period. This is one advantage of this dataset that makes it suitable for this study. Another advantage is that it is available to the public at IPUMS-International.¹⁷

¹⁷The census can be accessed by registering on the IPUMS-International website at: <https://www.ipums.org/IPUMSInternational.shtml>

The 2011 census provides basic demographic data on age, education, labor market participation, marital status, employment status, relationships within the household, as well as the number of children ever born and pregnancy in the 12 months prior to the survey. It also contains information on the household’s dwelling and its amenities. It does not, however, have information on labor market outcomes such as income and hours worked.

Education, which is the most important variable in this study, is reported in levels (i.e. primary, middle school, high school, and college and above), rather than in grades or years. Hence, in this study, the main outcome variable is a dummy variable that is equal to one when an individual has partially or fully completed college or above and zero otherwise. The number of years of college or graduate school attended is not observed.¹⁸

Age is another important variable in this study and is measured in years. I use father’s age when his sole son was 18 to identify whether or not the exemption law would apply to the sole son. If the father is 59 or older, the law applies to his sole son.¹⁹ In other words, the discontinuity in the exemption law starts at the end of age 58, just when the father becomes 59. In this study, sole sons whose father’s age was in a range around 59²⁰ when they were 18 are studied. This is a very small sample of the population. Therefore, one needs a dataset with many observations to be able to have enough number of sole sons with fathers in that age range. The fact that the 2011 census has over 1.5 million observations is another advantage of this dataset over other Iranian datasets.

One may argue that age is a variable for which “bunching” at certain values may occur. That is people are more likely to round their age to the closest multiple of 5. For example, people aged 58, 59, or 61 are likely to report their age as 60. Therefore, the number of observations with ages that are multiples of 5 (like 40, 45, 50, etc.) is usually larger than

¹⁸Education level is not reported for individuals who are illiterate. But whether or not an individual is literate is observed in the census. When defining the college dummy variable, one should make sure that it is zero for the illiterate.

¹⁹Unless the son goes to college and postpones his illegibility for military service until his father becomes older than 58 (59 or older).

²⁰The main age range used is 49 to 68 (± 10 years around the threshold). Other age ranges used for robustness check are 53 to 64 (± 6), 51 to 66 (± 8), 47 to 70 (± 12), and 44 to 73 (± 15).

the number of observations with ages around those multiples in surveys. For example, the number of observations with age 60 is larger than those with age 58, 59, or 61. Here, however, we are considering the age of a father when the child was 18 and not the age of a father reported in the survey. Therefore, bunching should not occur, particularly around the discontinuity threshold. Moreover, the distribution of father’s age when the child was 18 (depicted in Figure A in the appendix) supports this as it changes smoothly with no evidence of bunching. Table A in the appendix shows that there is no discontinuity in the number of observations around the threshold.

From the discussion of age, it is clear that we need to be able to identify fathers and sole sons. This is not particularly easy to achieve because the demographic information in the data set is very basic. None of the Iranian datasets identify a child’s father in the household. The best variables that can be used to identify fathers (and other household members) are the *relationship to the head*, and *gender*. The *relationship to the head* variable helps us identify the head’s spouse, the children of the head, other relatives of the head who live with the household including in-laws, and non-relatives. Using this variable, we can identify households that only consist of a male head, his spouse, and his children. Obviously, male heads in those households are fathers of individuals reported as their children. In the rare case that the head of the household is reported as female and her spouse is male (0.2% of the households), the spouse can be the father or the step-father. Therefore, those households are not considered. In households that have extended family members, particularly multi-generational households (households with grandfathers their children and grand children), it is not possible to accurately identify fathers.

One issue relevant to all Iranian datasets is that only the children present in the household are recorded in the data, whereas those who left the household for any reason (e.g. studying in another place or marriage) are not in the data. This makes the identification of sole sons difficult. For example, a household that seems to have one son in the data may actually have two or more if the other son(s) left the household. The 2011 census, however, has two

questions that help us eliminate this issue (this is another advantage of the 2011 census over other Iranian data sets.) The first question asks about the number of children ever born by a mother and the second question inquires about who each person's mother is in the household. Using these two questions one can restrict the sample to households for which children are all present. In order to do that, I first restrict the sample to households that only consist of a male head and his spouse and the children of the head. Then, I identify the number of children in the household who belong to the mother. We also know the number of children to whom the mother has given birth. Only households for which these two numbers are the same are considered. These are households that do not have children who left the household. Therefore, it is possible to identify sole sons within them with accuracy. The foremost focus of this paper is on these households. Table 1 shows the number of different types of households in the census data including the sample used in this study.

It is unlikely that this algorithm identifies individuals who are not sole sons as sole sons. But in the case that it does occur, the inaccurate identification of sole sons takes place on both sides of the threshold and hence does not bias the regression discontinuity results in favor of the hypothesis. In other words, it does not create an effect when in reality there is no effect. In fact, measurement error in identification of sole sons creates a noisy estimate (larger standard errors) and an under-estimation of the true effect of the military service law.

In rural areas, the size of the sample of sole sons (identified by the way explained above) is quite small and inadequate to achieve statistical power. This is because of two reasons: 1) we need to identify sole sons, aged 19 and over, from the sample of households whose all children are present. But rural children (especially in this age range) are substantially more likely to not be present in the household or to have siblings who are not present in the household than their urban counterparts. They leave the household to migrate (temporarily or permanently) to urban areas and marry earlier. 2) In 2011, less than 30% of the population was living in rural areas. Thus, the size of the urban population was more than twice the

size of the rural population. For these two reasons, fewer sole sons can be identified in rural areas.

Even if we have a sufficient number of sole sons in rural areas to get statistical power, we still cannot identify the true effect of exemption law on college attainment rates in rural areas. This is because almost all college-educated (or college-enrolled) rural children attend(ed) college in a city (not in the village) and usually remain there after graduation. In other words, most college-educated or college student sole sons have already left the household and are excluded from the sample. As a result, we do not observe them to be able to measure the impact of policies on the college attainment rates in rural areas. For these reasons, we only focus on urban areas in this study.²¹

Another concern that one may have is measurement error in father's age. Because we are interested in discontinuity close to a threshold of father's age, measurement error in age close to the threshold can easily take an observation from one side of the discontinuity to the other. This, however, can happen on both sides of the threshold, and hence, only increases the standard error of the estimate and produces an under-estimation of the true effect. A similar concern is that ineligible sole sons close to the threshold may misreport their fathers' age in order to move to the other side of the threshold and become eligible for the military service exemption. This means that there should be a discontinuity in the number of sole sons around the threshold. But, as will be discussed later, Table A and Figure A in the appendix provide evidence that there is no discontinuity in the number of sole sons observed at the father's age of 58. If anything, there are a few more ineligible sole sons than eligible ones at the threshold.

Table 2 reports the summary statistics of the variables in six samples: 1) Sole sons (top-left panel), 2) Sisters of sole sons (top-right panel), 3) Sons in multiple-son households (mid-left panel), 4) Daughters in multiple-son households (mid-right panel), 5) All men aged 19 to 28 (bottom-left panel), 6) All women aged 19 to 28 (bottom-right panel). These

²¹The results for rural areas are mostly statistically insignificant.

samples are all in urban areas. Since the military exemption law was applied between 2001 and 2010, in the 2011 census, the sole sons are 19 to 28 years old. Therefore, all samples used in this study and reported in Table 2 are of the same age range. As can be seen, the sample of sole sons and their sisters are different from the general population (the bottom panel). They are slightly younger but substantially more educated. Therefore, the results found in this study are Local Average Treatment Effects (LATE) and may not be generalized to the population.

4 Estimations and Robustness Checks

As explained in Section 2.1, we expect as a result of the exemption law that sole sons whose fathers were 58 or younger (when they were 18) attended college more than those whose fathers were older than 58. This means that there should be a discontinuity in the college attainment rate immediately after the father’s age of 58. This section documents this discontinuity and discusses its consequences. Figure 1 demonstrates the discontinuity in college attainment of the sole sons whose fathers’ ages were between 49 and 68 when they were 18 years old, in urban areas²². The figure has three sub-figures showing linear, quadratic, and polynomial fit of the data. The horizontal axis shows the father’s age when his sole son was 18 and the vertical axis is the share of sole sons who attended college and above. The solid lines are the fitted lines and the light gray lines show the 95% confidence interval. The dots represent the average college attendance rate at each father’s age. The discontinuous decline in college attendance rate right after age 58, in all specifications in Figure 1, is evidence for the impact of the exemption law.

We do not expect the exemption law to affect girls. Thus, as a robustness check, we can draw a similar figure as Figure 1 for sisters of sole sons. Since sisters of sole sons live in the same household (have the same parents and face a somewhat similar environment), they are

²²As explained in Section 3, we only focus on urban areas because the sample of sole sons for rural areas is small and selected.

a good comparison group. Figure 2 is drawn similar to Figure 1, but for these sisters. The horizontal axis is the age of a father who has a sole son when his daughter (sole son's sister) was 18 and the vertical axis is the share of sole sons' sisters who attended college and above. The figure does not show any discontinuity in the college attainment rate for sisters of sole sons immediately after the father's age of 58. This provides further evidence that it was the exemption law that affected college attainment of sole sons at father's age of 58 or lower, and not any other factor (particularly those that could have affected their sisters too).

To further validate the result, we can also check to see if the exemption law had any impact on sons in households with multiple sons. The law should not affect college attainment rates of these sons. Figure 3 shows that this is the case. Although it may seem that there was a decline, there is no statistically significant discontinuity in college attendance rate for this group just after age 58. Similarly, one expects that the exemption law does not affect daughters in households with multiple sons. Figure 4 is indeed the evidence for that. The fact that only sole sons (and not the other three groups) have a discontinuity in college attainment at the threshold is strong evidence that military service exemption law caused the discontinuity.

We can formalize these figures in regressions as follows:

$$Y_i = \alpha + \tau D_i + \sum_{k=1}^l \gamma_k (p_i - 58)^k + \sum_{k=1}^l \delta_k D_i (p_i - 58)^k + \beta X_i + u_i, \quad l = 1, 2, 3 \quad (1)$$

in which Y_i is the college attendance for individual i . It is a dummy variable equal to one if the individual attended (or is attending) college or higher levels of education and zero otherwise. D_i is a dummy variable equal to one if individual i 's father was 58 and younger when he/she was 18 and zero if the father's age was 59 and higher.²³ The running variable in this regression discontinuity setting is father's age when individual i was 18 and it is

²³Other age ranges were analyzed as well and their results reported in Table 3. See footnote 20 .

represented by p_i .²⁴ The regressions contain a polynomial of $(p_i - 58)$ with degree l .²⁵ l is equal to one, two, and three. X_i contains individual i 's characteristics: father's and mother's education and age.²⁶ The Local Average Treatment Effect (LATE) is τ .

Table 3 reports the results for Sole sons (left panel), sisters of sole sons (middle panel) and sons in multiple-son households (right panel).²⁷ The running variable, p_i , in the sample extends from 49 to 58 (i.e. ± 10 years from the threshold). In other words, the samples include individuals whose fathers were between the age of 49 and 68 when they were 18.²⁸ p_i is a discrete rather than a continuous variable. Lee and Card (2008) and Lee and Lemieux (2010) argue that, when the running variable is discrete, correlation in standard errors should be "clustered" at values of the discrete running variable. Therefore, all regressions correct for heteroskedasticity and within-cluster correlation in standard errors. The first column of Table 3 explores college attendance for sole sons in a linear setting ($l = 1$ in Equation (1)). The coefficient of D is positive and significant, thus, showing that sole sons whose fathers' ages were 58 and slightly below when they were 18 have about a 13 percentage point greater chance of attending college than those whose fathers' age was 59 and slightly higher. Since the average college attainment rate for the sample of sole sons is 66% (see Table 2), the effect translates to a 20 percent increase.

Columns (2) and (3) report the quadratic and third-degree polynomial settings. The coefficient of D remains statistically significant in those settings. It also increases in size to 0.23 and 0.33 which translate into a LATE of 23 and 33 percentage points (35% and 50% respectively). For robustness check, one can run similar regressions for sole sons' sisters. The results are reported in the middle panel of Table 3. All showing that there is no

²⁴ p is chosen to denote this variable since it is the first letter of the Latin word *pater* and the Persian word *pedar*, both meaning father.

²⁵The effect is the difference between actual and counterfactual at the threshold. Since the law affected sole sons with father's age of 58 not 59, we are interested in finding the counterfactual at the father's age of 58. This is why p_i is subtracted from 58 in the regression.

²⁶Excluding these variables from the regression does not change the results.

²⁷The results for daughters in multiple-son households are not reported because of limited space but are available upon the request.

²⁸We change the range of the sample in Table 4 and get similar results.

evidence of discontinuity in college attendance for them (as the coefficient of D is statistically insignificant). This indeed confirms that the discontinuity is attributable to being male and therefore related to the compulsory military service exemption. As another robustness check, we can estimate the effect of military exemption law on sons living in households with multiple sons. The right panel in Table 3, that is Columns (7), (8), and (9), report the result of such estimation. The coefficient of D , which is the effect of the military exemption law, is statistically insignificant, supporting the fact that this law should not affect college attainment of sons in multiple-son households. For further robustness check, one can estimate the same regressions for daughters living in multiple-son households. As expected and similar to Figure 4, there is little evidence that the effect of military service on this group is different from zero.²⁹ All these results show that the discontinuity in college attainment rate only exists for the sole sons, the only group that can benefit from the exemption law. Therefore, this discontinuity at such a particular father's age is evidence for the causal impact of the law. Sole sons preferred to go to college rather than serve in the military and the exemption law provided the incentive.

One may wonder if sole sons who are not eligible for the exemption, that is their father's age is below 59, try to exaggerate their father's age to become eligible. Military service in Iran, however, is a serious matter of national security and a process in which gaming the system is extremely rare and difficult. But even if sole sons whose fathers are a bit younger than the threshold try to become eligible by falsely reporting their father's age higher, we would only underestimate the effect of military service. Thus, such gaming of the system should not create a false positive. Moreover, this false representation of father's age should create a discontinuity around the threshold: one should see more observations on the eligible side of the threshold (59 and older) than the non-eligible side (58 and younger). Figure A, however, does not show any discontinuity at the threshold. If anything, there are a few more ineligible sole sons than eligible ones at the threshold. In addition, we can

²⁹The results are reported in Table B, but are available upon request.

estimate the coefficient of D in Equation (1), τ , when the dependent variable is the number of observations at each father’s age. Table A reports this coefficient which is insignificant in all specifications, showing no discontinuity in the number of observations at the threshold.

As another robustness check, we can change the range of the running variable, i.e. father’s age, from ± 10 years around the threshold (49 to 68 year old fathers) to ± 6 (53 to 64 year-olds), ± 8 , ± 12 , and ± 15 years (44 to 73 year-olds). Table 4 reports the estimates for the coefficient of D in Equation (1), τ , using these age ranges across the sample of sole sons, sisters of sole sons and sons in multiple son households. The results are the same as those reported in Table 3 for ± 10 years around the threshold. There is a statistically significant discontinuity in education of sole sons regardless of the range of running variable. But no discontinuity is found for sisters of sole sons and sons in multiple son households. Moreover, we can implement optimal bandwidth choices following Imbens and Kalyanaraman (2012), Ludwig and Miller (2007), and Calonico et al. (2014). The results confirm the findings above.³⁰

An additional robustness check is to see if there is any discontinuity in the covariates, X_i , in Equation 1. Those covariates should not have any discontinuity at the threshold. Table C reports the coefficient of discontinuity, τ , in Equation 1, when the dependent variable is the covariates. All covariates are excluded from the right-hand side. The results show no evidence of discontinuity.

Since the discontinuity in college attainment for sole sons does not exist for their sisters as well as sons and daughters of households with multiple sons, one can use the *difference-in-discontinuities* design, as another robustness check to estimate the effect of the exemption law. The difference-in-discontinuities (diff-in-disc) design, introduced by Grembi et al. (2016), is a quasi-experimental method to identify effects of an intervention, especially if

³⁰The results are reported in Table D in the appendix. The estimation following Calonico et al. (2014) does not converge and hence, is not reported. Note that at present the bandwidth selection method following Ludwig and Miller (2007) is not theoretically justified (Calonico et al., 2017). Therefore, one should take those results (reported in the right panel of the table) with a grain of salt. The new version of `rdrobust` in Stata (2016 version) is not able to create the bandwidths above the threshold. Hence, other optimal bandwidth choice methods, such as Coverage Error Rate (Calonico et al., 2017a,b) cannot be implemented.

the observations on the two sides of threshold are inherently different.³¹ It estimates the difference between two discontinuities in the outcomes at the same threshold. By taking the difference between the two discontinuities, it removes any selection that may exist around the threshold and is common between the two discontinuities. In our case, we can practically take the difference between the discontinuity in college attainment for sole sons and the discontinuity in college attainment for sisters of sole sons. This is essentially the difference between Figures 1 and 2. Since there is no discontinuity for sisters of sole sons, we can consider the difference between these two discontinuities as the effect of the exemption law on sole sons. Instead of using the sisters of sole sons to compare with sole sons, one can consider sons in multiple-son households or daughters in multiple-son households or a combination of these groups. One advantage of this method is that it creates more statistical power, since we include sole sons and their sisters in the same regression. Moreover, if the observations (in both the sole sons sample and the comparison group sample) before and after the father turns 59 are inherently different from each other, under mild assumptions, the diff-in-disc can remove this difference and give an unbiased result. It is hardly the case that there would be an inherent difference between the observations on the two sides of the threshold (father's age of 58), but we can employ this method as a robustness check.

The difference-in-discontinuities design can be formalized in the following regression:

$$\begin{aligned}
Y_i = & \alpha + \tau D_i + \sum_{k=1}^l \gamma_k (p_i - 58)^k + \sum_{k=1}^l \delta_k D_i (p_i - 58)^k + \beta X_i + \\
& S_i \{ \alpha_s + \tau_s D_i + \sum_{k=1}^l \gamma_{ks} (p_i - 58)^k + \sum_{k=1}^l \delta_{ks} D_i (p_i - 58)^k + \beta_s X_i \} + u_i, \quad l = 1, 2, 3(2)
\end{aligned}$$

in which S_i is a dummy variable equal to one if individual i is a sole son and zero if she/he belongs to a comparison group that was not affected by the exemption law. τ_s represents the Neighborhood Average Treatment Effect (NATE), which in our case is the effect of the

³¹Grembi et al. (2016) call the estimated effect Neighborhood Average Treatment Effect (NATE).

law on sole sons' college attainment rate at father's age of 58.

There are three potential comparison groups: sisters of sole sons, sons in multiple-son households and daughters in multiple-son households. We can run three separate diff-in-disc using these groups, or combine these groups in various ways into a single comparison group. Here, I estimate diff-in-disc between sole sons and their sisters first, and then gradually add the sons and daughters in multiple-son households to the comparison group. Table 5 shows the estimated effects. The right panel reports τ_s using the sample of sole sisters as the comparison group. This is referred to Sample I in the table. When we use this sample, S_i in Equation (2) is equal to one for sole sons and zero for their sisters. Columns (1), (2), and (3) show the estimates for this sample using linear, quadratic, and third-degree polynomial settings, respectively. In Columns (4), (5), and (6), the sample of sons in multiple-son households is added to the sample of sole sisters as the comparison group to form Sample II. In other words, S_i in Equation (2) is equal to one for sole sons and zero for sisters of sole sons and sons in multiple-son households. Finally, one can add the sample of daughters in multiple-son households to the comparison group and form Sample III. In this sample, S_i is zero for sisters of sole sons as well as sons and daughters in multiple-son households. Columns (7), (8), and (9) report the effect of the exemption law on sole sons using Sample III.

Notably, the size of the effects for the diff-in-disc design (particularly Samples II and III) resembles the simple regression discontinuity estimates for sole sons reported in Table 3. The coefficients of $D \times S$ in linear, quadratic, and third-degree polynomials for Samples I, II and III seem to be in the following ranges 0.10-0.13, 0.18-0.23, and 0.24-0.29, respectively. These are very close to the estimates reported in Columns (1), (2), and (3) of Table 3 which further strengthens the results found previously in that table.

The results of this paper are strongly in line with anecdotal evidence. In fact, one reason that was mentioned officially in 2011 for raising the father's age threshold for this law from 59 to 65 (and later to 70) was that non-eligible sole sons were attending college to get exemption

when their fathers reach 59.³²

An interesting next step is to see if this extra college attainment had any impact on labor market outcomes such as labor force participation, unemployment, and wages. There are two methods to identify these effects. One is to estimate the discontinuity in these labor market outcomes caused by the military service exemption law using an RDD or difference-in-discontinuity design. In other words, we estimate the coefficient of D in Equation (1) or the coefficient of $D \times S$ in Equation (2) when the dependent variable is any of these labor market outcomes. This is the reduced form estimation. The second method is to use the discontinuity in college attainment rate caused by the military service exemption law as an instrument for college (and above) education in a 2SLS setting that estimates the impact of college attainment on these labor markets outcomes. But as I discuss below, because the instrument in the first stage of the 2SLS is very weak, the most reliable results are found using the reduced form estimation (the first method).

The results of the reduced form estimation are reported in Table 6. To get the largest sample size and as much power as we can from the data, I combine the sample of sole sons and sons in multiple son-households and run a difference-in-discontinuity regression as in Equation (2). I refrain from including sisters of sole sons and daughters in multiple-son households in the comparison group because the female labor supply decision, and the industries they work in are generally very different from those of men in Iran. The top panel of Table 6 shows the coefficient of $D \times S$ in Equation (2) when the dependent variable is labor force participation (left side of the panel) and unemployment (right side). The results provide some weak evidence that the military service exemption law, which increased college attainment, increased labor force participation. But the evidence is not robust to specification (degree of polynomial control). Although the size of the coefficient is large as it shows a 15 percentage points increase in labor force participation, it is difficult to argue

³²Interview of *Khabar-online* with General Kamali, vice president of human resources for armed forces, on changes to military service conscription laws, (January 12, 2012), accessed October 17, 2015, <http://khabaronline.ir/detail/193772/>.

there is definitely an effect. On the other hand, the right side of the top panel in Table 6 depicts no evidence of discontinuity in the likelihood of unemployment. The coefficients are statistically insignificant and change sign from one specification to another (negative to positive).

How about wages? The census does not provide data on earnings, wages, or hours worked.³³ It does, however, contain the job the individual has. One can use the status of jobs as the labor market outcome variable. In the data, jobs are divided into ten categories: 1) legislators, senior officials and managers, 2) scientists, engineers, lawyers and other professionals, 3) technicians and associate professionals, 4) office workers, 5) sellers and semi-technical service workers, 6) semi-technical agricultural workers, 7) semi-technical construction and industrial workers, 8) machine operators and drivers, and 9) elementary occupations (laborers and unskilled workers).³⁴ These job categories seem to have a hierarchy, possibly legislators and senior officials and managers being the top category and the elementary occupations being at the bottom. Based on this hierarchy, one can turn this categorical variable into an ordinal variable for job status. But, turning job categories into a quantitative measure of job status could be challenging. For example, how much does job status differ between each of these categories, say Technicians and associate professionals (category 3) and Clerks (category 4)?

One subjective solution is to aggregate job categories that are perceived similar in status into one group and separate those that differ significantly into other groups. For example, category 9 can be one group (and the lowest value of job status, i.e. 1 is assigned to it); categories 5, 6, 7, and 8 can be aggregated into another group (and value 2 is assigned to their job status); categories 3 and 4 into a third group (with the value of 3 for job status), and categories 1 and 2 into a fourth group (and value 4 is assigned to their job status).

³³Efforts to use other Iranian datasets that have wages at the individual level proved futile. Because they do not contain information on children ever born and thus, it would not be possible to correctly identify sole sons.

³⁴Another category is armed forces. I exclude armed forces because there is a lot of heterogeneity in jobs in the army (since job status in the armed forces depends on the rank of the individual), and armed forces is not an informative category in terms of job status. Including it, however, does not change the results.

The results based on this definition of job status are reported in the bottom left section of Table 6. The discontinuity is negative and statistically insignificant in all specifications showing that college education had no impact on job status. Note that the theory predicts the discontinuity to be positive not negative.

There are at least two problems with this (or any) subjective definition of job status: first, how does one decide which categories should be combined? and second, what values should one assign to each of these categories (the values assigned above assume that for example, categories 1 and 2 are four times better than category 9 and two times better than categories 5 through 8)? To avoid these problems, I use the log of average wages for each job category as a measure of status for that job category. These average wages are both a cardinal and ordinal measure. They are also a measure of economic returns. Census data, however, does not report income nor hours worked. Therefore, I use the Iranian Household Income and Expenditure Surveys (HIES) data of 2006 through 2015 to calculate these average wages (adjusting for inflation) for wage earning individuals.³⁵ They are reported in Table E in the Appendix. The table shows a clear hierarchy among these job categories. Moreover, a close look at these numbers reveals that the subjective definition of job status described above is not unrealistic.

The discontinuity in this measure of job status (i.e. log of average wages in a job category) is reported in the bottom right section of Table 6. Similar to the bottom left section, all the coefficients are negative and statistically insignificant showing that there is no evidence of discontinuity. It is not just the statistical insignificance of the coefficients that makes this conclusion robust but also the fact that all the coefficients in the bottom panel are negative. If the attained education improves labor market outcomes, at least some of these coefficients should be positive, but none are.

As discussed, the second way to estimate the effect of this exogenous college attainment

³⁵In Iran, unlike the United States, employer-employee contracts are based on monthly rather than annual salaries. As a result individuals know their monthly incomes better than annual incomes and report them more accurately. Therefore, one needs to calculate wages based on gross monthly salaries rather than gross annual salaries which are less accurate. This is what I do in this study as well.

on labor market outcomes is to use it as an instrument for college (and above) education in a 2SLS estimation. To increase power, I again combine sole sons and sons in multiple-son households in one sample and use the difference-in-discontinuity design in the first stage.³⁶ In other words, Equation (2) becomes the first stage of the two-stage least squares, in which S_i is equal to one if individual i is a sole son and zero if he is a son in a multiple-son household. $S_i \times D_i$, which represents the discontinuity, is the instrument for college attainment. In the second stage, the effect of college education on various labor market outcomes is measured. Table F in the Appendix reports the return to college education using this 2SLS specification on labor force participation, unemployment, the subjective measure of job status, and the more objective measure based on average wages. None of the returns are statistically significant. Moreover, the first stage is weak as the Kleibergen-Paap Wald F-statistic for the first stage is less than one which is significantly smaller than 16.38, the 10% critical value calculated by Stock and Yogo (2005). In addition, one may argue that the instrument does not satisfy the exclusion restriction as some people on the left side of the threshold were conscripted while no one on the right side was. If conscription affects wages, the instrument is correlated with the error in the second stage. These issues make the results of 2SLS estimates unreliable.³⁷

In summary, the results show that the extra college education these sole sons acquired had no impact on their labor market outcomes. Therefore, although they attended college more, they did not acquire human capital that is useful in the labor market. This interesting result strengthens the fact that these sole sons only went to college to avoid conscription, and not to improve their future earnings. In other words, these results provide evidence that their main goal of attending college was to postpone conscription until they can avoid it. They probably did not exert much effort to accumulate human capital in college, and even if they had the intent to do so, their efforts were futile. It seems these individuals were at the

³⁶I refrain from including sisters of sole sons and daughters in multiple-son households in the comparison group because the female labor supply decision, and the industries they work in are generally very different from those of men in Iran.

³⁷and hence, I report them in the Appendix.

margin where it did not matter economically to go to college or not. Avoiding conscription, possibly, made the difference in enticing them to attend college, not calculations about labor market returns to education.

This is while entering college especially until the late 2000s has been very competitive and challenging as the supply of college seats has been a fraction of demand. It required the individual to be ranked in the top 30% in the national college entrance examination, known as *Konkoor*³⁸. It was estimated that, in 2011 alone, households spent about 4.3 billion USD³⁹ on supplemental educational sources beyond school, such as supplemental test taking books and tutoring, to help their children get an edge in *Konkoor*.⁴⁰ This amounts to nearly half of the Ministry of Education's budget for that year. According to the census data, 2.52% of households have someone who is planning to go to college. This amounts to about 520,000 households in 2011. Assuming that all of these households spent on supplemental educational sources outside of school, every household spent about 8,000 USD in 2011 which was roughly about 1.15 times the GDP per capita of Iran in that year. In other words, an average urban household is willing to spend more than the income of one year to increase the likelihood of their child going to college. Anecdotal evidence supports the fact that households start saving early on to afford such expenses, especially that college education can be free if the student gets into one of the public universities (which have a higher quality as well.) In this market for higher education, sole sons face an intense competition and challenge to enter college. Nevertheless, they are willing to go through this ordeal and come out successfully just to avoid conscription (even) in peace times.

³⁸It is based on the French word *concours* meaning contest.

³⁹70,000 billion Iranian Rials.

⁴⁰Source of data is Ali Abbaspour Tehrani, vice-chairman of the parliamentary committee on education and research, who mentioned it in an interview with *Aseman Weekly* (A Persian periodical in Iran), in December 2012. The Weekly is out of print but this part of the interview is reported on other websites, particularly, The Iranian Student News Agency (ISNA) on December 25, 2012, accessed August 23, 2016 <http://www.isna.ir/news/91100503204/>.

5 Conclusion

This study documents that a discontinuity in the law for military service exemption has created a wedge in education levels of sole sons. Sole sons whose fathers were 58 or slightly younger when they were 18, were 13 percentage points or 20% more likely to go to college only to get exemption from the service. In other words, if the military service exemption law did not exist, they would have attended college less. I show that this college attendance has no impact on their labor market outcomes which further strengthens the fact that their main reason to go college is not to accumulate human capital, but rather to avoid conscription.

These results provide a definite example that military service is disliked by at least some youth even during peace times. Governments in developing countries have few incentives, however, to abolish conscription as they need to create a large standing army on the cheap.⁴¹ But they and their respective military forces may benefit from making military service more appealing to the youth. One way to accomplish this is to offer some form of vocational training during the time of service. Not only does this provide the youth with skills valued in the labor market, but also reduces their anxiety about their lives being wasted during conscription. Understandably, this proposal may be an expensive one for the governments of developing countries. One way to make it feasible and cheap for these governments is to create collaborations with private sector. Private sector can provide unpaid or low-paid internship opportunities for the conscripted youth during which they can learn skills from firms. The youth would significantly benefit from this scheme as they learn skills that are valued in the broader economy, not just the armed forces. On the other hand, the firms may benefit from hiring these interns after their military service is over for two reasons. First, the firm has already trained these interns and the training costs little for the firm. Second, by the time the internship is over, there is little asymmetry of information between the employer and the intern. In addition, the interns have incentives to impress the firm

⁴¹Shieh et al. (2002) show that the optimal growth-enhancing share of military spending for a developing country is lower than welfare enhancing level. Hence, governments would be willing to reduce costs as much as possible so that the trade-off between welfare and growth becomes smaller.

by their productivity because some of the skills they learn on the job are firm-specific and non-transferable to other firms.

The results of this study have an important implication for education policy as well. They provide an example in which demand for education that is not based on returns to education calculations (or market-oriented cost-benefit analysis) provides little economic benefit to the individual. It could even misallocate resources in the economy when a significant portion of the population has such type of demand for education. This, for example, happens when the government policy or law entices individuals to go to school for reasons other than market returns. Therefore, governments should avoid creating situations that distorts education markets in that regard. As a corollary, the results suggest that governments should try to increase demand for education that is based on market-oriented cost-benefit analysis. Because there are market failures on the supply side of education markets in developing countries, governments usually ignore the demand side and focus on the supply by providing schools and reducing cost of education. But they should note that too much focus on the supply of education and ignoring the demand side may not lead to human capital accumulation that generates market returns. This is inline with recent evidence that shows near universal supply of primary education in developing countries (such as India) in the last decades did not lead to actual learning (Pratham, 2005).

This study shed light on one aspect of military service in a developing country, but there is a broader need in the literature for more (pseudo-)experimental studies on the impact of military service on various outcomes such as cognitive and non-cognitive skills, health, and basic labor and marriage market outcomes. Further research may expand horizons to do so.

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Figure 1: Discontinuity in College Attendance of Sole Sons

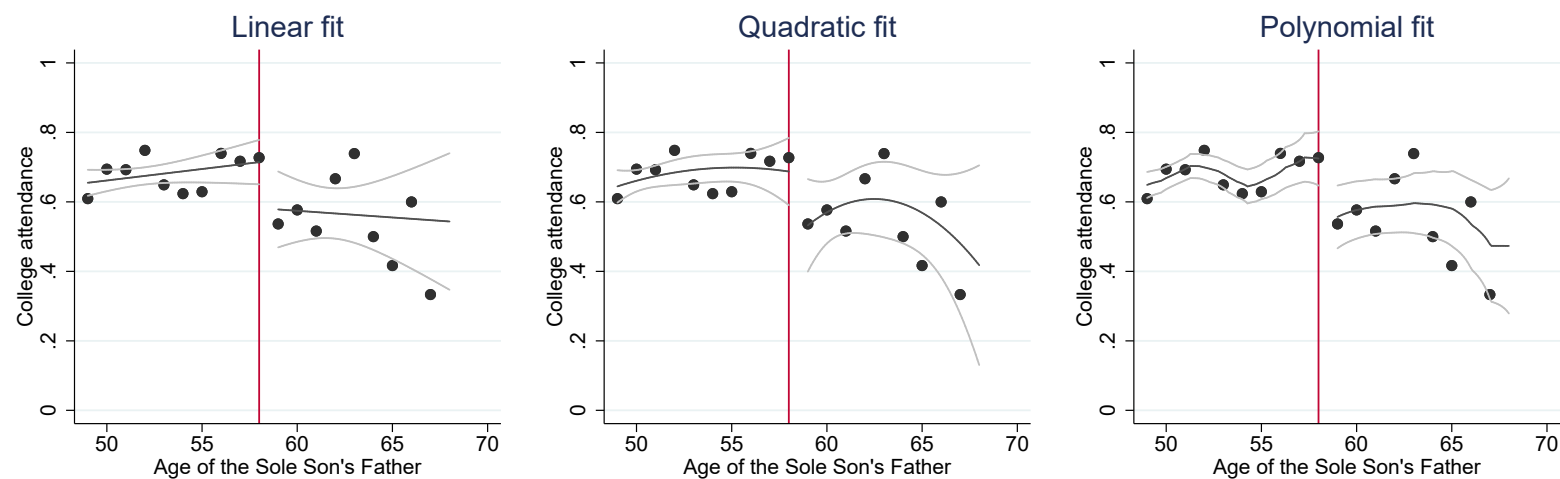


Figure 2: Discontinuity in College Attendance of Sole Sons' Sisters

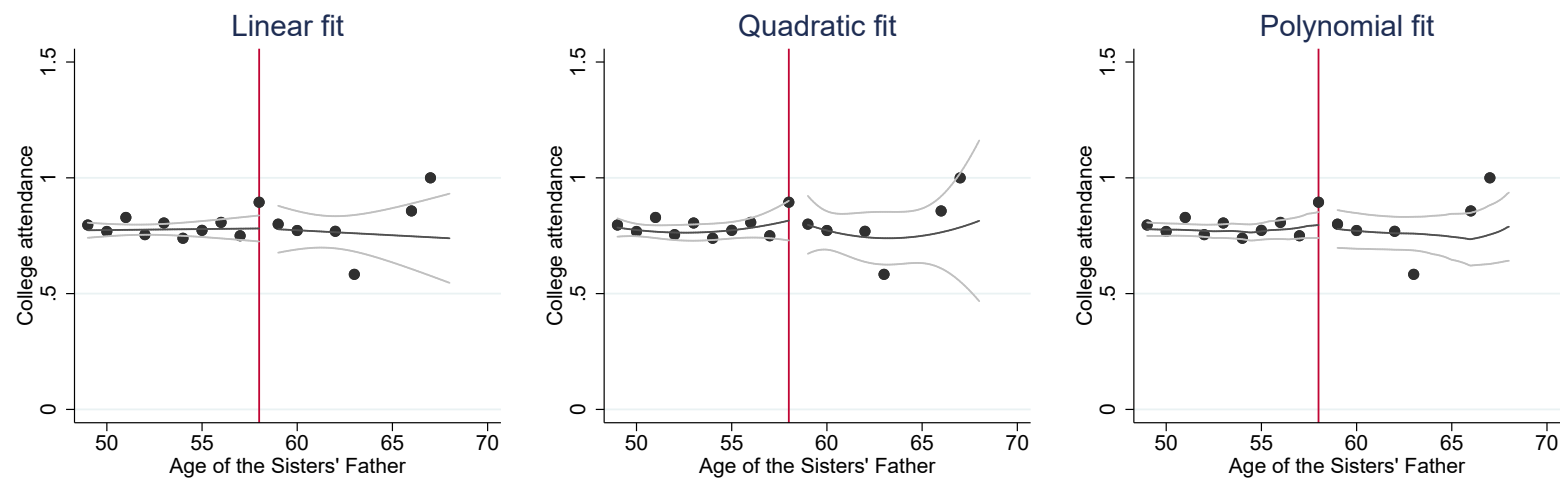


Figure 3: Discontinuity in College Attendance of Sons in Multiple Son Households

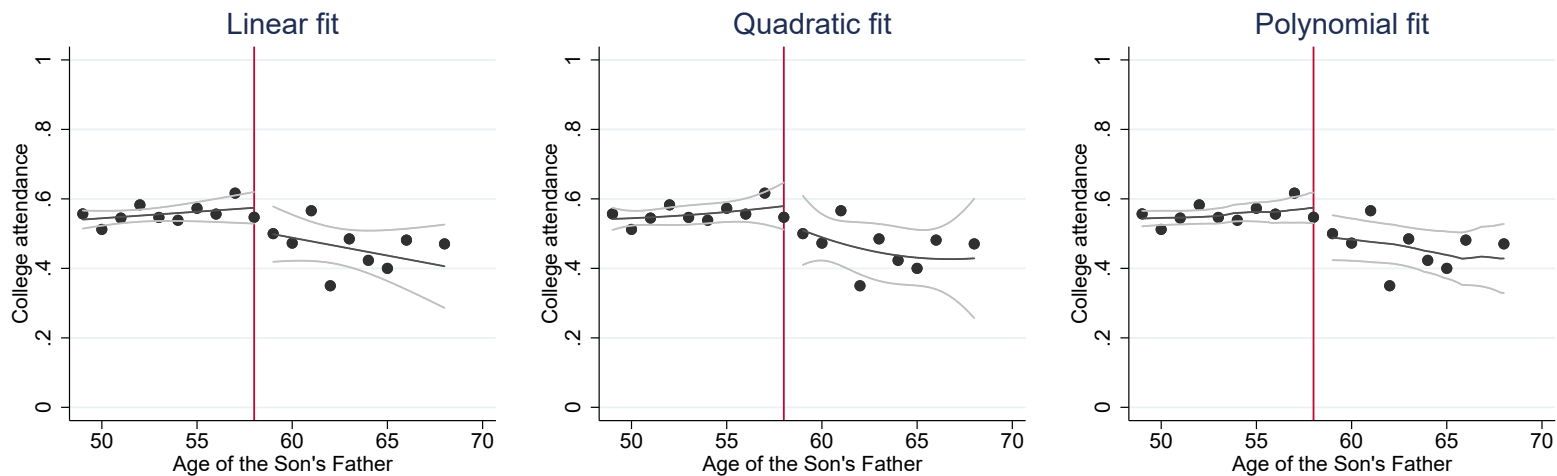


Figure 4: Discontinuity in College Attendance of Daughters in Multiple Son Households

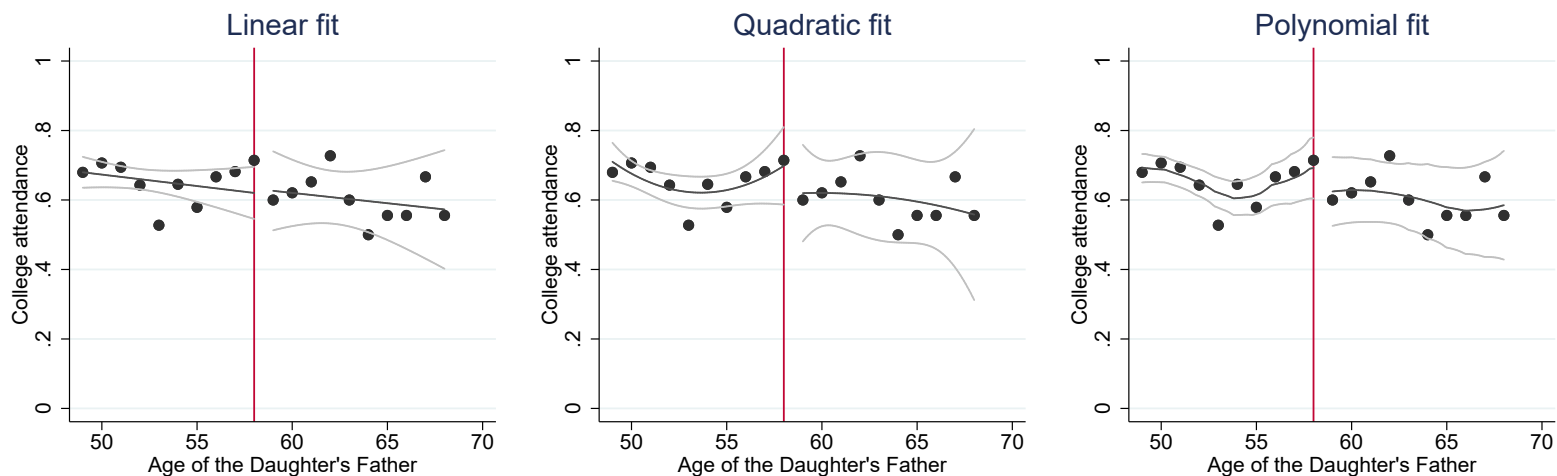


Table 1: Types and Number of Households in the 2011 Census

	Number	Share out of all Households with head (in %)
All Households	425,007	
without head	2,673	
with head	422,334	100.0
but no spouse	68,341	16.2
and one spouse	353,001	83.6
and more than one spouse	992	0.2
Households with head living with		
sons or daughter-in-laws of the head	6,312	1.5
parents of head or spouse	8,963	2.1
siblings of head or spouse	5,904	1.4
other relatives and non-relatives	2,542	0.6
Households with a mother and her husband	280,911	66.5
with all children present*	179,894	42.6
Sample of this study [†]	1,557	0.4

Note: This table contains the number of households in the census based on the composition of the household. There are 1,481,586 individuals in the data.

Only 0.4 percent of them (5,840) are living in households without a head. This study only focuses on households that have a head and one spouse but do not have any other member except children. These households may not have children at all.

* The households in this sample are identified using two rules: 1) The households only consist of a male head, his spouse, and their children (no step-child, additional spouses, or extended family members), and 2) the number of father's children in the household is equal to the number of children ever born by the mother. Table 2 contains summary statistics of these mothers.

[†] This is the sample of sole sons whose fathers age was between 49 and 68 when they were 18. Covariates are also non-missing for this sample.

Table 2: Summary Statistics

	Sole Sons					Sisters of Sole Sons				
	N	Mean	St. Dev.	Min.	Max.	N	Mean	St. Dev.	Min.	Max.
Age	1,557	22.4	2.6	19	28	1,933	22.1	2.6	19	28
Primary or Middle School	1,557	0.10	0.30	0	1	1,933	0.04	0.20	0	1
High School	1,557	0.23	0.42	0	1	1,933	0.17	0.37	0	1
College & Above	1,557	0.66	0.47	0	1	1,933	0.79	0.41	0	1
Sons in Multiple-son HHs					Daughters in Multiple-son HHs					
Age	3,450	22.2	2.6	19	28	1,184	22.2	2.6	19	28
Primary or Middle School	3,450	0.18	0.38	0	1	1,184	0.11	0.32	0	1
High School	3,450	0.27	0.44	0	1	1,184	0.22	0.41	0	1
College & Above	3,450	0.54	0.50	0	1	1,184	0.64	0.48	0	1
Men Aged 19-28					Women Aged 19-28					
Age	110,308	23.8	2.8	19	28	115,245	23.8	2.8	19	28
Primary or Middle School	110,308	0.35	0.48	0	1	115,245	0.25	0.43	0	1
High School	110,308	0.30	0.46	0	1	115,245	0.34	0.47	0	1
College & Above	110,308	0.35	0.48	0	1	115,245	0.41	0.49	0	1

Note: Age is the age of the individual at the time of survey. Urban is a dummy equal to one if the individual lives in an urban area and zero otherwise. Primary or Middle School is a dummy equal to one if the individual's last level of education was primary or middle school and zero otherwise. High school is a dummy equal to one if the individual's last level of education was high school and zero otherwise. College attendance is a dummy variable equal to one if the individual attended college or higher levels of education and zero otherwise. The means of "Primary or Middle School", "High School", and "College & Above" do not add up to one, since around 1 to 3 percent of the samples are illiterate. All samples include ages 19 to 28 only.

Table 3: Discontinuity in College Education

	Sole Sons			Sole Sons' Sisters			Sons in Multiple-Son HH		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
D	0.103** (0.048)	0.167*** (0.048)	0.246*** (0.074)	-0.030 (0.043)	-0.068 (0.055)	-0.016 (0.061)	0.040 (0.031)	-0.011 (0.035)	-0.027 (0.090)
$p - 58$	0.010 (0.008)	0.054** (0.024)	0.055 (0.082)	-0.010 (0.008)	-0.074** (0.028)	-0.046 (0.049)	0.003 (0.005)	-0.030 (0.023)	-0.036 (0.092)
$(p - 58)^2 \times 10^{-1}$	-0.009 (0.009)	-0.059* (0.029)	0.042 (0.088)	-0.005 (0.009)	0.092*** (0.032)	0.098* (0.055)	-0.001 (0.005)	0.034 (0.025)	0.027 (0.093)
$(p - 58)^3 \times 10^{-4}$		-0.047* (0.024)	-0.048 (0.193)		0.068** (0.030)	0.002 (0.116)		0.032 (0.024)	0.048 (0.196)
$D(p - 58)$		0.041 (0.033)	0.297 (0.212)		-0.036 (0.032)	0.113 (0.128)		-0.030 (0.025)	-0.079 (0.199)
$D(p - 58)^2 \times 10^{-1}$		0.080			4.347			-1.003	
			(11.948)			(8.239)			(11.384)
$D(p - 58)^3 \times 10^{-4}$			17.216 (13.320)			1.307 (9.084)			-1.244 (11.606)
Father's education	0.109*** (0.012)	0.108*** (0.012)	0.107*** (0.012)	0.046*** (0.008)	0.047*** (0.008)	0.047*** (0.008)	0.121*** (0.011)	0.121*** (0.011)	0.120*** (0.011)
Mother's education	0.086*** (0.017)	0.087*** (0.018)	0.087*** (0.018)	0.104*** (0.011)	0.105*** (0.011)	0.105*** (0.011)	0.072*** (0.010)	0.072*** (0.010)	0.073*** (0.010)
Observations	1,557	1,557	1,557	1,933	1,933	1,933	3,450	3,450	3,450

Note: Sample used in regression in the left panel only includes sole sons whose fathers' ages when they were 18 were between 49 and 68. Sample of the regressions in the middle panel includes sisters of sole sons whose father's age when the sister was 18 was between 49 and 68. Sample used in the right panel includes sons in multiple son households whose father's age when the son was 18 was between 49 and 68. Dependent variable is college attendance explained in notes for Table 2. D is a dummy equal to 1 if the father's age of a sole son is less than 59 when the son was 18 years old and zero otherwise. p is father's age. All regressions include parents' ages which are not reported in the table. Robust-heteroskedastic standard errors corrected for correlation inside clusters are in parentheses. Clusters are values of father's age when son was 18.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Discontinuity in College Education Across Various Samples (τ in Equation (1))

	Sole Sons			Sole Sons' Sisters			Sons in Multiple-Son HHs		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
53 to 64 (± 6)	0.168*** (0.042)	0.245*** (0.065)	0.023 (0.177)	-0.035 (0.053)	-0.011 (0.053)	0.120 (0.126)	0.009 (0.029)	-0.019 (0.081)	0.201 (0.121)
Obs.	631	631	631	759	759	759	1,309	1,309	1,309
51 to 66 (± 8)	0.120** (0.042)	0.204*** (0.044)	0.241** (0.108)	-0.036 (0.043)	-0.048 (0.062)	0.049 (0.061)	0.036 (0.033)	-0.047 (0.057)	0.083 (0.085)
Obs.	1,025	1,025	1,025	1,217	1,217	1,217	2,211	2,211	2,211
47 to 70 (± 12)	0.087* (0.046)	0.148*** (0.048)	0.255*** (0.065)	-0.043 (0.037)	-0.022 (0.064)	-0.128 (0.084)	0.017 (0.031)	0.028 (0.032)	-0.051 (0.070)
Obs.	2,333	2,333	2,333	2,876	2,876	2,876	5,235	5,235	5,235
44 to 73 (± 15)	0.052 (0.048)	0.152*** (0.044)	0.183*** (0.054)	-0.058* (0.029)	-0.025 (0.053)	-0.067 (0.071)	0.002 (0.029)	0.029 (0.030)	-0.006 (0.055)
Obs.	3,802	3,802	3,802	4,695	4,695	4,695	8,815	8,815	8,815
Polynomial order	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd

Note: See notes for Table 3 for information on each panel in the table. Only the coefficient of D in Equation (1) is reported for various samples. Father's age between 53 and 64 (± 6 years around the threshold, Father's age between 51 and 66 (± 8 years around the threshold), father's age between 47 to 70 (± 12 years around the threshold), father's age between 44 and 73 (± 15 years around the threshold). Robust-heteroskedastic standard errors corrected for correlation inside clusters are in parentheses.

Clusters are values of father's age when son was 18.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Discontinuity in College Attendance of Sole Sons (τ_s in Equation (2))

	Sample I			Sample II			Sample III		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$D \times S$	0.133** (0.060)	0.235*** (0.062)	0.262** (0.101)	0.101* (0.053)	0.203*** (0.056)	0.290*** (0.103)	0.102** (0.050)	0.182*** (0.054)	0.242*** (0.088)
Observations	3,490	3,490	3,490	6,940	6,940	6,940	8,124	8,124	8,124

Note: Regressions are based on Equation (2). See notes for Table 3 for more information on variables. Coefficient of $D \times S$ shows the Neighborhood Average Treatment Effect from a Diff-in-Disc regression. Sample I includes sole sons and sisters of sole sons. Sample II adds sons in multiple-son households to Sample I. Sample III adds daughters in multiple-son households to Sample II. Heteroskedasticity robust corrected for correlation inside clusters are in parentheses. Clusters are father's age of the individual when s/he was 18.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Discontinuity in Job Status (τ in Equation (2))

	Labor Force Participation			Unemployment		
	(1)	(2)	(3)	(4)	(5)	(6)
$D \times S$	0.150* (0.083)	0.139 (0.103)	0.144 (0.136)	-0.004 (0.071)	0.128 (0.086)	0.165 (0.159)
Polynomial order	1st	2nd	3rd	1st	2nd	3rd
Observations	2,621	2,621	2,621	1,995	1,995	1,995
	Job Status			$\ln(\bar{W})$		
	(1)	(2)	(3)	(4)	(5)	(6)
$D \times S$	-0.434 (0.274)	-0.283 (0.358)	-0.774 (0.623)	-0.163 (0.110)	-0.167 (0.134)	-0.238 (0.264)
Polynomial order	1st	2nd	3rd	1st	2nd	3rd
Observations	880	880	880	880	880	880

Note: Job Status is a variable that is one if the individual is an unskilled worker, two for semi-technical workers, three for technicians and associate professionals, four for scientists, doctors, lawyers, engineers, managers and top government officials. $\ln(\bar{W})$ is the natural log of the average wage for the category of the occupation an individual has. Robust-heteroskedastic corrected for correlation inside clusters are in parentheses. Clusters are father's age of the individual when he was 18.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

A Appendix

Table A: Discontinuity in Number of Observations of Sole Sons

	(1)	(2)	(3)
D	-21.230 (13.486)	3.133 (6.423)	9.974 (9.445)
Polynomial controls	Linear	Quadratic	Third-degree
Adjusted R ²	0.963	0.992	0.991
N	20	20	20

Note: Regressions are based on Equation (2). The dependent variable is the number of observations. Coefficient of D shows the discontinuity in the number of observations at father's age of 58 in urban areas only. Robust-heteroskedastic standard errors corrected for correlation inside clusters are in parentheses. Clusters are values of father's age when son was 18.

* p<0.10, ** p<0.05, *** p<0.01

Table B: Discontinuity in College Education for Daughters in Multiple-son Households

	(1)	(2)	(3)
49 to 68 (± 10)	-0.005 (0.040)	0.044 (0.046)	0.138* (0.076)
Obs.	1,184	1,184	1,184
53 to 64 (± 6)	0.096** (0.042)	0.063 (0.064)	-0.078 (0.055)
Obs.	494	494	494
51 to 66 (± 8)	-0.021 (0.039)	0.133** (0.060)	0.046 (0.079)
Obs.	790	790	790
47 to 70 (± 12)	0.035 (0.039)	0.005 (0.049)	0.104 (0.068)
Obs.	1,717	1,717	1,717
44 to 73 (± 15)	0.018 (0.037)	0.049 (0.047)	0.014 (0.058)
Obs.	2,714	2,714	2,714
Polynomial order	1st	2nd	3rd

Note: Regressions are based on Equation (1). The dependent variables are sole-son's parents' education and age. Only the coefficient of D in Equation (1) which shows the discontinuity in these variables at father's age of 58 in urban areas is reported. Robust-heteroskedastic standard errors corrected for correlation inside clusters are in parentheses. Clusters are values of father's age when son was 18.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C: Discontinuity in Other Variables

	(1)	(2)	(3)
<i>Discontinuity in:</i>			
Father's education	0.268 (0.207)	0.414 (0.332)	0.636 (0.530)
Mother's education	0.076 (0.159)	-0.210 (0.252)	0.137 (0.398)
Father's age	-0.501 (0.401)	0.128 (0.635)	-0.246 (1.004)
Mother's age	-0.870 (0.820)	1.860 (1.297)	5.103** (2.047)
Polynomial order	Linear	Quadratic	Third-degree
Observations	1,557	1,557	1,557

Note: Regressions are based on Equation (1). The dependent variables are sole-son's parents' education and age. Only the coefficient of D in Equation (1) which shows the discontinuity in these variables at father's age of 58 in urban areas is reported.

Standard errors in parentheses.

* p<0.10, ** p<0.05, *** p<0.01

Table D: Discontinuity in College Education for Sole Sons

	Imbens and Kalyanaraman (2012)			Ludwig and Miller (2007)		
	(1)	(2)	(3)	(4)	(5)	(6)
D	0.108* (0.059)	0.203* (0.116)	0.243* (0.139)	0.110* (0.066)	0.117 (0.093)	0.232* (0.133)
Polynomial order	1st	2nd	3rd	1st	2nd	3rd
Obs.	2,534	934	1,755	1,755	1,755	1,755

Note: This table shows the discontinuity in college education for Sole Sons using optimal bandwidth choices following Imbens and Kalyanaraman (2012) and Ludwig and Miller (2007). The estimation following Calonico et al. (2014) does not converge and hence is not reported. Note that presently the bandwidth selection method following Ludwig and Miller (2007) is not theoretically justified (Calonico et al., 2017). Therefore, one should take those results (reported in the right panel of the table) with a grain of salt. The new version of **rdrobust** in Stata (2016 version) is not able to create the bandwidths above the threshold. Hence, other optimal bandwidth choice methods, such as Coverage Error Rate (see Calonico et al., 2017a,b) cannot be implemented.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table E: Natural Log of Average Wages by Job Category

Job Category	$\ln(\overline{W})$
1) Legislators, senior officials and managers	12.24590
2) Professionals (doctors, lawyers, engineers, etc.)	12.37025
3) Technicians and associate professionals	11.86571
4) Clerks	11.83416
5) Service workers and shop and market salespeople	11.47818
6) Skilled agricultural and fishery worker	11.25746
7) Crafts and related trades workers	11.51462
8) Plant and machine operators and assembly workers	11.53646
9) Elementary occupation	11.24500

Table F: 2SLS Estimates of Return to College and Above Education

	Labor Force Participation				Unemployment			
	OLS	2SLS			OLS	2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College & above	0.012 (0.018)	2.070 (2.532)	1.041 (1.397)	2.517 (10.031)	0.086*** (0.025)	0.035 (2.368)	3.192 (16.996)	2.043 (8.093)
Polynomial order of the first stage		1st	2nd	3rd		1st	2nd	3rd
Kleibergen-Paap Wald F-statistic [†]		0.755	0.865	0.0639		0.218	0.0358	0.0680
Observations	2,579	2,579	2,579	2,579	1,973	1,973	1,973	1,973
	Job Status				$\ln(\bar{W})$			
	OLS	2SLS			OLS	2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College & above	0.981*** (0.068)	-2.147 (3.130)	-1.719 (5.547)	13.796 (67.547)	0.376*** (0.029)	-0.804 (1.221)	-0.999 (2.744)	-10.942 (207.151)
Polynomial order of the first stage		1st	2nd	3rd		1st	2nd	3rd
Kleibergen-Paap Wald F-statistic [†]		1.388	0.340	0.0351		1.388	0.340	0.00299
Observations	872	872	872	872	872	872	872	872

Note: Job Status is a variable that is one if the individual is an unskilled worker, two for semi-technical workers, three for technicians and associate professionals, four for scientists, doctors, lawyers, engineers, managers and top government officials. $\ln(\bar{W})$ is the natural log of the average wage for the category of the occupation an individual has. Robust-heteroskedastic corrected for correlation inside clusters are in parentheses. Clusters are father's age of the individual when he was 18.

[†] Kleibergen-Paap rk Wald F statistic. The critical value for 10% maximal IV relative bias is 16.38. For more information on critical values, see Stock and Yogo (2005).

* p<0.10, ** p<0.05, *** p<0.01

Figure A: Discontinuity in Number of Observations of Sole Sons

