Family Income and Children's Education: Evidence from Targeted Economic Sanctions*

Safoura Moeeni†

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Abstract

While there is substantial evidence on the effect of parents' financial resources on children's education, the size and causal impact are subject to disagreement. I exploit a persistent negative shock in the family income to estimate the causal effect of parental resources on children's education. The United Nations Security Council sanctions imposed on Iran in 2006 caused a large and persistent reduction in households' income. Exploiting variation in the strength of sanctions across industries and using unique survey data with detailed information on children's education and living circumstance, I obtain two main findings. First, the negative income shock decreased children's total years of schooling by 0.2 years and the probability of attending college by 8.7%. This effect is larger for children at crucial ages and children from low income families. Second, households reduced expenditure on children's education by 61% - particularly on expenditure for school tuition. This finding indicates households respond to the reduction in income by substituting away from higher-quality private schools towards lower-quality public schools for their children. This negative effect on education expenditure is larger for children from middle income families. The sanctions impact on children's education is larger than implied by the income elasticity estimates from the previous literature likely because sanctions have persistent effects on parent income. Taken together the results imply that a persistent reduction in parents' income has large negative effects on education and permanent income of children.

Keywords: Education; Family income; Parental investment; Economic sanctions.

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†PhD Candidate, Department of Economics, University of Calgary, 2500 University Drive NW, Calgary, Alberta, Canada, E-mail: smoeeni@ucalgary.ca

1 Introduction

Investment in children's education has long lasting consequences on their future welfare including labor market outcomes. As early human capital investment is hard to substitute with the investment in later life (Heckman (2011)), adverse educational experiences in childhood could put children at a disadvantage for the rest of their lives. Given the significant private and social benefits of education, policymakers use tax credit and transfer programs, besides providing public education, to encourage parents to invest more in their children's education. There is substantial evidence on the positive effect of parents' financial resources on children's education. There is less evidence, however, on causal mechanisms. The major challenge of estimating the causal effect of family income on children's education is the endogeneity of income. Parents' income may be correlated with unobserved factors (e.g. ability) which transmitted across generations and affect schooling outcomes of children. In this paper, I contribute to the literature by providing new quasi-experimental evidence on the effects of family income on investment in children's education by using Iranian data.

The theoretical effect of family income on children's education is ambiguous. On the one hand, a rich theoretical literature following Becker and Tomes (1986) has argued that parental resources matter for education decisions because of credit constraints, or because education is, to some degree, a consumption good rather than a pure investment good. On the other hand, another influential literature following Cameron and Heckman (2001) argues that parental investment in children's human capital needs not be related to parental income. One possible reason for this disagreement is that temporary and persistent, small and large changes in household income may have different effects on children's education. Households are more likely to reoptimize the consumption in response to large and persistent shocks. Therefore, a large and persistent reduction in household income would be expected to affect children's education, whereas a small and temporary reduction in household income will not necessarily affect children's education. As Browning and Crossley (2009) suggests, households who are temporarily constrained (if they are unable to smooth through borrowing) will cut back more on goods that exhibit high intertemporal substitution, e.g., luxuries, because the utility cost of fluctuations would be lower. Thus, parents can invest in their children's education by reducing other expenditures, selling assets, or raising their own working effort. However, a persistent reduction in household income hampers their ability to consumption smoothing, especially when the shock increased uncertainty about future income (Stephens Jr (2001)). Moreover, the same shock can have different effects on households consumption depend on households' characteristics including budget constraints, adjustment costs, and their preferences.[1] Even when parental spending on children's education reduces, much of which may be offset by financial aid e.g. college loans.

In this paper, I investigate the effects of a persistent negative income shock caused by targeted

[1]On average, changes in household income or liquidity cause significant changes in household spending among households with low liquid wealth or low income, even when the shock is predictable (Johnson et al. (2006); Stephens Jr (2008); Jappelli and Pistaferri (2014)). Moreover, adjustment costs vary across households. Many households have consumption commitments that are costly to adjust especially in the short run. For example, most homeowners do not move during unemployment spells because of their commitment to make mortgage payments. Consumption of many other durable goods (vehicles, furniture) and services (insurance, utilities) may also be difficult to adjust (Chetty and Szeidl (2007)).

economic sanctions to identify the impacts of family income on children's education. In 2006, the UN Security Council passed Resolution 1737 (on 23 December 2006) and imposed economic sanctions after Iran refused to suspend its uranium enrichment program. UN sanctions include trade and financial restrictions. Trade restrictions targeted specific firms and individuals including oil and gas production and shipping companies, nuclear research and production companies, and military and security services companies owned or controlled or acting on behalf of the Islamic Revolutionary Guard Corps. Theses sanctions mostly targeted investments in and export of oil and gas. Financial restrictions include any transactions with the Central Bank of Iran, disconnecting Iranian bank from the SWIFT, and freezing assets of specific firms and individuals. A consequence, crude oil exports declined to less than one million barrels per day and the growth rate reached -6% in 2012. The targeted sanctions were associated with large, sudden reductions in households' income and consumption. As Figure 1 shows, very shortly after the implementation of the sanctions, the average real income of Iranian households decreased and the decreasing trend last for seven years. During 2007-2013, households' real income on average decreased by 35%. As a result, households cut their spending on education by 43%. The reduction in education spending reflects both young children not attending school and parents cutting back on school expenditures.

My identification strategy uses variation in the impact of sanctions on labor income across industries. The empirical strategy to evaluate this negative income shock relies on a difference-in-difference approach. I define households in which the head works in the oil and gas industry as the treated group because these households were directly affected by the sanctions through labor earning reductions. I use water supply and information industries as the control group because there are little income changes for households in these industries, as they are heavily regulated by the government. Therefore, the sanctions have little effects on wages and the employment levels of these sectors. Moreover, these industries are not dependent on trade, thus making them unaffected by the changes in the exchange rate. As I show later, these two groups have parallel trends in education outcomes in the absence of the sanctions.

My analysis reveals two main findings. First, sanctions decreased the years of schooling significantly by 0.2 years and probability of attending a four-year college by 8.7%. This effect on children's education is more than six times larger than previous estimates of the effect of family income on attending college (e.g., Acemoglu and Pischke (2001); Blanden and Gregg (2004); Hilger (2016)) likely because of the persistent shock and lack of adjustment possibilities.[2] I also find this effect is larger for children at crucial ages (high school dropout age and matriculation at a university) and children from low income families (marginal students). Education outcomes of these subgroups of children who are known as academically at-risk youth are more sensitive to family income. In particular, the economic sanctions decreased the probability of attaining college at age 18 and 19 (the average age of matriculation) by 37% and decreased the enrollment rate at the high school by

[2] Acemoglu and Pischke (2001) find a 10% decrease in family income is predicted to decrease college enrollment by 1-1.4 percentage point. Other studies find even smaller effects, for example, Hilger (2016) finds a father's layoff reduces children's college enrollment by less than half of one percentage point, despite dramatically reducing current and future parental income (by 14% initially and 9% after 5 years). He explains that much of reduction in parental spending on education may be offset by greater financial aid.

12% among children at high school dropout age (16 years old). Furthermore, only children from the lowest income quintile experienced a reduction in the years of schooling. I consider a simple back of the envelope calculation to understand the economic significance of these results. My calculation shows if these children were able to enroll in college at the same rate as college enrollment in the year 2006 and have the wage rates of the year 2006, their lifetime earnings would increase by 41%.

Second, I examine the effects of the decrease in parental resources on investment in children's education by looking at household spending on education. I find that after the sanctions, households reduced expenditure on education by 61% - particularly on expenditure for school tuition. This finding indicates households respond to the reduction in income by switching their children from higher-quality, more expensive private schools to lower-quality, free public schools.[3] This negative effect on education expenditure is larger than implied by the income elasticity estimates from the previous literature (Qian and Smyth (2011); Huy (2012); Acar et al. (2016)). Most of these studies find that the income elasticity of education spending is significantly less than one.[4] I find an income elasticity of 1.6 and 2.1 for all households and for households in the oil and gas industry respectively after the sanctions. This finding indicates households allocate a smaller share of their budgets to education spending after the sanctions. I also find this negative effect is larger among children from middle income families (-72%).[5]

Overall, the persistent reduction in family income has large negative effects on both educational attainment and investment in education measured by family education spending. The adverse effects on children's education are larger for children at crucial ages, and children from low and middle income families. This reduction in children's education will reduce their future earnings (by 41%) such that affected children will experience a larger decline in their earnings than their parents.

This paper contributes to the literature on the effect of family income on children's education in several ways. First, my analysis adds to a recent quasi-experimental literature that exploits income shocks by estimating the effect of a persistent income shock caused by the 2006 UN sanctions and last seven years (2007-2013). As explained before, persistent changes in family income could have different effects on children than do temporary changes. Most of previous studies exploits temporary income shocks generated by, for example, casino revenue, lotteries, cash transfer, tax credit, housing prices, and oil revenue (Akee et al. (2010); Bleakley and Ferrie (2016); Bulman et al. (2016); Dahl and Lochner (2012); Duryea et al. (2007); Løken et al. (2012); Lovenheim (2011); Lovenheim and Reynolds (2013); Manoli and Turner (2018)). The resulting estimates vary greatly in magnitude, ranging from over 1 percentage point per $1,000 to less than 1 percentage point per $100,000. This wide range likely reflects differences in the research designs such as the affected populations, the size, and salience of the changes in resources, the identifying assumptions, the timing of the changes in children's lives, and offsetting effects of changes in financial aid eligibility. Despite these differences, all of these papers look at the case in which the exogenous shock in family income is temporary and

[3] In contrast, expenditures on consumption goods, health, savings, etc did not decrease as much as the expenditure on education.

[4] Previous studies find that even for those group of household that education spending is a luxury good, income elasticity is less than 2.

[5] These effects are not significant for children from high income families.

find small effects compared to my results. Even when the shock is large e.g lotteries, as Bulman et al. (2016) and Manoli and Turner (2018) show, lump-sum transfers are more likely to be spent on durable e.g housing. Therefore, these shocks have small effects on children's education. The existing studies that exploit persistent income shocks generated by, for example, tax credit and job loss (Bastian and Michelmore (2018); Coelli (2011); Hilger (2016); Pan and Ost (2014)) find larger effects compared to the above studies (1.3 and 4.3 percent increases the likelihood of completing high school and college per $1,000). Different responses of households to a persistent versus a temporary income shock could explain these larger effects. Still, the results of these studies are small compared to my results because much of reduction in parental resources is offset by greater financial aid (Hilger (2016)). I study the effects of changes by looking at a persistent income shock while other financial resources are not available to children. Moreover, people could not predict whether sanctions would be lifted or not.

Second, I add to the distributional debate about the burden of family income effects. Unlike the existing studies, I estimate differential effects on education investment for households with low, average, and high income. As explained before, households respond to an income shock could vary across different income quintiles.[6] The results of existing studies that exploit persistent income shocks are limited to a specific population. For example, Bastian and Michelmore (2018) evaluate a persistent income change generated by a tax credits policy. The results of this study are limited to the population of low-income households because this income change was not randomly imposed on households. Thus, there was no change for middle and high income households. Contrary, the sanctions affect treated households at any level of income. Therefore, I can estimate the causal effects for high income households as well as low income households. By comparing the effects for heterogeneous groups of households, I find that sanctions decreased educational attainment most for children from low income families, and investment in education most for children from the middle income households.

This paper also adds to the literature on the effects of the economic sanctions. Economic sanctions have become the defining foreign policy tool of the 21st century, sometimes as a prelude to warfare, and sometimes as an alternative to it.[7] While humanitarian impacts often feature prominently in the debate about economic sanctions, traditional estimates of the effects of sanctions have focused largely on the efficacy of sanctions in accomplishing political objectives (Hufbauer et al. (2010)). More recent literature has investigated the adverse consequences of sanctions on the civilian population while sanctions are in place (Petrescu (2016)). However, as the effects of sanctions may last beyond the lifting of sanctions, effects on current generation may not fully capture the neg-

[6]For example, as many studies show, lower income families have higher income elasticity of education expenditure whereas the higher income families have lower income elasticity of education.

[7]Economic sanctions are commercial and financial penalties applied by one or more countries against a targeted country. Sanctions are designed to pressure the targeted countries to change offending policies, and/or to weaken the ability of them to govern (Askari et al. (2001)). For the first time, the United Nations (UN) applied multistate sanctions to Southern Rhodesia in 1991. Since that date, the Security Council has established 25 sanctions regimes, in South Africa, the former Yugoslavia, Haiti, Al-Qaida and the Taliban, Iraq, Iran, etc. Today, there are 14 ongoing sanctions regimes which focus on supporting the political settlement of conflicts, nuclear non-proliferation, and counter-terrorism.

ative impacts of sanctions. In particular, if sanctions reduce the educational attainment of young people, the effects of sanctions may last long after they are lifted.[8]

The central empirical challenge in measuring the effects of sanctions on children's education is one of identification. Sanctions that are not confounded with other factors, that also affected children's education, are difficult to come by. Farjo (2011) finds a reduction in primary school enrollment during 1990-2003 when the UN imposed economic sanctions on Iraq. However, its causal implications are limited because this study does not distinguish the effects of sanctions from the effects of several other relevant factors such as war and political instability.[9] The second challenge is a dearth of reliable data. In most cases, the presence of conflicts poses a substantial obstacle to the collection of survey data especially on the displaced populations and people in conflict areas (Barakat et al. (2002)). Even if data are collected, their accuracy is an open question. For estimation the sanction effects on children's education, the Iranian setting is well suited for two reasons. First, other factors which affect children's education (e.g. political stability) arguably remain unchanged after the sanctions (Borszik (2016)). Second, there are rich data, Iranian Household Income and Expenditure Survey (HIES), that roughly span the four decades from the 1980's to 2010s (before, during, and after the sanctions). These surveys collected detail information on the children's years of schooling and their family income and expenditure including spending on education. Using this unique survey data, I find the targeted sanctions had large negative effects on children's education. I also find that the costs to the society associated with the reduction in earnings after the sanctions total about 18% of GDP. 45% of this reduction comes from decreased earning for the current workers, and 55% comes from decreased earning for the next generation. It suggests that the cost estimates using only earnings of current generation may only capture less than half of the overall cost. Although the effects of sanctions depend on the context and severity of the sanctions and how government and households cope with this shock, establishing this potential negative shock to human development can edify future policy regarding the use of the economic sanctions.

This paper proceeds as follows. In section 2, I provides the institutional setting. In section 3, I describe the data and present the identification strategy. In Section 4, I present the main empirical results on the impacts of the 2006 UN economic sanction on children's education. Section 5 reports some robustness checks. Section 6 explores heterogeneous effects. In Section 7, I discuss mechanisms behind the impacts of the 2006 UN economic sanction on children's education. Section 8 concludes the paper.

[8] Economic downturns, caused by recessions, sanctions, etc may affect children's education through the family and society level mechanisms (Weiland and Yoshikawa (2012)). Unlike recessions, which people anticipate economic recovery sooner or later, people could not predict whether sanctions would be lifted or not. While the literature on business cycles finds that education attainment increases during recessions, this paper finds that education attainment decreases.

[9] Although there are a few studies which analyze the education trends during the years of sanctions, there is a growing literature on the effect of armed conflict on schooling. The results of these studies cannot be generalized to the sanctions cases. Besides that the overall evidence is mixed (depending on the context of conflict and intensity of recruitment during warfare), channels through which education might have been affected are different. The reasons that education during the war may be affected negatively include school closure, migration and displacement, the quality and availability of school facilities, and shocks to income and security (Justino (2011)).

2 Institutional Setting

2.1 The 2006 UN Sanctions

On 23 December 2006, after Iran refused to suspend its uranium enrichment program, the UN Security Council passed Resolution 1737 and imposed economic sanctions against Iran. While Iran's programs to enrich uranium were stopped in 2002, they restarted in late 2005. In July 2006, the UN Security Council in Resolution 1696 had expressed concern at the intentions of Iran's nuclear program and demanded that Iran halt its uranium enrichment program by August 31. However, the Council did not show any action after Iran's failure to comply with the requirements of the Council and the International Atomic Energy Agency (IAEA). Moreover, President Mahmoud Ahmadinejad warned Iran would break off all talks over its nuclear program if any sanctions were imposed. Unexpectedly, in December 2006, the Council imposed trade and financial sanctions on Iran. UN sanctions targeted investments in oil, gas, and petrochemicals, exports of refined petroleum products, and business dealings with the Iranian Revolutionary Guard Corps. Trade restrictions targeted specific firms and individuals including oil and gas production and shipping companies, nuclear research and production companies, and military and security services companies owned or controlled or acting on behalf of the Islamic Revolutionary Guard Corps. Theses sanctions mostly targeted investments in and export of oil and gas. Financial restrictions encompass banking and insurance transactions (including transactions with the Central Bank of Iran), shipping, web-hosting services for commercial endeavors, and domain name registration services. The 2006 sanctions were effective to pressure Iran to negotiate on its nuclear program. In 2013, Iran accepted negotiation for a framework deal over the nuclear program with permanent members of the UN Security Council and Germany (P5+1).[10] On 2 April 2015, they had reached an agreement on a framework deal (Joint Comprehensive Plan of Action (JCPOA)) known commonly as the Iran deal. Thus, the European Union, the United States and UN Security Council have terminated all nuclear-related resolutions and sanctions.[11]

The 2006 sanctions are the most severe sanctions ever put on Iran because most countries including the European Union stopped buying oil from Iran. Moreover, the United States has introduced sanctions for punishing other countries that buy oil from Iran. Furthermore, sanctions have reduced Iran's access to products needed for the oil and energy sectors, have prompted many oil companies to withdraw from Iran. The sanctions have also caused a decline in oil production due to reduced access to technologies needed to improve oil production efficiency. Therefore, Iran lost $160 billion oil revenue. In addition, more than $100 billion in Iranian assets was held in restricted accounts outside the country. As a result, Iran's economy got 15 to 20% smaller than it would have been absent the sanctions (U.S. Treasury Secretary Jacob Lew report, 2015). Since Iran's economy is highly dependent on oil exports and goods imports, economic activity shrank and the sanctions

[10] China, France, Russia, the United Kingdom, and the United States plus Germany

[11] United Nations Security Council Resolution 2231, passed on 20 July 2015, sets out a schedule for suspending and eventually lifting UN sanctions, with provisions to reimpose UN sanctions in case of non-performance by Iran, in accordance with the Joint Comprehensive Plan of Action. The provisions of Resolution 1737 were terminated by United Nations Security Council Resolution 2231 effective on the implementation day of the Joint Comprehensive Plan of Action (JCPOA), 16 January 2016.

threw the economy into a two-year recession. The growth rate has reached an all-time low of -6% in 2012. Meanwhile, the value of the Rial (the currency of Iran) declined by 56% and inflation reached 35%. As Figure 1 shows, very shortly after the implementation of the sanctions, the average real income of Iranian households have decreased. During 2007-2013, households' real income in average decreased by 35%. As a result, households cut their total expenditure and spending on some classes of goods. Households' spending on education showed the highest drop of -43%.

2.2 Educational Trends in Iran

Although Iran's economy has faced a lot of challenges during 1995-2006, the years before the sanctions was instituted, educational attainment and household spending on children's education have never stopped growing.[12] .

Educational attainment in Iran has improved substantially in the past four decades. Education has expanded in MENA faster than in any other region of the world (World Bank). Some countries such as Iran, Turkey, Egypt, and Jordan experienced more growth in education. In Iran, enrollment rates exceed 90% at the primary and secondary levels, comparable to that of Western countries. Thus, the youth literacy rate has increased from 56% in 1976 to 97% in 2006 (World Bank).[13]

The rapid growth in the education sector is supported by both private and public spending. The average private and public investment in education as a percentage of GDP is 5% and 4% of GDP in 2006 respectively. In the past three decades, due to the rising population of youth and the high demand for education, the Iranian government has shown a strong commitment to funding public education and promoting access to fee free public schools at all level of education.[14] However, like most Middle Eastern countries, a large share of Iranian government spending on education is allocated to post-secondary education in large urban areas.[15] Thus, public universities are high quality and free-tuition, but the number of places at public universities are limited. A highly competitive university entrance examination rations these free-tuition places at public universities.[16] The competition to succeed in school and the university entrance examination have promoted parents to use their superior means to give their children a leg up in the competition, by spending on their

[12]Over these years, Iran's economy has been under various economic sanctions. The first economic sanctions on Iran were imposed by the United States following the Iranian Revolution of 1979. US sanctions were gradually expanded to the present level with a total embargo on all bilateral trade and investment. The studies show US sanctions' economic and political effects have been insignificant (Alikhani (2000); Askari et al. (2001)). According to Hufbauer et al. (2012), the average welfare loss caused by US sanctions on Iran over the period 1984-2005 was around $80 million, less than 1% of Iranian GDP over that period.

[13]The youth literacy rate measures literacy among persons aged 15 to 24 years.

[14]The article 30 of the Constitution of the I.R. of Iran stating that "the government is obliged to provide free of charge education for all individuals up to the end of the secondary level of education and to facilitate free higher education up to achieving self-sufficiency", indicates the priorities attached to education at national level.

[15]The main reason for this allocation is that governments are very sensitive to demands of the urban middle class, and college education is very important for this group (Richards and Waterbury (1996)). Tertiary education was nearly all public until the 1980s. In 2006 about half of all university students were enrolled in public universities.

[16]Only 10% of students who take the university entrance exam, win that scholarship.

education such as sending them to private schools or hiring private tutors (Salehi-Isfahani (2012)).[17] As Figure 1 shows, Iranian households' spending on education, which is the major source of education funding in Iran, has increased by 67% during 1995-2006. Spending on primary and secondary schools tuition is a significant share of total household expenditure on education in Iran. Many of the best overall primary and secondary schools in Iran are privately funded. Parents believe that private primary and secondary schools offer a better education, an environment more conducive to learning, additional resources, and better policies and practices. Indeed, results from school final exams show that private school students averaged higher than their public school counterparts in standardized tests (Dolatabadi (1997); Rabiei and Salehi (2006)). Moreover, children who attend private schools perform better in the university entrance examination and have better academic outcomes than those in public schools.

Evidence of how the 2006 sanctions affected children's education can be found in the time series trends. While the enrollment rates did not change for primary and secondary education, the enrollment rate in the undergraduate program dropped after the sanction. According to the Statistics Center of Iran (SCI), during 2007-2013, the enrollment rates in primary and secondary school were always around 97% and 89% respectively. At the same time, the number of first-year students in four-year college decreased by 11.5% (source: Statistics Center of Iran).

Moreover, during the sanctions, the investment in children's education measured by household spending on education has decreased. Households' spending on education in average decreased by 43%. The reduction in households education spending reflects the combination of young children not attending school and parents cutting back on school expenditures, for instance, choosing free public school instead of private school. The data shows although the enrollment rates did not change for primary and secondary, the proportion of primary and secondary students who were enrolled in private schools decreased from 21% in 2006 to 10% in 2013 (source: Iranian Households' Income and Expenditures Surveys).

One mechanism by which economic sanctions may affect children education is through changes in the relative prices. In addition to the reduction in household income, rising prices decreased households' spending capacity after the sanctions. During the sanctions, prices of many commodities spiraled upwards and inflation reached 35%. However, the magnitude of this change is different across goods and services.[18] Thus, the relative prices and so the budget shares of the various commodities have changed.[19] Although education prices doubled, the changes are not as much as other commodities. Thus, the share of household spending on education has been broadly unchanged.[20]

[17] For instance, in HIES, 58% of pre-university students receive private tutoring to increase their probability of success at the university entrance examination. Such tutoring spending is a significant item in households' education expenditure (52%).

[18] In particular, the prices of tradables (typically goods) have risen significantly relative to non-tradables (typically services).

[19] The budget shares of the various commodities are related to the real total expenditure and the relative prices (Deaton and Muellbauer (1980)). Indeed, the descriptive analysis shown sanctions significantly changed the households' consumption pattern. The biggest change is related to the expenditure share allocated to food. While food prices became sixfold in 2013, since expenditure on food is necessary expenditure and unsubstituable, expenditure share on food increased by 6% (from 40% to 46%).

[20] Education Price Index (EPI) have increased in average 8% less than the overall rate of inflation.

The sanctions had no effect on public spending on education. The sanctions affected Iranian government revenue and its internal composition because on average 60% of government revenues come from oil and gas which was affected by the sanctions.[21] However, as Farzanegan (2011) shows the Iranian government only reduced the military and security spending after the sanctions. Other social spendings of the Iranian government including health and education does not show a significant response to this shock.[22]

3 Data and Identification Strategy

3.1 Data

The main data source is the Iranian Households' Income and Expenditures Surveys (HIES). This sample covers near 40,000 households every year. It is conducted yearly by the Statistics Center of Iran (SCI). These surveys which are rotating panels gather extensive data on expenditures of households. Moreover, this data contains rich information at the individual level including the individuals' demographic (such as age, gender, marital status, relation with the head of family and years of education) and households' characteristics (such as family income, parents' education, family expenditure including education spending).

The Iranian data are ideal for studying the effects of family income shock on children for two reasons. First, I can link children to their parents. Second, the HIES contains child years of schooling and comprehensive measures of family income and family education spending.[23] Education spending includes payments for books, tuition, private tutoring and donation to the school for the different level of education (pre-primary and primary, secondary, post-secondary non-tertiary, tertiary and education not definable by level).

I restrict my main sample to the households with children aged 6-24 because children start school at age 6 and most individuals complete their education by age 24 in Iran.[24] Children aged 6 who born at the start of the academic year (September 23th) or later are excluded because they are not eligible to enroll in school.

I choose my sample period to be all observations during years 1995 to 2013 (1374 to 1392 in Persian Calendar), 12 years before and 7 years after the sanctions. I exclude the years 2014 and

[21] There are two broad categories of government spending in Iran: current and capital expenditures. In detail, current expenditures include the following items: expenditures on goods and services such as wage bills of government employees, employer contribution including social security and pensions, interest payment, subsidies and all other payments which relate to the management of government functions in military, health, education, cultural, and social activities. In general, the main share belongs to defense and security expenditures followed by spending on education.

[22] Habibi et al. (2001) shows the basic social expenditures on health, education and welfare are shielded against fluctuations in oil revenues in Iran and other oil exporting countries of the Middle East. Moreover, the composition of public spending for primary to tertiary education has not changed after the sanctions. Government expenditure per student at the primary, secondary and tertiary level were always about 26%, 37% and 37% of total government spending on education respectively (source: World Bank).

[23] HIES reports detail information on labour income including permanent and non-permanent incomes, and non-labor incomes for each member of the family. HIES also reports detail information on expenditures on education according to Classification of Individual Consumption According to Purpose (COICOP) for each household.

[24] Less than 5% of students are aged above 25.

2015 when Iran and P5+1 were negotiating over the nuclear program and people would expect the sanctions to be terminated.

For the main analysis, I study households who live in urban regions of the country because there are rural-urban differences in the factors that affect educational expenditure. Computed elasticities indicate that spending on education by rural households is more sensitive to changes in income compared with urban households (see, for example, Mussa (2013)). Moreover, I do not lose too much of the sample because 75% of the population live in urban areas.

3.2 Identification Strategy

The empirical strategy to evaluate the reduction in family income generated by 2006 economic sanctions relies on a difference-in-difference approach. The first difference is over time. The second difference is across groups of households. My identification strategy uses the different severity of the effects of sanction across industries. The difference-in-difference comparison is implemented by estimating regressions of the following type:

$$Y_{ispt} = \alpha + \gamma \left(Oil_i \times Post2007_t\right) + \beta\, Oil_i + \lambda_t + X'_{ispt}\delta + \phi_p + \psi_s + \varepsilon_{ispt} \tag{1}$$

where Y_{ispt} is the outcome variable of interest (family income, family expenditure, and children education outcomes) of individual (or household) i in province p and industry s at time t. The variable Oil_i is a dummy for treatment group (equals one if household's head works in the oil and gas industry, and zero otherwise) to control for group-specific differences; $Post2007_t$ is a dummy to reflect sanctions being imposed in 2007; λ_t is a vector of time fixed effects to control for changes in macroeconomic conditions. I also add province and industry fixed effects, ϕ_p and ψ_s, to control for time-invariant local market and industry characteristics that affect family income but are not observable to me. The vector X_{ispt} is a set of individual or region specific characteristics to control for any observable differences that might confound the analysis (for instance age for estimation years of schooling). The coefficient of interest is γ which measures the effect of the economic sanctions on the treated group relative to the comparison group, using variation over time.

I define households in which the head works for the oil and gas industry as the treated group.[25] Although the sanctions affected many sections of Iran's economy, the severity is different across industries.[26] Based on detailed policy documents on the 2006 sanctions, only people who work for oil and gas industry were directly affected by the sanctions.[27] As Figure 2 shows, the average real annual income of households that the head works in the oil and gas industry decreased from 198 to 115 million Rials (decrease by 42%). The reduction in household income can be related to a decline in working hours or wage rate (or both). Figure 2 also shows the working hours have not changed

[25] There are some households in the sample with an old head that have married children older than 40 years living with them. These families consider the eldest person as the household head. However, I consider such families as extended families of grandparents. Thus, I redefined the household head as the person who earns highest monetary income, most of time same as the person reported as household head.

[26] SCI classifies industries according to International Standard Industrial Classification (ISIC).

[27] United Nations Security Council Resolutions 1696, 1737, 1747, 1803 and 1929

during the sanctions. However, the average real wage per hour in this industry decreased from 45 in 2006 to 25 thousand Rials in 2013 (decrease by 45%).

The definition of the comparison group is crucial, as it should capture counterfactual education outcome trends in the absence of the sanctions. One potential comparison group would be households in which the head works for non-oil industries. This group is not a good comparison group because workers in oil and gas industries differ from workers in non-oil industries in characteristics that are thought to be related to the potential for children's education. In fact, the pre-treatment trends of family income and education outcomes are not parallel for these two groups.

A better comparison group is households in which the head works for either water supply or information industry. As I show later, households in water supply and information industries are comparable to households in oil and gas industries for two reasons. First, these two groups have parallel trends in outcomes in the absence of the sanctions. Second, households in water supply and information industries experienced the lowest incidence of family income changes after the sanctions. Two features of these industries protect them from the sanctions. First, these industries are heavily regulated by the government. Therefore, their wages and the employment size are little responsive to the market conditions. Second, these industries are not dependent on trade, thus making them unaffected by the changes in the exchange rate due to trade restrictions after the sanctions.

To explore the dynamic impact of the sanctions, Eq (1) is generalized by replacing $Oil_i \times Post2007_t$ with a full set of treatment times year interaction terms:

$$Y_{ispt} = \alpha + \sum_{l=1995}^{2013} \gamma_l \ (Oil_i \times d_l) + \beta \ Oil_i + \lambda_t + X'_{ispt}\delta + \phi_p + \psi_s + \varepsilon_{ispt} \tag{2}$$

where d_l is a dummy that is 1 in year l and 0 otherwise. The pre-2007 interaction terms provide pretreatment specification tests, although they may capture possible anticipation effects.

3.3 Additional Considerations

The coefficient γ in Eq (1) is the DID estimate of our primary interest because it captures the average effect of the economic sanctions on the treated group relative to the comparison group. This estimation method requires several identifying assumptions. First, the key identifying assumption is that treatment and control groups have parallel trends in outcomes in the absence of the sanctions. Treatment and control groups that differ on observables should not be directly compared (LaLonde (1986); Heckman et al. (1998)). Therefore, I conducted a placebo test by allowing a placebo treatment in all years before the actual timing of the sanction implementation. I use households where the head works for different industries as different control groups. The outcome variable is the real family income. Table 1 reports the results of the Wald test ($H0 : \gamma = 0$). If the estimate is different from 0, the trends are not parallel. As this table shows, there are 12 potential control groups that satisfy common trend assumption: households which the head work in agriculture, manufacturing, water supply, construction, wholesale and retail, transportation, food service, information, real estate activities, administrative and support, art and other service activities.

Second, the sanctions could not influence control group. Based on the sanctions documents, only people who work for oil and gas industry were directly affected by the sanctions. However, sanctions indirectly affected many sections of Iran's economy through the government budget and the exchange rates because Iranian economy is highly vulnerable to revenue from oil exports. Most of those 12 potential control groups are an inadequate comparison group because they indirectly were affected by the sanctions. However, the effect of the sanctions is different across industries: (1) oil and gas industry directly affected by export and financial limitations caused by the sanctions, (2) the export-oriented industries and the industries that have foreign rivals benefit from the increase in the exchange rate as a result of sanctions (agriculture, food and all most services sectors), (3) the industries that need to import raw materials suffer from import restrictions and the increase in the exchange rate (for instance manufacturing industries), (4) the construction industry is one of the most affected industries by an oil income shocks in Iran. After oil and gas industry, construction industry was the first industry that experienced a negative growth rate of value added during the sanctions.[28] While most industries were affected by the sanctions, there were some industries that do well no matter what is happening with the economy. For instance, while workers in many industries experienced a reduction in their real wage, the wage of workers in water supply and information industries have not changed (Figure 3). At the same time, workers in oil and gas industry experienced a large and persistent shock to earnings. Moreover, as Table 2 shows in the absence of the sanctions, trends in family income, family expenditure and education outcomes (enrollment rate and years of schooling) are parallel for these two groups (oil and gas industry as the treated group, water supply and information industries as the control group). Thus, the group of households in which the head works in water supply and information sectors is an adequate comparison group.

Third, there is no anticipatory effect. If the economy responds to the sanction before its implementation, the estimated effects could, at best, serve as a lower bound. As I mentions in the Section 2.1, since UN Security Council did not show any action after ultimatum on stopping Iran's nuclear program in August 2006, imposing the sanction in December 2006 was unexpected. I estimate Eq (2) and the result suggests no anticipatory effect. The estimates γ_l are all statistically insignificant for years before 2007.

Fourth assumption is that there is no unobserved group specific changes that (1) are correlated with the sanction change and (2) are correlated with group specific changes in the outcome variables. All observations are clustered at province (29 provinces) and year (19 years) level (348 clusters) to account for correlation within observations across time, which may result in an underestimation of standard errors.

Table 3 reports summary statistics for the full sample and separately by treatment status, as well as tests of treatment-control balance. The variables overall are well balanced between the control

[28] The average growth rate for oil value added is -6.4% during the years of the sanctions. The growth rate in this sector has reached an all-time low of -37% in 2012. The average growth rate for agricultural value added and service value added are 4.6% and 3.7% respectively during the years of the sanctions. The value added of manufacturing industries decreased by 8.5% and 4% in 2011 and 2012 respectively. Although, at first, the 2006 sanction was a positive shock on the construction industry, the growth rate for construction value added became -3.2% in 2009 and remained at this level until 2013.

and the treatment groups. Although households in the treated group used to be richer before the sanctions, the trends were parallel. Formal tests suggest that randomization was successful: the p-value for the F-test that characteristics jointly predict treatment is 0.89. Tests for each individual baseline covariate also do not reject equality of means for treatment and control groups (column 4).

Another identifying assumption is that adding control variables on the right hand side of the regression do not affect the coefficient of interest much. This assumption is confirmed if the estimated effect of interest is insensitive to the control variable addition (coefficient comparison test). As Pei et al. (2018) show, a more powerful test of the identifying assumption is to put the control variable on the left-hand side of the regression (Eq (1)) instead of the outcome variable (balancing test). A zero coefficient on the causal variable of interest then confirms the identifying assumption. Table 4 reports the estimated coefficient γ of balancing test for all control variables (X) including parent's education, age, etc. As the results show, the coefficient of interest (γ) is not significantly different from zero. Thus, the balancing test is successfully passed. Moreover, these results show the selection does not change differentially in terms of gender, age, family size, head's education, and employment status of mother and father.

4 Results

First, I document the direct impact of the 2006 economic sanctions on family income. I then analyze the indirect effects of the sanctions in terms of children education. For all specifications, I report the results estimated using OLS regressions. Standard errors are adjusted for clustering at the province and industry level.

4.1 Effect on Family Income

I first examine how the sanctions affected family income. To do so, I look at the effects on total family income as well as labor market earnings, wage rate, and employment. UN sanctions targeted investments in and exports of oil, gas, and petrochemicals. As a result, crude oil exports have declined from 2.5 million barrels per day to less that one million in 2013. This change could potentially affect the income of workers in oil and gas industry through unemployment, inflation and falling wages.

As Table 5 reports, labor income and total income of families that the head works in oil and gas industry decreased by 13% and 10% respectively. Columns 3 shows the real wage rate in oil and gas industry had decreased by 12% after the sanctions. In fact, nominal wage rate had increased in oil and gas industry but it had not been synchronized with the rate of inflation. There is no significant effect on working hours (Columns 4). This reduction in income is independent of worker's abilities since it is due to a shock in the economy whose effects does not depended on skills and abilities.

Table 6 shows the effect this negative income shock on household expenditure. As Table 5 shows, the total income of families that the head works in oil and gas industry decreased by 10%. Consequently, they reduced the total spending by 5%. Although spending decreased for most components,

it did not decrease by the same rate. As Table 6 shows, households cut spending on education by 61%. Moreover, spending share on education decreased by 0.7%.

4.2 Effect on Children's Education

The reduction in education spending reflects the combination of young children not attending school and parents cutting back on school expenditures, for instance, parents may choose free public school instead of private school for their children.

I measure education outcome using enrollment rate, completed years of education and education spending. The sample consists of all children aged 6-24 over the period 1995 to 2013. Children start school at age 6 and most individuals complete their education by age 24 in Iran. Less than 5% of students are aged above 25. I exclude children age 6 who born at the beginning of the academic year (September 23th) or later because they are not eligible to enroll in school.

4.2.1 Effect on Enrollment and Years of Schooling

First, I find the impact of the reduction in family income on the educational attainment measured by the enrollment rate and years of education. Table 7 presents the effects on school enrollment in primary school and high school,[29] and attending any college.[30] As panel A of Table 7 shows, the probability of attending college significantly decreased by 8.7% after the sanctions. I Also find years of schooling significantly decreased by 0.2 years after the sanctions (panel A, column 4 of Table 7). I compare my results to current literature and the overall effects on current generation to find how bis these negative effects on children's education are. This reduction is large compared to other studies which have found positive effects of family income. I find that a 10% decrease in family income is predicted to decrease college enrollments by 8.7 percent. Acemoglu and Pischke (2001) find that a 10% increase in family income increases college enrollments by 1-1.4 percentage points. Bulman et al. (2016) find the modest per-dollar effects of a positive income shock caused by lottery. They find the relationship is weakly concave, with a high upper bound for amounts greatly exceeding college costs. They also find the effects are smaller among low income households because lump-sum transfers are more likely to be spent on durable e.g housing. My results are also larger compared to the results of existing studies that exploit persistent income shocks generated by, for example, tax credit and job loss. for example, Hilger (2016) finds a father's layoff reduces children's college enrollment by less than half of one percentage point, despite dramatically reducing current and future parental income (by 14% initially and 9% after 5 years). He explains that much of reduction in parental spending on education may be offset by greater financial aid. Such financial aids e.g., collage loans are not available to Iranian children. Therefore, the large effects estimated in this paper are expected because of the persistent shock and lack of adjustment possibilities to the income shock. The sanctions have no significant effect on enrollment in primary school and high school.In Iran, education is compulsory until the end of high school one or grade 9. Therefore,

[29] The sample for this analysis is children of the age group that officially corresponds to each level.
[30] The sample for this analysis is high school graduates.

nonsignificant effect on enrollment in primary school can interpret as the falsification test, because this group of children attend school anyway. Moreover, in panel B, I investigate gender differences. The results show the effects are not different across gender.

I consider a simple back of the envelope calculation to understand the economic significance of these results. Children growing up after the imposition of sanctions may have lower earnings throughout their adult lives. Sanctions can affect the lifetime income of the next generation through two channels: lower wage rates and lower education levels. To find the children's earnings loss due to the sanctions, I compare the present value of future lifetime earning of children with and without the sanctions.

$$I_j = \sum_{t=0}^{T} \beta^t (w_j^H Income_{tj}^H + w_j^C Income_{tj}^C) \quad , j = s, ns \tag{3}$$

where I_s and I_{ns} are children's lifetime earning with and without the sanctions respectively. w_j^H and w_j^C are the percentage of children with a high school or less and the percentage of children with university degree. T is the number of working years and β is the discount rate (0.95). I do not observe $Income^H$ and $Income^C$ (real annual income at different ages for high school graduates and college graduates) because these children who are affected by the sanctions are not yet old enough to directly measure their earnings. Children's future annual income may be imputed from the information on children's levels of education, using the relationship between earnings and education in observed data. I consider different scenario for their income: (i) median/average of (all/oil and gas) workers' income in the last year of sanctions (year 2013),[31] and (ii) median/average of (all/oil and gas) workers' income before the sanctions (year 2006).[32] Since HIES is a cross-sectional survey, I observe single-year measures of the earnings. Short-run measures of workers' earnings include both measurement error and transitory fluctuations in earnings. Thus, I select a period to observe the representative-workers when their earnings are most likely to accurately reflect permanent earnings, ages 30-50 (the prime earnings years). Similarly, I estimate the present value of lifetime earning of current generation employing the annual income before and after the sanctions to find parents' earnings loss.

The first exercise is to calculate what the expected magnitude of the children income would be if the sanctions had not been imposed. As mentioned before, the sanctions can affect the lifetime income of the next generation through two channels: lower wage rates and lower education levels. To find the total effect, I compare the case where college enrollment rate has decreased, and the real income is constant at its lowest value in the last year of sanctions (year 2013), to the case where children were able to enroll in college at the same rate as college enrollment in the year 2006 (before the sanction), and real income equals to its highest value in the year 2006. A back of the envelope calculation shows a 41% reduction in children's lifetime earnings. I also decompose the total effect of the sanctions on the children lifetime income into the sole effect of the reduction in

[31] For this scenario, I assume the wage rates cannot recover after the lifting sanctions.

[32] For this scenario, I assume the wage rates will recover after the lifting sanctions.

education levels and the sole effect of the reduction in the wage rates. My calculation shows the reduction in college enrollment rates will decrease children's future lifetime earnings by 3-4%. A similar calculation shows the reduction in wage rates will decrease children's future lifetime earning by 38%.[33]

It is also interesting to ask, how large is the children income loss in economic terms? One way to assess the size of this loss is to compare it with earnings loss of the current workers due to the sanctions, and real GDP. My calculations suggest that a one dollar reduction in parents' permanent earnings leads to a subsequent reduction in children's earnings of 1.2 dollars.[34] I also find that the costs to the society associated with the reduction in earnings after the implementation of the sanctions total about 18% of GDP. 45% of this reduction comes from decreased earning for the current workers, and 55% comes from decreased earning for the next generation. It suggests that the cost estimates using only earnings of current generation may only capture less than half of the overall cost.

There is, however, some potential drawbacks of this method. First, this procedure relies on the assumption that cohort effects on the earnings profile are minimal. Second, this simple calculation ignores individual characteristics that can affect children's earning.

4.2.2 Effect on Education Spending

So far, I have looked at the educational attainment measured by the enrollment rate and years of education. Now, I examine the effect of the reduction in family income on investment in children's education measured by household spending on education.[35] The education spending is the explicit costs associated with payments in cash such as books, school tuition, donation, tutoring, university tuition and other education expenditures (for instance extra classes). Based on HIES, before the sanctions, the average percentage of family educational spending was about 3%.[36] The school tuition fee constituted a significant proportion of total education costs (20%). Table 8 shows the share of education spending to each item before the sanctions for the full sample and separately by treatment status, as well as tests of treatment-control balance. The variables overall are well balanced between the control and the treatment groups.

[33] If children were able to enroll in college at the same rate as college enrollment before the sanction, but the wage rates decrease from the rate in 2006 to the rate in 2013.

[34] This effect is larger to previous studies. Oreopoulos et al. (2008) using Canadian data find that a one dollar reduction in father's permanent earnings due to a job loss leads to a subsequent reduction in his son's earnings of 66 cents. One possible reason for this difference is that previous studies looked at cases that affect the lifetime income of the next generation only through a reduction in the education levels. In the case of Iran, the economic condition, e.g., wage rates have also changed after the sanctions. Moreover, as Grawe (2001) shows the intergenerational earnings mobility in the developing countries is larger because of the larger credit constraints.

[35] While the effect of high-quality education on the returns to schooling and economic growth is well known (Castelló-Climent and Hidalgo-Cabrillana (2012)), previous research has largly focused on children's educational attainment.

[36] For Canada and UK, the percentages were about 1.1 and 1.2% respectively in 2009. Furthermore, according to Huston's study (1995) using 1990-1991 Consumer Expenditure Survey for the US, the household educational expenditure consisted of about 1.95% of total household income. For the 25 EU countries, the private expenditure on education as a percentage of total household consumption during 1995-2004 ranged from 0.1 to 2.9%. The average was about 1% (Lin and Lin (2012)). The share of education expenditure in household expenditure is 4.3% in all India (Azam and Kingdon (2013)).

Table 9 presents the effect of the sanctions on education spending (it includes zero education spending for the non-enrolled children). As this table shows, households spent less on school tuition, books and private tutoring after the sanction. Column 1 shows spending on school tuition significantly decreased by 60%. This finding indicates households respond to the sanctions by substituting away from higher-quality private schools towards lower-quality public schools for their children. Moreover, households spend 22% less on books after the sanctions. Also, spending on private tutoring decreased by 76%. The second Column of Table 9 shows the effect of the sanctions on the share of each item in the total household expenditure. The percentage allocated to school tuition significantly decreased by 0.4%.

I also test the effect of the sanctions on the education spending per child. The decline of fertility in Iran over past decades can explain the reduction in household education expenditure. The decline of fertility drives the number of students in households to fall. The average number of students in household declines from 1.7 in 1995-2006 (before the sanctions) to 1.2 in 2007-2013 (after the sanctions) period. The average number of children in households who are enrolled in elementary and high schools also shows a decrease from 1.6 to 1. However, the average number of college students in household shows an opposite trend and increases from 0.14 to 0.25. In other words, the average number of college students is not affected by the recent decline in fertility. Column 3 and 4 of Table 9 present the results for education spending per child. For school tuition, the sample consists of all children aged 6-24 who have not graduated high school. For university tuition, the sample consists of children aged 6-24 who have graduated high school. For spending on books and private tutoring, I have considered all children aged 6-24. As column 3 and 4 of Table 9 show, the spending on school tuition for each child significantly decreased by 57% and the percentage allocated to school tuition of each child significantly decreased by 0.2%. Moreover, the percentage allocated to books for each child significantly decreased by 13%.

Although college attendance significantly decreased after the sanctions, as Table 9 show, there is no significant effect on the university expenditure. The baby boom in the 80s can explain it. The population of this group has increased as the result of the baby boom in the 80s. The percentage increase of population of this group was greater than the increase in the population college students. Thus, the enrollment rate has decreased. However, since the number of college students in households has increased, the household spending on university has not changed.

4.2.3 Income Elasticity of Education Spending

To compare these negative effects on education spending to the current literature, I calculate the income elasticities of education spending, allowing the elasticities to vary across industries. I use the Tobit model for specification of an Engel curve formulation for household education spending. Education spending has the value of zero for a number of households. Thus, it is censored at zero. The OLS method, which assumes that the dependent variable is normally distributed, is inappropriate in this case. I also use total family expenditure as a proxy for family income for two reasons. First, total expenditure is considered to reflect permanent income better than income itself.

Second, it is believed that there are less errors of measurement in total expenditure than in income. I estimate the following equation:

$$lnEdu\_exp_{ipt} = \delta_i + \delta_p + \delta_t + \alpha Z_{ipt} + \xi lnTotal\_exp_{ipt} + \varepsilon_{ipt} \tag{4}$$

where i denotes family, p denotes province, and t denotes time. Edu_exp_{ipt} is household education spending and $Total\_exp_{ipt}$ is total household expenditure as a proxy for family income. The vector Z_{ipt} is a set of family specific characteristics that are correlated with both educational spending and income like parents' education. ε_{ipt} is a family specific error term. Since education spending and total household expenditure are both in logarithmic form, ξ denotes elasticity.

Table 10 shows the maximum likelihood estimation results of the Tobit model of education spending (the unconditional marginal effects). I find that income elasticities are significantly greater than one for the overall sample. The null hypothesis that the elasticity coefficients is equal to one is rejected. Thus, as total expenditure decreases, education spending decreases more rapidly than total expenditure, indicating that education is a luxury item in the households' budget. The results also show that the income elasticity of education spending increases over time, indicating that households allocates smaller share of their budgets to education spending. This negative effect on education spending is greater for households in the oil and gas industry. While income elasticity of education spending used to be around one before the sanction, it has increased to more than two after the sanction for households in the oil and gas industry. Therefore, education became more luxury after the sanctions. Expectation can explain this change. Before the sanction, changes in the household's income were small. Thus, people may consider them as temporary shocks. Sanctions caused a large reduction in the household's income, so people may expect the shock last longer and consider it as a permanent shock.

This negative effect on education spending is large compared to studies which have found the income elasticity of education spending (Qian and Smyth (2011); Huy (2012); Acar et al. (2016)). The findings of these studies suggest that the income educational expenditure elasticity is different across countries, level of family income, and other household characteristics such as parents' occupation. However, most of these studies find that the income elasticity of education expenditure is significantly less than one implying that education is a necessity item. For those group of household that education expenditure is a luxury good, income elasticity is less than two.

Overall, after the sanctions, both the educational attainment (measured by enrollment rates and years of schooling) and investment in children's education (measured by family education spending) have decreased. First, the reduction in family income generated by the sanctions decreased the probability of attending college. Therefore, the years of schooling decreased. Second, spending on school tuition significantly decreased that suggests households respond to the reduction in their income by switching their children from higher-quality, more expensive private schools to lower-quality, free public schools. Reduction in children's education will reduce their future earnings such that affected children will experience a larger decline in their earnings than their parents.

5 Robustness Checks

I now consider several robustness checks of the main results. I first analyze whether considering different periods (1995-2015) and excluding years 2007 and 2009 affects the results. Then I compare the results with and without control variables. My results pass these robustness tests (see the online appendix). Finally, I discuss whether the estimated effects are related to the sanctions or other changes in economic and political factors.

Some may argue that the end of sanctions was expected by Iranian people especially when Iran and P5+1 started negotiation over the nuclear program in 2013. Given this concern, I re-conduct the analysis using a different period. For the main analysis, I restrict the data to 1995 and 2013 and exclude the negotiation years, 2014 and 2015. I reproduce my benchmark exercise including 2014 and 2015 and found the signs of the coefficients and significance are all the same. I also consider the robustness of my results by excluding years 2007 and 2009. First, I exclude the first year of the sanctions, the year 2007, because Iran could have come up with some ways to avoid sanctions after the first year when sanctions imposed unexpectedly. The results are not sensitive to this change. Second, I exclude 2009 because the Iranian economy was affected by the presidential election in 2009. The signs of the coefficients and significance are all the same. The election results are not likely to change the long run economic trend largely because Ahmadinejad's policies in the second term were similar to his policies in the first term.[37]

Finally, I performed an analysis excluding covariates altogether to compare the results with and without control variables. The idea is that if the results are unaffected this would to some extent confirm how successful the randomization was. The outcome of this exercise is not significantly different from the baseline model.

Other Factors

To make sure the estimated effects are solely due to the sanctions, I check whether there were other changes in economic (including oil price changes and workers' movement) or political factors that affected the treated and control groups differently.

First, I discuss two events (Great Recession and oil price changes) that can affect the time trend of the treated and control groups differently. While the sanctions period (2007-2013) includes the Great Recession of 2008-09, Iran has felt few effects from the global recession because Iran has been a closed economy due to economic sanctions. The other important factor is oil prices. The Iranian economy is highly vulnerable to oil price fluctuations (Farzanegan and Markwardt (2009); Berument et al. (2010)). However, during sanctions oil prices were steadily increasing, except for a spike followed by a sharp drop in 2008 from 130 USD to 40 USD per barrel. Otherwise, the prices were relatively stable between $50 and $80. Thus, I assume that there are no large events that affect

[37] The election period ended on June 12, 2009, when the incumbent president Mahmoud Ahmadinejad won the election for the second time. The election results were upsetting to many people in Iran, who had supported opposition candidates and resulted in large-scale protests. However, the major turbulence caused by the protests had ceased by December 2009.

the time trend of the sample groups differently.

Another key assumption for identification is that the comparison group consists of the same members before and after the sanctions. This assumption is necessary so that if any trend change occurs between groups, I can attribute the deviation from the time trend to the effect of the sanctions, not to the change in the composition of the group members. Workers movement across sectors could bias estimates of sanctions effects obtained by comparing outcomes according to the family's head economic activity (Rosenzweig and Wolpin (1988)). To examine if this assumption is violated, I check whether the sanctions significantly affects moving workers within industries. As mentioned before, the 2006 UN sanctions mostly affected the oil and gas industry. Since real wage decreased in this industry, it is possible that the workers in oil and gas industry leave their job and move to other industries.

To provide evidence on the impact of the sanctions on labor composition, I use Iranian Labor Force Survey (ILFS) from 2005 to 2013, a rich and large data set provided by the Statistical Center of Iran. The advantage of ILFS data is that it provides some information about the former job of unemployed individuals. In particular, the ILFS offers detailed information about the respondents' demographic characteristics, labor supply, residential area, recent migration, the current job for employees, previous job and reasons for leaving for unemployed. The data are repeated cross sections that have been collected on the same reference population under rotating panel design. The ILFS collects the data on over 400,000 individuals quarterly using random sampling. Using this data, I look at changes of four variables: the employment share of each industry, the percentage of unemployed individuals who used to work in each industry, average skill of workers in each industry, and average skill of unemployed individuals who used to work in each industry. The employment shares remain the same before and after the sanctions. In particular, the share of the oil and gas industry of total employment was always about 0.6%. Also, the share of the water supply and information industries were always about 0.32% and 0.55% respectively. I also check the average and distribution of years of schooling of workers (as a proxy for workers' skill) in each industry. As Table 11 shows, the average years of schooling has not changed over time across treated and control groups. Unfortunately, I cannot observe the former job of an employed person. However, I can observe the former job of an unemployed person and reason of the leaving job (low income, getting fired or layoff, the company went out of business, family circumstances, temporary job, position ended, going back to school, illness, relocating, retiring, etc). The percentage of unemployed individuals who used to work in the oil and gas industry has not changed during the sanctions years. Only 7% of these unemployed individuals have left their job because their income was low and this percentage is constant over time (years before and after the sanctions). Moreover, I check the average and distribution of education of unemployed individuals who have left their job in different industries. As Table 12 shows, the average years of schooling has not changed over time across treated and control groups. High rate and duration of unemployment can explain why workers did not move from the oil and gas industry to other sectors. During the sanction years, the unemployment rate was high (more than 10%) and increasing, and duration of unemployment after losing a job was one year on average. Moreover,

different skills needed among industries is another obstacle for the labor movement. In fact, Iranian labor market was sticky even before the sanction. Thus, the sanctions effects on labor movement are ignorable and most of the members in the treated and control groups remain the same.

Finally, I show during the sanction years no major political changes took place. As Borszik (2016) shows, although sanctions have contributed to elite infighting in Iran, they have not weakened the targeted regime. The ultimate arbiter of Iranian politics and the person responsible for setting the national course is the Supreme Leader. Moreover, from 2005 to 2013, Ahmadinejad was the president who had adopted same policies during these years. These policies were consistent with the Supreme Leader strategic preferences. Shortly after taking office, Ahmadinejad requested the International Atomic Energy Agency (IAEA) to remove its seals from Iran's nuclear facilities, announced the resumption of uranium enrichment activities. These steps led to the initiation of the economic sanctions (Meier (2013)).

Although there were no major changes in Iran's policies between 2005 and 2013, sanctions led to some political changes in 2013. Impressed by the economic impact of the sanctions, the political elite agreed on the necessity of revising the defiant nuclear strategy and reversing the undesirable economic decline. The outcome of the presidential elections in June 2013 was the victory of the moderate Hassan Rouhani. In his campaigning, president Rouhani pledged to improve the economy and unemployment, and as a former nuclear negotiator, he said he would reduce the high tension between Iran and the outside world by addressing sanctions related to Iran's nuclear program. President Rouhani and his team have succeeded in finalizing the interim nuclear deal.

6 Heterogeneous Effects of the Economic Sanctions

In this section, I examine whether the effects of 2006 economic sanctions are heterogeneous across different contexts (by age, family financial resources, and structure). The estimates results in Section 4 show the average impact of the sanctions. However, these effects could also be heterogeneous across demographic groups. Finding heterogeneous effects is important to understand the distribution of the costs associated with the sanctions. Thus, I can determine the groups of children who are more vulnerable to the changes from the sanctions.

Table 13 presents estimates of effects of the sanctions on the enrollment rate by crucial ages. Age plays an important role in the enrollment. The crucial ages for children's enrollment/dropout rates are at the entrance to the first grade (6 years old), high school dropout age (16 years old) and matriculation at a university (18 and 19 years old). As this Table shows, the economic sanctions increased the probability of dropping out from high school. The enrollment rate of children at high school dropout age (16 years old) decreased by 12%. Moreover, the economic sanctions decreased the probability of attaining college at age 18 and 19 by 37%. Lack of access to financial resources for post-secondary education prevents marginal students from making such investments (Bound and Turner (2007); Zimmerman (2014)). Consequently, some students may perceive a reduced benefit from a high school degree if they are unable to access post-secondary education.

To further explore heterogeneity in the effects of the sanctions, individuals are grouped based on their family financial resources (as measured by total family income and family nonlabor income). Then Eq (1) is estimated separately for each group. Table 14 presents the results of these estimations. As this table shows, only children from low income families experienced a reduction in the years of schooling. Children from the 25th percentile (in total family income and non-labor income) experienced 0.5 years decrease in years of schooling. This effect is not significant for children from middle and high income families. I also find parents of children from middle income families (in total income and non-labor income) spent less on their children's education by 72% and 88%. The effect is not significant for children from low and high income families. Low income families are less likely to spend money on education even before the sanctions, for example most of these children go to public schools.[38] Overall, children from low income families are more affected in term of the educational attainment and children from middle income families are more affected in term of investment in education. The sanctions have no significant effect on the education of children whose family rank above the 75th percentile.

I also look at the effect by mother's employment and income. There are numerous ways that maternal employment may affect children's education. First, maternal working brings more income to the family, which can be used to spend for children's education. Second, mothers who have income have more bargaining power on the decision regarding the children's education. Third, maternal employment may increase children's education if working mothers serve as role model. Last, all else equal, a working mother will spend less time with her child than one who does not work. Depending on the quality of mother-child time together and the quality of the alternative, this may either improve or decrease child's education. To explore this heterogeneity, I estimate Eq (1) separately for individuals in different groups based on their mother's employment and income. Table 15 presents the results of these estimations. As the first and second columns show, for children whose mother is not employed, school enrollment and college attendance decreased by 4.5% and 24% respectively after the sanctions. I also find a 45% reduction in education spending among this group of children. The effect of sanctions is insignificant on the education of children whose mother has a job. Since mothers can have income from others sources than wages and salaries, in the two last columns, I show the effect of mother's income on children's education. The results are the same: for children whose mother's income is zero, school enrollment and college attendance decreased by 4.5% and 24% respectively after the sanctions. Moreover, education spending decreased by 41%. The effect of sanctions is insignificant on enrollment of children whose mother has a positive income.

In sum, the sanctions had a negative effect on children's education, and the effect is larger for children at crucial ages, children from low and middle income families, and children's whose mother has no income.

[38] While middle and high income households spent an average of 26 (2% of their total consumption) and 83 (3%) thousand Rials on education in 2006 respectively, households in the lowest income quintile spent only 4 thousand Rials on education (0.4% of their total consumption).

7 Mechanisms behind Sanctions

In this section, I explore the mechanisms by which economic sanctions may decrease investment in children's education. The sanctions affect children education through changes in demand side (labor income and relative prices) and supply side of schooling (government budget). As is discussed in section 2, the sanctions had no effect on public spending on education.[39] Moreover, although education prices doubled, the changes are not as much as other commodities. Education Price Index (EPI) have increased in average 8% less than the overall rate of inflation.

One mechanism by which the sanctions affect children education is through labor income. As explained before, the sanctions targeted Iran's oil and gas industry. Therefore, the growth rate in this industry has reached an all-time low of -37% in 2012.[40] As a result, labor earnings decreased in this industry. The changes in labor income may affect investment in children's education through two channels: family budget constraint and changes in returns to education.

First, labor income shocks may affect children's education through family budget constraint. In influential work, Acemoglu and Pischke (2001) provide theoretical and empirical support for the idea that parental resources might matter for education decisions because of credit constraints, or because education is, to some degree, a consumption good rather than a pure investment good. Because children are dependent on others, they enter or avoid poverty by virtue of their family's economic circumstances. Children cannot alter family conditions by themselves, at least until they approach adulthood. Reduction in family income after the sanctions may have made it harder for children to attend school. However, as it explained before, households might can adjust this shock to mitigate the impact of sanctions on children. For example they can draw down savings or sell off assets to smooth consumption in response to a negative income shock (Deaton (1992); Browning and Lusardi (1996)). However, if sanctions increased uncertainty about future income, households consume less and save more (Sandmo (1970)). I estimate Eq (1) for family savings and investment,[41] debt and non-labor income.[42] I find no significant effect (Table 16). Thus, there is no evidence that sanctions changed family saving.

Second, labor income shocks may affect children education by decreasing returns to education, a theoretical possibility explored formally by Eckstein and Zilcha (1994). In the standard economic model, the accumulation of human capital is seen as an investment decision, where the individual gives up some proportion of income during the period of education and training in return for increased future earnings. Individuals will only undergo additional schooling if the costs (tuition fees and forgone earnings) are compensated by sufficiently higher future earnings. Thus, optimal

[39] Although the sanctions decreased Iranian government budget, the Iranian government only reduced the military and security spending after the sanctions (Farzanegan (2011)). Other social spendings of the Iranian government including health and education does not show a significant response to this shock.

[40] The average growth rate for oil value added is -6.4% during the years of the sanctions.

[41] The family savings and investment are not reported in HIES. I calculate the summation of savings and investment by subtracting total consumption from total family income (savings+investment=income-consumption).

[42] The non-labour income of each member of a household includes financial transferred aids, real estate incomes, subsidies, interest on bank deposits, bonds yield and share dividends, scholarships and cash gifts from others. I have considered the summation of all members' non-labor income as the family non-labor income.

investment in children's education requires that parents take into consideration the income gain to their children due to their education. Falling labor income due to economic sanctions affects the returns to education.

I find that college attendance and years of schooling significantly decreased after the 2006 economic sanctions. My finding is consistent with the literature documenting a connection between family income and children's education(Acemoglu and Pischke (2001); Blanden and Gregg (2004); Akee et al. (2010); Løken (2010); Coelli (2011); Lovenheim (2011); Lovenheim and Reynolds (2013); Pan and Ost (2014); Bastian and Michelmore (2018); Bleakley and Ferrie (2016); Hilger (2016); Manoli and Turner (2018)). My results complement these studies by showing that family income shocks related to economic sanctions have a causal impact on investment in children's education.

8 Conclusion

This paper analyzes the impact of the family income on investment in children's education. While there is substantial evidence on the positive effect of parents' financial resources on children's education, the size and causal impact are subject to disagreement. This paper seeks to fill the gap by examining the effects of a large and persistent reduction in households' income caused by the UN economic sanctions against Iran on children's education. The targeted sanctions were associated with large, sudden reductions in households' income that last for seven years.

Relying on a difference-in-difference approach and using a sub-sample of data on the Iranian Households' Income and Expenditure (oil and gas industry as the treated group, water supply and information industries and the control group), the empirical analysis suggests that the family income shock had a significant negative impact on children's education. The analysis reveals two findings. First, the sanctions decreased children's probability of attending college by 8.7% and years of schooling by 0.2 years. Second, households reduced expenditure on children's education by 61% - particularly on expenditure for school tuition. This finding indicates households respond to the reduction in their income by substituting away from higher-quality private schools towards lower-quality public schools for their children. The sanctions impact on children's education is larger than implied by the income elasticity estimates from the previous literature likely because sanctions have persistent effects on parent income. Overall, after the sanctions, both educational attainment and investment in education have decreased. Reduction in children's education will reduce their future earnings (by 41%) such that affected children will experience a larger decline in their earnings than their parents.

This paper also investigates the cause of the heterogeneity. I find that the negative effect of the sanctions on children's education is larger for children at crucial ages, children from low and middle income families, and children's whose mother has no income. First, the enrollment rate of children at high school dropout age (16 years old) and matriculation at a university (18 and 19 years old) decreased by 12% and 37% respectively. Second, I find parents of children from middle income families spent less on their children's education by 72%. The effect is not significant

among children from high income families. Third, while the effect of sanctions is insignificant on the education of children whose mother has income, there are negative effects on school enrollment, college attendance, and education spending among children whose mother has no income.

This paper completes the literature on the effect of family income on children's education. I find larger effects compared to previous studies because the income shock is persistent and large. Moreover, other financial resources had not been available to children during the years of sanctions. This paper also adds to the literature documenting the negative effects of economic sanctions by estimating the effects on the next generation. Current studies show the negative effects on economic growth and the living standards and humanitarian situation of the civilian population. In the case of Iran, Iran's economy got 15 to 20% smaller than it would have been absent the sanctions (U.S. Treasury Secretary Jacob Lew report, 2015). Moreover, previous studies find adverse impacts of the 2006 UN sanction on the current generation by showing a reduction in the total welfare level of final consumers (Ezzati and Salmani (2017)) and public health (Karimi and Haghpanah (2015)). My results go beyond these studies and show that economic sanctions have long lasting consequences on children's well-being even after they are lifted by a reduction in children's education. I find that the costs to the society associated with the reduction in earnings after the sanctions total about 18% of GDP. 45% of this reduction comes from decreased earning for the current workers, and 55% comes from decreased earning for the next generation. It suggests that the cost estimates using only earnings of current generation may only capture less than half of the overall cost. The estimates presented in this paper suggest that although economic sanctions against Iran was successful in term of political goals, such negative effects on human development are not ignorable. The effect of sanction on children's education depends on the context and severity of the sanctions and how government and households cope with this shock. However, establishing this potential negative shock to human development can edify future policy regarding the use of the economic sanctions.

There are several worthwhile directions for future research. First, a structural model incorporating different features of the sanctions may offer other policy counterfactual implications. Second, estimating the impacts of the lifting sanctions on children's education using the data for years after the lifting of the sanctions would be interesting. The households' responses to positive and negative changes in income may be asymmetric. Third, it would be fruitful to estimate the long term effects of the sanctions on labor market outcomes of affected children.

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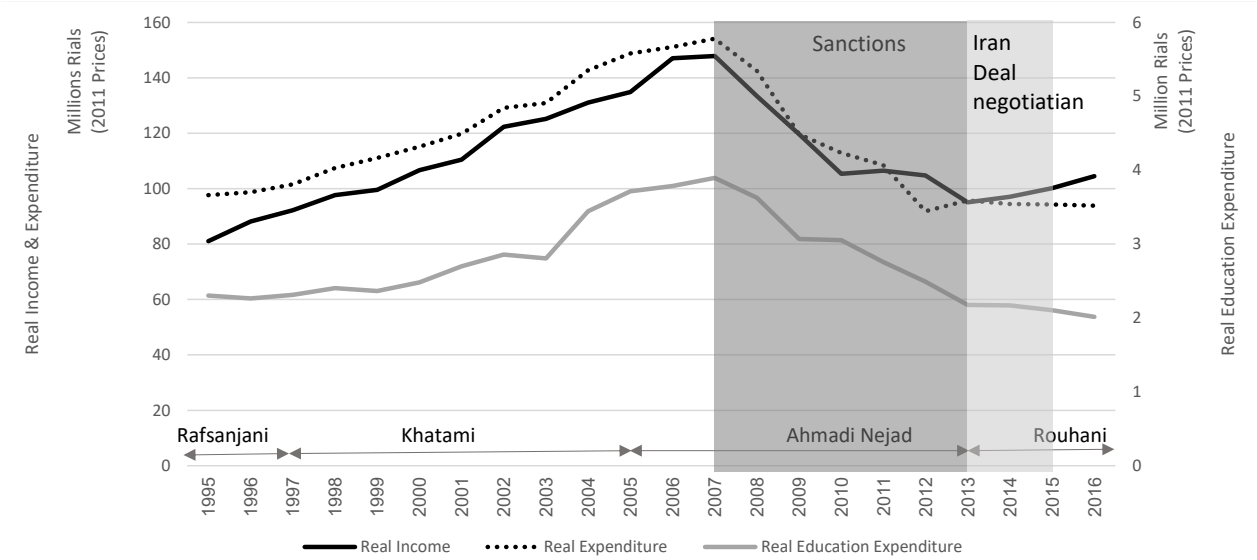
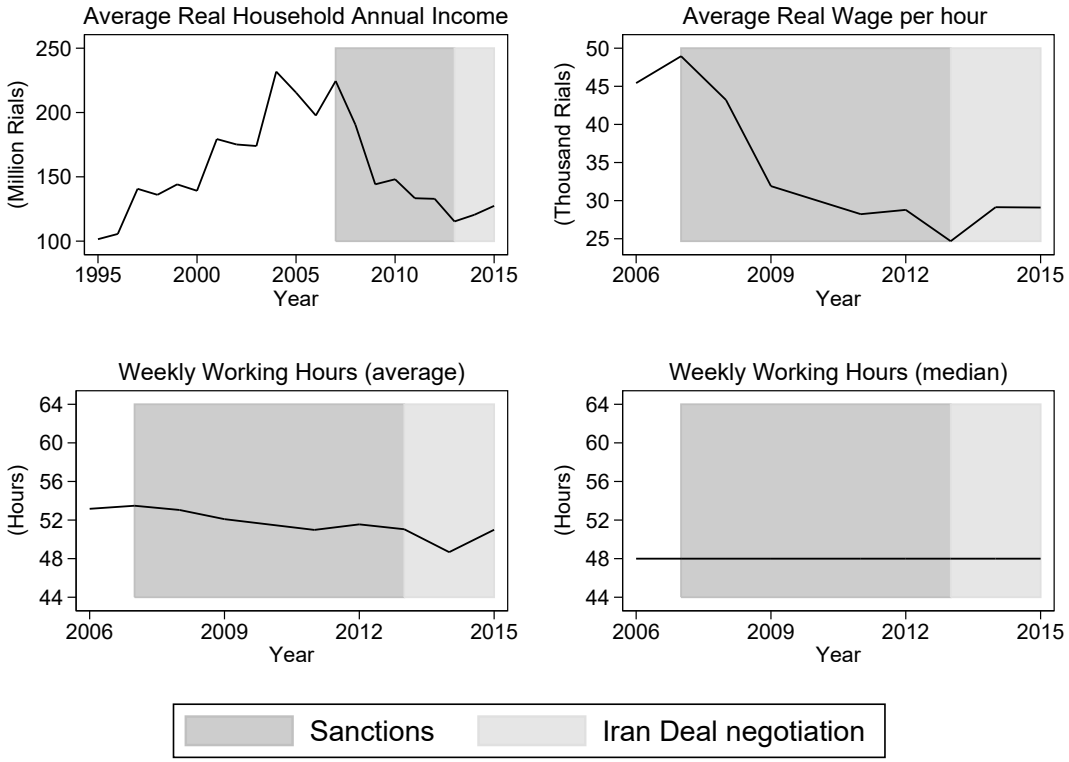
A Figures

Figure 1: Average Real Income, Expenditures and Education Expenditures for Iranian Household



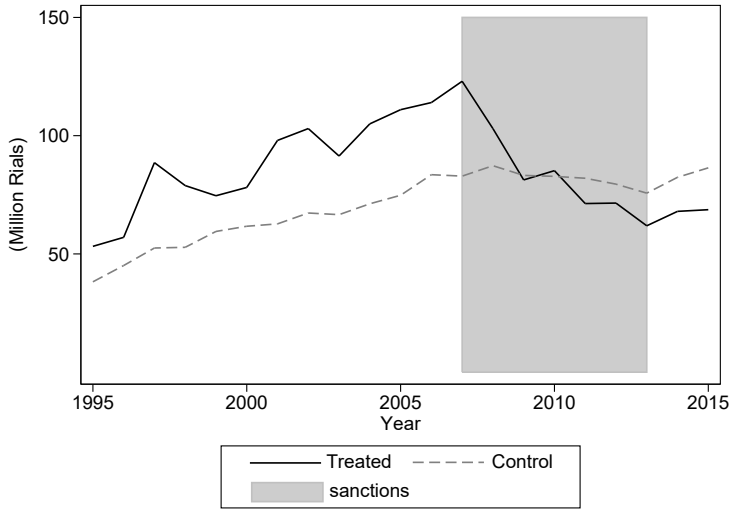
Note: Figure shows the decreases in average real annual income, expenditures and education expenditures for Iranian household during the economic sanctions.
Source: HEIS 1995-2015 data by Statistics Center of Iran

Figure 2: Household Income, Wage Rate and Working Hours in Oil and Gas Industry



Note: Figure shows the reason of reduction in household income is a decrease in average wage rate in the oil and gas industry. The average real income of households that the head works in the oil and gas industry decreased from 198 to 115 million Rials (decrease by 42%). The average real wage per hour in this industry decreased from 45 in 2006 to 25 thousand Rials in 2013 (decrease by 45%). At the same time, the average working hours was constant around 50 hours per week. Moreover, Median of working hours was always 48 hours per week.
Wage rate and working hours were not asked before 2006.
Source: My calculations, based on HIES

Figure 3: Real Wage and Salary Income



Note: Figure shows the trends in head's real wage and salary income over the sanctions among Oil and Gas industry (as Treated) and Water supply and Information industries (as control group).
Source: My calculations, based on HIES

B Tables

Table 1: Wald test: $H0 : \gamma = 0$

	Fake Treatment Year					
Control Group	2000	2001	2002	2003	2004	2005
All Other Sections (non-oil)	0.322	0.766	0.328	0.081	0.034	0.006
Agriculture	0.353	0.117	0.136	0.081	0.130	0.410
Manufacturing	0.825	0.769	0.908	0.435	0.224	0.052
Electricity supply	0.007	0.037	0.017	0.003	0.004	0.001
Water supply	0.276	0.813	0.240	0.106	0.082	0.070
Wholesale & Retail	0.320	0.141	0.463	0.901	0.645	0.214
Transportation	0.387	0.257	0.307	0.879	0.980	0.353
Food service	0.152	0.119	0.114	0.385	0.531	0.312
Information & Communication	0.068	0.199	0.087	0.073	0.045	0.064
Financial	0.000	0.037	0.017	0.001	0.001	0.000
Real estate activities	0.249	0.712	0.557	0.237	0.158	0.034
Administrative & Support	0.401	0.347	0.225	0.240	0.324	0.407
Social Security	0.002	0.027	0.004	0.001	0.000	0.000
Education	0.000	0.004	0.000	0.000	0.000	0.000
Health	0.001	0.009	0.005	0.002	0.006	0.000
Arts, Entertainment & Recreation	0.847	0.800	0.505	0.124	0.087	0.012
Other Service Activities	0.222	0.279	0.568	0.954	0.597	0.144
Households as employers	0.537	0.227	0.031	0.007	0.001	0.084
Central Offices	not enough observations					
Extraterritorial Organizations	not enough observations					

Note: I conducted a placebo test by allowing a placebo treatment in years different from the actual timing of the sanctions implementation and using different control groups for regressing equation(1). The treated group is households in which the head works for the oil and gas industry. For example, by using the year 2000 as the fake treatment year and water supply industry as the control group, I can check whether the real family income of households in which head works in oil and gas industry and households in which head works in water supply industry were similar in year 2000. This table shows the p-values of the Wald test ($H0 : \gamma = 0$). If p-value is more than the α level (0.05), the results are not significant and I cannot reject the null hypothesis. Thus, the trends are parallel. Therefore, there are 12 potential control groups (gray rows) that satisfy common trend assumption: households which the head work in agriculture, manufacturing, water supply, construction, wholesale and retail, transportation, food service, information, real estate activities, administrative and support, art and other service activities.

Table 2: Wald test: $H0 : \gamma = 0$
(treated group: oil and gas industry, control group: water supply and information industries

	Fake Treatment Year					
Dependent Variable	2000	2001	2002	2003	2004	2005
Family Income	0.363	0.621	0.189	0.132	0.305	0.274
Family Expenditure	0.452	0.539	0.612	0.576	0.388	0.387
Education Expenditure	0.683	0.901	0.192	0.185	0.172	0.240
School Enrollment (children aged 6-18)	0.991	0.417	0.962	0.366	0.367	0.454
College Enrollment (children aged 19-24)	0.116	0.168	0.118	0.368	0.267	0.299
Years of schooling (children aged 6-24)	0.616	0.624	0.823	0.151	0.178	0.700

Note: I conducted a placebo test by allowing a placebo treatment in years different from the actual timing of the sanctions implementation and using the oil and gas industry as treated group and the water supply and information industries as control group for regressing equation(1). For example, by using the year 2000 as the fake treatment year, I can check whether the outcome variables e,g. the real family income of households were similar across the group of households. Family income and expenditure are log transformed, and have been deflated by CPI which equals 100 in year 2011. For education outcomes, the sample is households with children aged 6 to 24. Education expenditure is also log transformed, and has been deflated by Education Price Index (EPI) which equals 100 in year 2011. This table shows the p-values of the Wald test ($H0 : \gamma = 0$). If p-value is more than the α level (0.05), the results are not significant and I cannot reject the null hypothesis. Thus, the trends are parallel. As this table shows, in the absence of the sanctions, trends in family income, family expenditure and education outcomes (enrollment rate and years of schooling) are parallel.

Table 3: Mean, Standard Deviations, and Tests of Treatment-Control Covariate Balance Before the 2006 UN Economic Sanctions

	(1) All	(2) Control	(3) Treatment	(4) Diff (2)-(3)	(5) H0:diff=0 (p-value)
Household-level variables					
% Family with a male head	97.86	97.68	98.09	-0.41	0.72
Head's years of schooling	10.80	10.87	10.73	0.14	0.32
	(3.82)	(3.74)	(3.83)		
Spouse's years of schooling	9.29	9.33	9.23	0.11	0.43
	(3.66)	(3.74)	(3.56)		
Family size	5.15	5.13	5.17	-0.04	0.52
	(1.84)	(1.75)	(1.91)		
Total Family income (Millions Rials)	137.28	121.47	156.03	-34.56	0.00
	(115.70)	(76.33)	(147.35)		
Family Labor income (Millions Rials)	87.48	74.03	103.42	-29.39	0.00
	(92.33)	(44.49)	(125.80)		
Family Education Expenditure (Millions Rials)	2.96	2.46	3.56	-1.09	0.00
	(7.24)	(5.24)	(9.01)		
Observations	2,741	1,487	1,254		
Child-level variables ($6 \leq age \leq 24$)					
Age (female)	14.15	14.10	14.20	-0.09	0.55
	(4.50)	(4.49)	(4.52)		
Age (male)	14.41	14.27	14.54	-0.26	0.12
	(4.73)	(4.76)	(4.68)		
% In school: girls	83.94	84.12	83.76	0.36	0.79
% In school: boys	81.78	82.14	81.41	0.73	0.61
% In school: girls 6-17	97.16	97.19	97.13	0.05	0.94
% In school: boys 6-17	97.16	97.09	97.22	-0.13	0.84
Girls' years of schooling	7.58	7.57	7.59	-0.02	0.83
	(3.74)	(3.75)	(3.74)		
Boys' years of schooling	7.44	7.34	7.54	-0.19	0.13
	(3.63)	(3.68)	(3.58)		
Observations	5,800	2,897	2,903		

Notes: Table reports summary statistics for the full sample and by treatment status. Standard deviations are in parenthesis in columns (1)-(3). The forth and fifth columns contain differences in means between the control and the treatment samples and t-tests of these differences. Tests do not reject equality of means for treatment and control groups. Treatment group (column 3): Oil and Gas industry, control group (column 2): Water Supply and Information industries.

Table 4: Balancing Test and Selection on Observables

Dependent Variable	Female	Age	Family Size	Head's Education	Employed	
					Mother	Father
Post2007 × Oil	-0.003	0.050	-0.062	-0.603	-0.033	0.002
	(0.023)	(0.289)	(0.149)	(0.384)	(0.025)	(0.023)
Oil	0.010	0.252	0.233*	-2.243***	-0.031	-0.007
	(0.017)	(0.209)	(0.133)	(0.252)	(0.021)	(0.019)
R-squared	0.007	0.021	0.222	0.116	0.039	0.036
Observations	7,065	7,065	7,065	6,935	7,065	7,065
Mean y control	0.459	14.766	5.491	9.716	0.147	0.93

Notes: Table shows the coefficient γ and standard errors from OLS regressions (Eq (1)) for each control variable. The results are not significantly different from zero. Thus, the balancing test is successfully passed. Moreover, these results show the selection does not change differentially in terms of gender, age, family size, head's education, and employment status of mother and father. The sample is households with children aged 6 to 24. Standard deviations are in parenthesis. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 5: Effect on Family Income

	Real Family Income		Real	Weekly
	Total Income	Labor Income	Wage Rate	Working Hours
Post2007 × Oil	-0.10***	-0.13***	-0.12**	-0.21
	(0.03)	(0.03)	(0.00)	(1.04)
Oil	0.20***	0.25***	0.26***	0.19
	(0.02)	(0.02)	(0.04)	(0.89)
R-squared	0.13	0.14	0.12	0.01
Observations	5,335	5,334	2,773	2,776

Notes: This table presents estimated coefficients from a linear model for weekly working hours, wage rate and household's income. Dependent variables (wage, labor income and total income) are log transformed, and have been deflated by CPI which equals 100 in year 2011. The time period is 1995-2013. Weekly working hour was not asked before 2006. Thus, it is not possible to find wage rate for years before 2006. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 6: Effect on Consumption Expenditure of Households

		γ			
	share of total expenditure	All Households		Households with children	
Dependent Variable	(2006)	log	share	log	share
Education	2.19	-0.61**	-0.007**	-0.58**	-0.007**
		(0.25)	(0.003)	(0.31)	(0.003)
non-Education	97.81	-0.05	0.007**	-0.08	0.007**
		(0.08)	(0.003)	(0.09)	(0.003)
Total Expenditure		-0.05	-	-0.08	-
		(0.08)	-	(0.09)	-
Observations		5,335	5,335	4,460	4,460

Notes: This table presents estimated coefficients of Post2007 $\times$ Oil (γ in Eq (1)). Dependent variables are family expenditure on education and non-education goods and services according to COICOP classification. Dependent variables have been deflated by CPI which equals 100 in year 2011. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. The time period is 1995-2013. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 7: Effect on Enrollment Rate and Years of Education

	Dependent variable			
	School Enrollment / Ever Attending College			Years of
	Primary School (6-11 yr old)	High School (12-18 yr old)	Any College (HSG, ≤24 yr old)	Education
A. No differences across gender				
Post2007 × Oil	-0.004	-0.012	-0.087**	-0.186***
	(0.007)	(0.022)	(0.039)	(0.088)
Oil	-0.003	0.005	0.012	-0.010
	(0.004)	(0.011)	(0.021)	(0.041)
R-squared	0.015	0.007	0.080	0.759
B. Allowing differences across gender				
Post2007 × Oil	0.007	-0.014	-0.119**	-0.349***
	(0.006)	(0.027)	(0.048)	(0.121)
Oil	-0.007	0.009	0.002	0.058
	(0.006)	(0.014)	(0.029)	(0.061)
Female × Post2007 × Oil	-0.022*	0.004	-0.068	-0.035
	(0.011)	(0.034)	(0.054)	(0.155)
Female × Oil	0.008	-0.009	0.017	-0.043
	(0.007)	(0.019)	(0.038)	(0.088)
Female	-0.000	-0.017	-0.044*	0.034
	(0.004)	(0.013)	(0.026)	(0.059)
R-squared	0.016	0.008	0.082	0.675
Mean	99.24	88.96	76.88	7.50
Observations	2,878	4,656	2,526	10,060

Notes: This table presents estimated coefficients from a linear model for enrollment and years of schooling. Dependent variable for two first columns is being students enrolled in each school level (primary school, high school). The sample for this analysis is children of the age group that officially corresponds to each level (children age 6 who born at the start of the academic year (September 23th) or later are excluded because they are not eligible to enroll in school). Dependent variable for the third columns is ever attending any college. The sample for this analysis is high school graduates. Dependent variable for the last columns is years of schooling. The sample for this analysis is children aged 6 to 24. The time period is 1995-2013. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. In the panel B, I examine gender differences. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 8: Mean, Standard Deviations, and Tests of Treatment-Control Covariate Balance of Education Expenditures Before the Sanctions

	(1) All	(2) Control	(3) Treatment	(4) Diff (2)-(3)
School Tuition	18.83	16.04	23.37	-7.33
	(30.00)	(27.63)	(33.56)	
University Tuition	25.75	27.27	23.27	3.99
	(39.66)	(40.64)	(38.63)	
Books	33.53	30.38	38.67	-8.28
	(34.27)	(33.25)	(35.91)	
Private Tutoring	6.50	6.44	6.60	-0.16
	(12.87)	(13.11)	(12.68)	

Notes: Table reports the share of education spending to each item before the sanctions for the full sample and by treatment status. The sample is households with children aged 6 to 24. Standard deviations are in parenthesis in columns (1)-(3). The last column contains t-tests of the difference in means between the control and the treatment samples. Tests do not reject equality of means for treatment and control groups. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group (column 3): Oil and Gas industry, control group (column 2): Water Supply and Information industries.

Table 9: Effect on Education Expenditure of Households by Item

	γ			
	total spending		per child	
	log	share	log	share
School Tuition	-0.600***	-0.004**	-0.574**	-0.002**
	(0.246)	(0.002)	(0.240)	(0.001)
University Tuition	0.056	-0.002	0.002	-0.003
	(0.686)	(0.008)	(0.161)	(0.006)
Books	-0.216***	0.000	-0.126**	0.000
	(0.071)	(0.000)	(0.063)	(0.000)
Private Tutoring	-0.762**	-0.001***	-0.616*	-0.000**
	(0.348)	(0.000)	(0.362)	(0.000)

Notes: This table presents estimated coefficients of Post2007 $\times$ Oil (γ in Eq (1)). Dependent variables are log of different classes of education expenditures according to COICOP classification. All education expenditures have been deflated by Education Price Index, which equals 100 in year 2011. The sample for this analysis is children aged 6 to 24. For school spending the sample consists of all children aged 6-24 who have not graduated high school. For university spending the sample consists of children aged 6-24 who have graduated high school. For spending on books, I have considered all children aged 6-24. The time period is 1995-2013. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 10: Income Elasticity of Educational Expenditure

Dependent variable: Ln (educational expenditures by households)

	All		Oil & Gas	
	before sanctions	after sanctions	before sanctions	after sanctions
Variables	(1998-2006)	(2008-2013)	(1998-2006)	(2008-2013)
Ln (Total household	1.173***	1.581***	1.039***	2.096***
expenditure)	(0.012)	(0.017)	(0.117)	(0.153)
Household head's age	1.079***	1.058***	1.774***	1.554***
	(0.005)	(0.006)	(0.060)	(0.085)
Household head's age	-0.011***	-0.011***	-0.019***	-0.016***
squared	(0.000)	(0.000)	(0.001)	(0.001)
Household head's years of	0.222***	0.240***	0.077***	-0.008***
education	(0.005)	(0.006)	(0.043)	(0.053)
Household size	0.826***	1.100***	0.550***	1.066***
	(0.005)	(0.007)	(0.038)	(0.065)
Log likelihood	-761457.46	-658668.17	-10852.278	-7704.397
LR chi2	159021.45	103704.43	2201.320	1734.120
Pseudo R2	0.0945	0.073	0.092	0.101
Observations	318,227	272,184	4,161	2,775

Notes: This table presents estimated coefficients of Eq (4) ($lnEdu\_exp_{ipt} = \delta_i + \delta_p + \delta_t + \alpha Z_{ipt} + \xi lnTotal\_exp_{ipt} + \varepsilon_{ipt}$). Dependent variable is Ln (educational expenditures by households). Since education spending and total household expenditure are both in logarithmic form, ξ denotes elasticity. The income elasticities are significantly greater than one for the overall sample. The null hypothesis that the elasticity coefficients is equal to one is rejected. Thus, as total expenditure decreases, education spending decreases more rapidly than total expenditure, indicating that education is a luxury item in the households' budget. The results also show that the income elasticity of education increases over time, indicating that households allocates smaller share of their budgets to education spending. This negative effect on education spending is greater for households in the oil and gas industry. While income elasticity of education spending used to be around one before the sanction, it has increased to more then two after the sanction for households in the oil and gas industry. *Significant at 10% level; **significant at 5% level; ***significant at 1% level.

Source: My calculations, based on Iranian Labor Force Survey (ILFS)

Table 11: Employee's Years of Schooling

	Treatment		Control	
Year	Average Years of Schooling	difference between two years	Average Years of Schooling	difference between two years
2005	8.91	-	10.43	-
2006	9.69	0.77	10.79	0.37
2007	9.36	-0.32	10.85	0.06
2008	9.24	-0.12	11.08	0.23
2009	8.79	-0.44	11.05	-0.03
2010	8.96	0.16	11.10	0.05
2011	9.21	0.25	11.54	0.44
2012	9.48	0.27	11.44	-0.10
2013	10.05	0.56	11.57	0.13

Notes: This table presents the average education of workers (as a proxy for workers' skill) in treated and control industries for each year. The columns 2 and 4 contains t-tests of the difference in means between years. Tests do not reject equality of means over years. Thus, As this Table shows the average years of schooling has not changed for both treated and control groups. The time period is 2005-2013. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Source: My calculations, based on Iranian Labor Force Survey (ILFS)

Table 12: Unemployed Individuals' Years of Schooling

	Treatment		Control	
Year	Average Years of Schooling	difference between two years	Average Years of Schooling	difference between two years
2005	7.93	-	10.21	-
2006	8.23	0.30	10.39	0.18
2007	7.42	-0.81	10.99	0.59
2008	7.43	0.01	11.85	0.86
2009	9.00	1.57	11.95	0.10
2010	7.33	-1.67	11.88	-0.07
2011	8.48	1.14	11.45	-0.43
2012	8.55	0.07	11.34	-0.11
2013	10.22	1.67	12.16	0.82

Notes: This table presents the average education of unemployed individuals (as a proxy for skill) who used to work in treated and control industries for each year. The columns 2 and 4 contains t-tests of the difference in means between years. Tests do not reject equality of means over years. Thus, As this Table shows the average years of schooling has not changed for both treated and control groups. The time period is 2005-2013. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Source: My calculations, based on Iranian Labor Force Survey (ILFS)

Table 13: Heterogeneous Effect on Enrollment Rate by crucial ages

Dependent variable: School Enrollment/Attending College			
	Age		
	6 yr old	16	18,19
Post2007 × Oil	0.008	-0.116**	-0.373**
	(0.042)	(0.051)	(0.164)
Oil	-0.008	0.043*	0.300**
	(0.042)	(0.025)	(0.150)
R-squared	0.294	0.032	0.048
Observations	209	676	638

Notes: This table presents estimated coefficients from a linear probability model. The sample for this analysis is children at crucial ages. The time period is 1995-2013. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 14: Heterogeneous Effect on Education by percentiles of Family Resources

	Total Family Income			Wealth (Family non-labor Income)		
	25th	50th	75th	25th	50th	75th
A. Years of Schooling						
Post2007×Oil	-0.510***	-0.084	0.000	-0.523**	-0.144	-0.004
	(0.197)	(0.118)	(0.161)	(0.196)	(0.118)	(0.163)
Oil	-0.117	-0.114**	-0.045	-0.039	-0.055	-0.057
	(-0.276)	(0.121)	(0.177)	(0.083)	(0.055)	(0.084)
R-squared	0.719	0.775	0.792	0.720	0.770	0.804
B. Education Spending						
Post2007×Oil	-0.638*	-0.715***	-0.039	-0.635*	-0.877***	-0.145
	(0.329)	(0.272)	(0.428)	(0.446)	(0.263)	(0.346)
Oil	0.139	0.081	0.058	0.341**	0.317**	-0.12
	(0.201)	(0.169)	(0.256)	(0.252)	(0.158)	(0.226)
R-squared	0.080	0.043	0.022	0.025	0.045	0.050
Observations	2,570	5,281	2,508	2,505	5,414	2,440

Notes: This table presents estimated coefficients from a linear model. Dependent variables (total income and non-labor income are log transformed, and have been deflated by CPI which equals 100 in year 2011. The sample for this analysis is children aged 6 to 24 (children age 6 who born at the start of the academic year (September 23th) or later are excluded because they are not eligible to enroll in school). The time period is 1995-2013. I control for age and age-squared effects for estimating years of schooling. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 15: Heterogeneous Effect on Education
by Mothers Activity and Income

	Mother's Employment		Mother's Income	
	employed	non-employed	positive	zero
A. School Enrollment				
Post2007 × Oil	-0.037	-0.045**	-0.063	-0.045**
	(0.062)	(0.020)	(0.059)	(0.021)
Oil	-0.011	-0.003	-0.022	0.000
	(0.025)	(0.010)	(0.024)	(0.010)
B. College Attendance				
Post2007 × Oil	-0.085	-0.239**	-0.111	-0.242**
	(0.125)	(0.104)	(0.122)	(0.112)
Oil	0.122	0.233**	0.111	0.241**
	(0.123)	(0.095)	(0.122)	(0.104)
C. Education Spending				
Post2007 × Oil	-0.240	-0.445***	-0.262	-0.413***
	(0.545)	(0.136)	(0.478)	(0.138)
Oil	-0.107	0.255***	0.059	0.256***
	(0.175)	(0.058)	(0.168)	(0.058)
Observations	1,223	7,576	1,486	7,313

Notes: This table presents estimated coefficients from a linear probability model. The sample for this analysis is children aged 6 to 24 (children age 6 who born at the start of the academic year (September 23th) or later are excluded because they are not eligible to enroll in school). The time period is 1995-2013. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.

Table 16: Effect on Family Savings and non-Labor Income

	Savings+Investment		Debt		non-Labor Income	
	log	share	log	share	log	share
Post2007 × Oil	-0.12*	0.00	0.19	-0.12	0.29	0.02*
	(0.07)	(0.01)	(0.24)	(1.6))	(0.19)	(0.01)
Oil	0.29***	0.04***	0.32**	0.15	0.16	-0.03***
	(0.0))	(0.01)	(0.15)	(1.00)	(0.12)	(0.01)
R-squared	0.08	0.04	0.23	0.08	0.03	0.03
Observations	4,221	4,221	1,114	1,114	5,335	5,335

Notes: This table presents estimated coefficients from a linear model for household's savings and investment, debt and non-labor income. Dependent variables have been deflated by CPI which equals 100 in year 2011. The share values are share of total family income. The sample for analysis of savings/debt is only those households that have positive savings/debt. Heteroskedasticity-consistent standard errors accounting for clustering at the province and year level in parentheses. The time period is 1995-2013. *Significant at 10% level; **significant at 5% level; ***significant at 1% level. Treatment group: Oil and Gas industry, control group: Water Supply and Information industries.