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# ESSAYS IN WOMEN'S FERTILITY AND PUBLIC POLICIES

by

Safoora Javadi

A Dissertation Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in Economics

at

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August 2019

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ABSTRACT

ESSAYS IN WOMEN'S FERTILITY AND PUBLIC POLICIES

by

Safoora Javadi

The University of Wisconsin-Milwaukee, 2019
Under the Supervision of Professor Scott Drewianka

My dissertation consists of three essays on the relationship between public policy, women's education, and birth rates in two very different societies, Iran and the United States. A sharp decline in the Total Fertility Rate (TFR) in Iran over the last three decades has put the country at the risk of an aging population. In the first two chapters, I detail the dimensions of changes in Iran's TFR, examines some possible determinants, and estimate the impact of the government's family planning policies on Iranian women's fertility and marriage. I find that the policies mainly operated through the former channel – especially in rural areas, where the government's family planning policies account for only 3 percent of the decrease in the marital fertility rate.

In last chapter of dissertation, I use county level data over the years 2005-2017 to test whether easier access to local colleges affects teens' birth rate. The difference-in-difference method was used to assess associations between availability and affordability of county-level 2-years schools, and teens' birth rates. Results show that younger teens (15-17) increase their birth rate by opening a new 2-year school, but older teenagers (18-19) postpones their birth decision. Despite their contrary response to the number of schools, teenagers, either younger or older,



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increase their birth rate if attending a 2-year school is more affordable, with younger teenagers and those living in smaller counites being most sensitive to changes in tuition.



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To

my parents,

my lovely sister, Flora,

and all my amazing friends

that without their presence, support, love, and understanding

I would have never been able to achieve my goal.



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## TABLE OF CONTENTS





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www.manaraa.com

## LIST OF FIGURES

Chapter 1 Figures





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Chapter 2 Figures





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## LIST OF TABLES





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**Chapter1: Iran's fertility declines in the context of socioeconomic changes**

"Over the past generation Iran has registered one of the most rapid and pronounced fertility declines ever recorded in human history" Nicholas Eberstadt and Apoorva Shah 2011


**Abstract**

A sharp decline in the Total Fertility Rate (TFR) in Iran over the last three decades has put the country at the risk of an aging population and its consequences including a lower working age population, greater dependency ratio, lower national saving and investment rates, and lower GDP. Some scholars remarked that the TFR decline was due to the restoration of the government's anti-natal policy at 1989. This paper detail the dimensions of changes in Iran's TFR, examines some possible determinants including the government's family planning policies, and speculate about some of those determinants' implications.


## 1. Introduction

The World Bank data indicates that among all countries around the world, Iran, has had the greatest decline in the TFR over 1980's and 1990's. In 20 years, the country's fertility declined over two-thirds from 6.0 to 1.8 bpw from 1986-2006. Eberestat and Shah (2011) state that "this pace of change exceeded the tempo of fertility decline in almost all the Pacific Rim societies; the BRIC economies; and the other non-Muslim emerging market economies". Since an intense



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change in the TFR changes the country's population's age structure in the future, the UN has projected that by 2100, 30.9 percent of Iran's population is likely to be aged 65 and older and country's dependency ratio will exceed 80 percent. Thus, the recent level and trend in fertility are fearfully watched by the country's policymakers, demographers, and economists for the signs of an upturn in fertility back to the replacement level needed to prevent future aging population and its socioeconomic subsequences. Some scholars pointed out to the restoration of the government's national anti-natal family planning policy in the late 1980's as a main reason of the fertility decline. Therefore, in 2006, in order to increase the TFR the government stopped the anti-natal family planning policies unofficially and in return by a pro-natal approach tried to encourage couples to have more children.

Since effective treatment depends on an accurate and complete understanding of possible causes of a disease, this paper, with an economic viewpoint, attempts to determine whether and how socioeconomic factors may be agitated Iran's TFR. The number of children a couple have will be determined through supply and demand interaction. Factors like age at the first marriage, the marriage rate, and prevalence of infertility affect number of children a couple could have if they do not use any mean of contraception (supply of children). While, factors including family's income, the inflation rate, the housing price, and women's education and employment status affect the demand for children which is number of children that a couple would like to have. Among those studies done on Iran's fertility decline, Abbasi et al. (2009) and Saadat et al. (2010) had a wide-ranging investigation on possible cause of fertility decline in Iran. However, they mainly focused on supply side factors of the child market. In this paper, I examine effective factors on fertility from an economics viewpoint and mainly focus on demand side of the child market.



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The paper is organized as follows. Since women are more involved in both child bearing and child rearing, section 2 describes a historical background of the government's family planning policies, and the TFR in Iran, and how women's status in society and within a family has changed over time. Section 3 introduces determinants of the TFR in Iran which comprises factors influence demand for children (family Income, inflation and housing price, and women's empowerment, etc.), supply of children (age at first marriage, the marriage rate, prevalence of Infertility), and the regulation costs. Finally, Section 4 presents the conclusions.

## 2. Iran's TFR and the National Family Planning Policies in the context of socioeconomic changes

Iran underwent remarkable changes throughout the 1960's. The White Revolution, a six-point program of socioeconomic and legal reforms, was launched by the country's monarch, Mohammad Reza Pahlavi, in 1963. These reforms were intended to transform Iran into an economic and industrial power (Abrahamian, 1982). The White Revolution included the abolishment of Feudalism; the privatization of some state factories, such as sugar, textiles, and construction materials factories; the nationalization of forest lands; the introduction of profit sharing for some industrial workers; extending suffrage to women; and the foundation of a Literacy Corps[1]. These reforms were later complemented with the introduction of the Health Corps[2], the Reconstruction

1 Because of this program, for the first time young men who had completed their secondary education were given the option of serving for two years in the Literacy Corps to teach children in rural areas instead of spending those years in the military (Sabahi, 2001). Later in 1969, women also could join this Corps.

2 The Health Corps was established in late 1963 when a fraction of the Literacy Corps were sent out to improve public health care throughout the villages and deprived regions of Iran (Abbasi-Shavazi et.al, 2009).



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and Development Corps [3], free and compulsory elementary education, and additional socioeconomic reforms. Recognizing women's right to vote, as well as enhancing their health and education opportunities created a turning point for women's social life in Iran, a country where women had previously lagged far behind men.

Families were thus particularly affected throughout the 1960's. By 1967, Iran had adopted a set of progressive family laws called the Family Protection Law, which provided married women with more rights within the framework of the family. This law created a family protection court that restricted the husband's power in the family and provided married women with more legal protections, though these protections were very limited. For example, a man's absolute right to divorce was curbed so that a woman could now initiate divorce proceedings. Furthermore, polygamy, which was unregulated before 1967, now required the first wife's permission as well as the court's consent; and the minimum legal age for marriage was increased to twenty for men and eighteen for women (Haghighat-Sordellini, 2010). Hence, as a result of the White Revolution's reformist projects and the Family Protection Law, a woman's legal status both in society and within the family started to improve.

In 1965, the 1955-1965 census indicated an annual population growth rate of 3 percent, a rate which would double the country's population by 1988[4] (Moore, 2007). As Figure 1 shows, the

3 This regiment began in 1965, when a faction of the Literacy Corps were sent to villages to teach peasants new farming techniques and to help them build new roads and bridges (Hooglund, 2014).

4 In spite of government's concern, Iran's population almost doubled (1.9) by 1986 anyhow because of political events. The program had failed miserably.



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TFR in Iran was relatively high at 6.7 births per woman (bpw) in 1966[5]. Thus, in 1966 the Pahlavi government formed a population committee to alleviate the population boom. In that same year, the government also invited the Population Council, an international nonprofit organization researching on social science and public health in developing countries, to make recommendations on how Iran might deal with its impending population problem (Keeny et al., 1967). By 1967, Iran was among the first wave of developing countries to initiate a national anti-natal family planning program (Moore, 2007). This program sought to change fertile couples' knowledge, attitudes, and practices in relation to contraception. It intended to increase access to and use of modern means of contraception, particularly in urban areas. The government introduced new legislation and also adjusted existing laws to facilitate family planning program's implementation. For example, restrictions on sterilization and abortion were repealed. Furthermore, family planning linked to the educational system. One-day sessions were held for public school teachers to introduce the population concerns; high school and university curricula were revised to consider controlling the size of family (Moore, 2007). In rural areas, the Health Corps women played an essential role to inform the villagers about contraception. However, the TFR only decreased to 6.4 bpw by 1979, the same year as the end of Iran's Islamic Revolution.

The new Muslim government immediately abolished the family courts and the Family Protection Law (Higgins, 1985), and stopped the current anti-natal family planning program. Instead the new government, attempting to inculcate Islamic values in the nation's population policies, encouraged families to marry early and have many children (Fahimi-Roudi, 2002). Since

5 This rate was similar to those of most other developing countries of the time. The TFR in all developing countries, except those located in Europe & Central Asia, was roughly 6 bpw in 1966. In developing countries in Europe & Central Asia it was about 3.3 (World Bank, 2012).



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giving birth out-of-wedlock is legally and religiously forbidden in Iran, the legal minimum age to marry for girls and boys was lowered to 9 and 15 years old, respectively. Laws regarding marriage, divorce, abortion, contraception, and child custody were developed in strict accordance with the interpretation of the nation's religious leaders. Married women's presence and contribution to society depended upon their husband's permission. Therefore, after the Islamic Revolution, married women's status in society and within the family was restricted.

In 1980, Iran and Iraq went to war with each other. Generally, during times of war having a large population is considered an advantage and the fertility rate increases to mitigate the child mortality. During the war with Iraq, basic goods were rationed in Iran and infants were entitled to an adult-sized portion of subsidized goods (Saadat et.al, 2010). This rationing system became an economic incentive to push families to have more children. By 1983, the TFR in Iran had risen to a peak of 6.52 bpw. In 1988, when the war ended, Iran had a 3.58 percent population growth rate, one of the highest rates[6] in the world.

In the context of a weakened and damaged post-war economy, a high population growth rate was not expected to result in a pleasant economic outlook, so Iran's government reinstated an anti-natal family planning program in 1989. However, the post-revolution policy focused mainly on rural areas and was supported by the clergy at the national and the local levels. The 1989 policy encouraged families to have at most two children, to avoid pregnancies before age 18 or after 35, and to increase birth spacing. Pre-marriage family planning counseling classes became mandatory for couples and the government provided all families with free modern contraceptives through the public health centers. Even in remote areas, these services were carried out through the mobile

6 In 1988, based on World bank data set, Iran was the fourteenth country (2013)



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clinics (Vakilian & Mirzaii, 2011). Iran's first Economic Development Plan since the revolution (1989-1993) aimed to decrease the population growth rate to 2.3 percent by 2011, i.e. a TFR of 4 bpw. To achieve this goal, in 1991 the parliament approved 58 billion Rials (in 2010 prices) devoted to the population control policies, and that budget sharply increased to 302 billion Rials (in 2010 prices) in 1992. Moreover, in 1993 parliament passed further legislation withdrawing food coupons, paid maternity leave, and social welfare subsidies after the birth of the third child for every family. Following the restoration of the anti-natal family planning policy, the TFR decreased from 5.1 bpw in 1989 to 1.9 bpw by 2002, well below the replacement level[7].

Currently, the reduction of the birth rate that was once crucial to checking rapid population growth turned out to be an economic and political crisis in Iran. Whereas a sharp decline in the TFR affects both the population's age structure (see Figure 2) and the population level, the country is impacted by an aging population and its subsequently high total dependency ratio (see Figure 3). In 2010, Iran had its lowest total dependency ratio since 1950 and the country's population swelled among 20-40-year-olds —a bulge that will be quite prominent as they move into the 60 and older age category by 2050. An examination of data from the UN reveals that by 2100, 30.9 percent of Iran's population is likely to be aged 65 and older. Figure 3 indicates that the total dependency ratio is high in Iran, both before the year 1990 and after 2060. However, the former is the result of high fertility, while the latter is result of the population aging.

In order to prevent the socioeconomic consequences of the population aging (including lower labor force participation and saving rates, and slow economic growth rates), Iran's government

7 A trend of Age-Specific Fertility Rates (ASFRs) from which the TFR is calculated reveals that fertility rates across all age groups trend in a similar manner.



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started to urge couples to have more children in 2006. In this regard, the government introduced a baby bonus scheme in 2009 to encourage larger families. Under the new scheme, each child born in the current Iranian year would receive a deposit of 10 million Rial[8] in a government bank account. They would then continue to receive another 1 million Rial every year until they reach 18. Parents would also be expected to pay matching funds, at least 200 thousand Rial, into the accounts. However, the scheme stopped after one year because of budget insufficiency. In 2010, the welfare restrictions on families after the birth of a fourth child were repealed. In 2012, Iran's supreme leader, Ali Khamenei, warned of the country's aging population and suggested that the number of Iranian citizens should be at least doubled. The following year, the country's anti-natal family planning program was officially eliminated and funds were reallocated to programs that encourage having larger families. These programs were included a broader range of policies from punitive to incentive. For example, in 2014, Iran's parliament voted to ban any permanent forms of birth control for men and women. Those involved in encouraging contraceptive services and abortions were criminally prosecuted. On the other side, the government extended maternity leave from six months to nine and introduced a two-week paternity leave. Despite the remarkable role that the government's family planning policies played in fertility decline, there are some other possible determinants which have also affected the TFR.

## 3. Determinants of the TFR in Iran

Fertility can be influenced through three broad channels: demand for children, supply of children, and the costs of regulating fertility. "Demand" here refers to the number of surviving children and composition a couple would like to have and "Supply" refers to the number of

8 Approximately 1,014 current US$



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surviving children a couple would have if they do not regulate their fertility (i.e. by using a contraceptive or by seeking an abortion). The interaction of demand and supply consideration presumably determines whether and how strongly a couple wishes to have or to avoid a birth. Indeed, when the supply of children matches or exceeds the demand for children, then families are more likely to be more motivated to regulate the family size. However, translating this motivation into regulating fertility depends on such regulation's accessibility, affordability, and desirability (Bulatao, 1984).

### 3.1 Factors influence demand for children

According to Becker's (1965) theory of the allocation of time, children are home-produced commodities. Thus, like other commodities, the demand of children will change by socioeconomic factors such as family's income, cost of childbearing, urbanization, child mortality rate, parents' taste or preferences, education, and employment, ethnicity, and religion.

#### 3.1.1 Family Income

Studies show that the direction and the magnitude of the income effect on fertility at the household level depends upon three interconnected factors: family wealth, gender of the primary breadwinner, and the main source of family's income (Willis,1973; Mincer,1963; Schultz, 1994; Jones et. al, 2008). Willis (1973) states that as income rises, the price of child quality falls relative to the price of quantity, regardless of the source of income. In other words, the income effect for quantity is less than the income effect for quality, which means families prefer to invest on their children's quality of life rather than having more children. Changes in the source of a family's income also affects the number of children a couple would like to have by affecting the economic



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opportunities that parents sacrifice to have a new child (Mincer, 1963). For example, an increase in a family's income that comes as a result of a higher value of a woman earning more money discourages fertility, while an increase in income due to a higher rate of return to physical assets encourages fertility (Schultz, 1994). In fact, a higher wage induces the usual wealth and substitution effect, and demand for children is decreasing in income only if the substitution effect dominates the wealth effect. Finally, since child rearing is mostly female time-intensive, it is assumed that women have a higher substitution effect than men, who have a greater wealth effect. So, depending on whose income has increased in the family, we may observe a different result on fertility.

Similarly, at the national level, the total fertility rate depends on three interconnected income factors: real per capita income, the income inequality rate, and the primary economic activity (Jones and Tertilt, 2008; Larry E. Jones et al., 2008; Hotz and Willis, 1993). A country with a greater real per capita income has a higher standard of living including more developed educational and health systems, so that the per capita economic growth rate and net fertility tend to move inversely (Becker et. al, 1990). Figure 5 shows the trend of real per capita GDP in Iran from 1960 to 2014, which has been divided into three stages of economic growth. In the first stage, which covers the years from 1960 to 1976, real GDP per capita skyrocketed due to rising oil prices, so that in just 16 years real GDP per capita tripled. The second stage includes the years 1976-89 when the country was suffering from the inflation followed by the Islamic revolution and war with Iraq. In most of those years the country experienced negative economic growth, and real GDP per capita decreased 60.5 percent in 13 years. From 1989 until present is the third stage, when real GDP per capita has been increasing, even though it is still below the level in 1976.



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The effect of real per capita income on the fertility rate in Iran could be explained by the Easterlin (1975) Relative Income Theory. According to this theory, a household's relative income affects the number of children a couple would like to have. Relative income in Easterlin's viewpoint is defined as income over "material aspirations." According to this view, skyrocketing real per capita income during the first stage increased future parents' "material aspirations." So, when real per capita income collapsed in the second period, the result was a decline in fertility.

Besides per capita income, the distribution of income also affects the total fertility rate. Countries with higher income inequality tend to have a higher TFR. Higher income inequality lowers the average educational level (De la Croix and Doepke, 2003). Since less-educated workers have a higher birth rate than more-educated workers, the proportion of future unskilled workers goes up. Subsequently, lower wages for unskilled workers decrease their opportunity cost of having a child, which in turn generates a vicious cycle, where the poor stay unskilled and populous (Kremer and Chen, 2002). Iran's Lorenz Curve shown in Figure 6 indicates that the income inequality rate has decreased from 47.42 in 1986 to 38.28 in 2005.[9] Thus, the lower income inequality is consistent with the lower fertility rate over the last decades.

In addition to the level of income and income distribution, over time the transition from a traditional agricultural society to a modern industrial economy has led to a decline in the total fertility rate (Tamura, 2002). For example, in traditional agrarian economies, children had an essential contribution in the current and future of the family's economy. Children provided their family with cheap labor force of production and in the absence of social security services, children

9 Gini index in Iran is to somewhat higher than other Asian upper middle income countries but lower than the upper middle income countries in other continents, especially in Latin America.



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were a guaranteed future. So, having more children was an advantage for agrarian families. While in modern industrial economies children have lost those previous roles. Children are more cost than advantage. Figure 4 illustrates that over the last half-century, Iran's services and industrial shares of real GDP per capita have increased by 6 and 17 percent, respectively while agriculture's share fell by 20 percent. It is then possible that the decreasing fertility rate in Iran could be due to the shrinking agricultural sector. To sum up, these three income factors (real per capita income, the income inequality rate, and the primary economic activity) help explain Iran's falling TFR over the last five decades.

### 3.1.2 Shadow price of children

In addition to income, the "price" of children could also considerably affect the demand for children (Deaton, 1986). This price is the additional income that a household must receive in order to have the same welfare level as it had before having an additional child.

#### 3.1.2.1 Inflation and Housing price

A higher inflation rate induces the usual income and substitution effects on the demand for children, as well as on consumption of other goods and services. The inflation rate declines the TFR either by postponing the family formation or by reconsidering child bearing decision (Dettling and Kearney, 2014; Yi and Zhang, 2010). However, the demand for children decreases by inflation only if the elasticity of substitution between children and consumption is high enough (Jones et. al, 2008).



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The decreasing level of fertility in the 1980's in Iran is consistent with a higher cost of living due to inflation. Figure 7 illustrates Iran's inflation rate over the last fifty years in comparison with other countries. According to the World Bank data, in the 1960s, Iran experienced on average 1.7 percent inflation rate annually. The next decade started with skyrocketing oil prices, and the economic boom ended with an economic and political uncertainty. The country suffered on average 12 percent inflation per year. In the 1980s, the inflation rate highly averaged 19.7 percent annually and in the mid-1990s Iran experienced the highest inflation rate of 50 percent ever recorded in its history.

Higher inflation raises households' expenditures. A major component of households' expenditure in urban areas which has a significant impact on family formation and a couple's decision to have a child is the housing cost (Dettling and Kearney, 2014; Yi and Zhang, 2010; Simon and Tamura, 2009). Considering children as normal goods, a change in housing price may affect households' demand for childbearing differently. Since housing price is a part of the shadow price of children, it is supposed that a higher housing price negatively affects fertility among non-homeowners. In other words, the "substitution effect" leads couples to postpone childbearing or to decide to have fewer children. A change in housing prices may also positively affect homeowners' fertility due to a traditional wealth effect. When housing prices constitute a substantial portion of household wealth, then higher housing prices increase homeowners' wealth, so that may lead them to either expedite childbearing or to have more children. Thus, response of the total fertility to a raise in housing price also depends on the rate of homeownership in an economy. Iran's census results indicate that homeownership rates in Iran have decreased by 10% and 5% in urban and rural areas respectively from 1982 to 2012 (SCI,1976;SCI,2011). The Housing Rent Index (Figure 8) also has increased more than 56 times from 1989 to 2012. Regarding Table 1 which indicates



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that in 2012, 32.9 percent of an urban household total expenditure spent on housing in Iran, a rapid increase in rent and decrease in the rate of homeownership is consistent with lower fertility rate in Iran after 1983.

#### 3.1.2.2 Women's Empowerment

Child-rearing is mostly female time-intensive, and cost of child-rearing mainly consists of the present value of the time that a woman sacrifices to raise a child. Thus, a more empowered woman has a higher opportunity cost of giving birth. Women's empowerment increases their contraceptive prevalence rates, lowers their fertility rate, and lengthens their birth intervals (Upadhyay, 2014). Higher levels of education and employment status are two main key factors that empower women. Table 1 summarizes some indicators of the relative position of Iranian women and men over thirty-five years in the education and labor markets, and Figures 9 and 10 show specifically some key indexes in education sector.

Figure 9 illustrates that value added (constant 1997) of education and its contribution in country's GDP were low in the early 1960s. In line with Figure 9, Figure 10 shows that in the years 1956-1966, the literacy rate in rural areas was much less than the rate in urban areas. Furthermore, women's literacy rate was considerably less than men's within each area. For example, in 1966, 4 percent of rural women were literate vis-à-vis 25 percent of rural men. In urban areas, these numbers were 38 and 62 percent, respectively. During the years of 1960s and 1970s, in the context of the social development occurred in the country and rising oil prices, the value added of education as well as its share in the country's GDP sharply increased. So, in 1979, 10 percent of real GDP came from the education. One reason of such a fast growth in this section was the country's low literacy rates before 1970s, predominantly women's and the villagers' (See Figure



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10). In 1976, one decade after the implementation of the first family planning program in Iran, the literacy rate among women was still half of men's. However, from 1976 to 1992, the female literacy rate almost doubled, mainly due to the government's active programs in eradicating the illiteracy in form of the Literacy Movement Organization.

Table 2 shows that in 1976, female primary school enrollment was 76.7 percent of the school-age children in Iran, which increased to 105.1 percent in 1992. Access to secondary education sharply increased between the years 1992 and 2002 for both females and males, rising 50 and 24 percentage points respectively. In 2012, about 55.2 % of women and 55.1 % of men had completed tertiary school; the rates were considerably greater than the average of those in upper middle income countries. Women's higher levels of education is consistent with a lower fertility rate in Iran either caused them to postpone the marriage or they have more knowledge about contraception.

Table 2 shows in 2012, Iranian female labor force participation was 16.4 percent. This rate, considering the high speed of educational improvement, is low. Based on World Bank data, in 2013 Iran had the 6$^{th}$ lowest female labor force participation in the world, while female labor force participation in the world averaged 50.3 percent. Thus, despite a big jump in women's education, and since the female labor force participation rate is still much lower than in other upper middle-income countries, we can say that the higher opportunity cost of childbearing in the form of mothers' wage likely did not play a major role in decreasing Iran's fertility.

However, education not only affects fertility by changing the opportunity cost of having a child, but also through other channels. For example, education may provide better knowledge of contraceptives (Monstad and Salvanes, 2008) and may decrease fertility by increasing the contraceptive self-efficacy (Longmore, 2003).



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### 3.1.3 Rural-Urban Migration

Rural to urban migration within a country may influence the timing and pace of the decline in total fertility over the country. Indeed, women's fertility rate in urban areas has consistently been lower than in rural (United Nations, 2001). In rural areas children constitute a noticeable proportion of the agricultural labor force, and having more children is thus an economic advantage. In urban areas, a simple cost-benefit analysis shifts families' preferences to substitute quality for quantity. Thus, compared to rural areas, in urban areas there are lower economic contributions of children and higher costs of their upbringing and education, so having more children is economically disadvantageous.

Apart from economic reasons, urbanization is also a proxy for changes in social norms and gender roles, which generate a preference for smaller families (Guo et. al, 2012). Women progressively find themselves free from household obligations and their new economic roles are less compatible with childbearing. In other words, higher levels of wages, improvement in women's empowerment, and higher cost of childcare decrease the fertility rate by increasing opportunity costs of having a child. As Figure 11 confirms that TFR and urbanization have been inversely related in Iran over the last 50 years. The World Bank data indicates that 54.3 percent of the population had been urban in 1986, the number which grew to 68.4 percent of the total population in 2006. During the same years, the TFR in rural areas decreased from 6.5 to 2.10 and in urban areas from 4.9 to 1.7 (Abbasi et. al, 2009).

I used the Blinder-Oaxaca decomposition technique to identify and quantify the effect of change in urbanization on Iran's TFR. The country's TFR is weighted average of the TFR in rural and urban areas:

$$TFR_C^K = TFR_U^K * u^K + TFR_R^K * r^K \quad (1)$$



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Where $TFR_C^K$, $TFR_U^K$, and $TFR_R^K$ are the country's TFR, TFR in urban areas, and TFR in rural areas at time K, respectively. $u^K$ is percentage of the nation living in urban areas at time K, and $r^K$ is the share of those living in rural areas at time K. Thus, change in the share of people living within each region and their birth rate affect the country's TFR together.

$$\Delta TFR_C = \sum_{K=1}^{N}(u^K - r^K) * TFR_U^K + \sum_{K=1}^{N} r^K * (TFR_U^K - TFR_R^K) \quad (2)$$

The first term in equation (2) specifies how urbanization has been responsible for fertility decline and the second term clarifies effect of change in region-specific birth rates in fertility decline. Table 3 shows results of the Blinder-Oaxaca Decomposition of TFR in Iran by region from 1970's to 2000's. It indicates that except during the years of 1972-1982, in which urbanization's effect was actually in the opposite direction, about 5% of change in country's TFR has come from the urbanization. For example, during the years 1986-2006 the country experienced 3.81 bpw decline in TFR, 3.67 bpw of the decrease in women's fertility is due to change in region-specific birth rates, and just 0.14 bpw is due to changes in urbanization.

### 3.1.4 Child Mortality Rate

According to the Demographic Transition Theory, a higher childhood mortality rate contributes to parental desires to have many children, as households seek to replace deceased children or to insure against those who may die. From economic viewpoint, there is a quantity-quality tradeoff for children (Becker, 1960). In the presence of a high mortality rate, investments in children's human capital will be less attractive because it decreases the expected time horizon over which such capital can be used (Angeles, 2010). In other words, parents would prefer to invest



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in number of children rather than their human capital. However, a decreasing mortality rate induces parents to move from quantity to quality, decreasing the total fertility rate.

To improve the health and life chances of the rural population in Iran, rural health facilities began to be constructed before the Islamic Revolution in 1979, but accelerated in the mid-1980s, closely timed with fertility decline (Salehi-Isfahani et.al 2009). Moreover, Health Corps workers visited the villages frequently and held public forums that taught proper household hygiene, how to avoid food contamination, and so forth (Hooglund, 2014) which would decrease the child mortality rates. In 1967, Iran with a mortality rate of 192.4 per 1,000 birth was the tenth highest country in the world among 148 countries. Over the last five decades in Iran, the infant mortality rate dropped from 101.1 to 44.1, then to 14.4 per 1000 live birth in 1976, 1989, and 2013(World Bank). Hence, a decreasing child mortality rate could partially explain a lower fertility rate.

### 3.2 Factors influence supply of children

Natural fertility reflects biology, culture, the age of marriage, frequency of intercourse, and duration of postpartum infecundability. These are among the main factors that influence the supply of children. Marriage and divorce rates are particularly important factors in countries like Iran where out-of-wedlock childbearing is not acceptable.

#### 3.2.1 Age at first marriage

In the absence of any effective contraceptive, the age at first marriage and first birth influence the total number of children a woman bears during her reproductive period. The age at the first marriage is negatively affected the number of children a woman is likely to have. As figure 12 indicates, while many countries have experienced decreases in fertility when the age at marriage



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has risen, the experience in many other countries casts doubt on the importance of this mechanism. Over thirty years from 1980 to 2010, many countries like Iran, Tunisia, Republic of Korea, and Costa Rica had a higher average age at the first marriage and lower TFR.

Women's higher average age at the first marriage in Iran could explain the country's decreasing TFR. Table 4 represents the trend of average age at first marriage in Iran from 1956-2011. In 2011 the female average ages at first marriage were 23.0 and 23.6 in rural and urban areas respectively. These average ages have increased gradually between 1966-2011, in rural areas by 5.1 years and in urban areas by 4.6 years. In addition to the age at the first marriage, the marriage rate also matters. The UN data shown in Figure 13 indicates that the probability of marriage has decreased in Iran for women in their twenties. Women are respectively 12.8, 21.3, 16.8, and 10.9 percent more likely to be single in the age of 15-19, 20-24,25-29, and 30-34 in 2011 than they were in 1986. However, since the probability of being single at older ages has not changed, we can infer it indicates that Iranian women have been postponing marriage into their thirties and forties, rather than avoiding marriage entirely. Women's marriage in older age decreases the chance and number of their pregnancies. Besides the marriage rate, divorce rate also matters for fertility rate. Figure 14 shows that over the years 1966 to 2011 Iran experienced the lowest divorce rate across all age ranges in 1996. Recently, the divorce rate has been increased particularly among women between the ages 30-50.

### 3.2.2 Prevalence of Infertility

Obviously, infertility has a dampening effect on TFR and the supply of children. Thus, improvements in the ability to bear children could be considered as a pro-natal tool. For example, Frank (1983) estimated that a reduction in infertility in sub-Saharan Africa to "normal" levels



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would increase fertility in that region by 15 percent, and Larsen and Menken (1989) found that the total fertility rate would rise from 5.5 to 7.3 in the absence of sterility in Cameroon, a country with an unusually high level of infertility (WHO, 2004).

Maya N. Mascarenhas et al. (2012) analyzed household survey data from 277 demographic and reproductive health surveys in 190 countries and territories to reveal global patterns and trends in infertility. They considered infertility as an inability to have a live birth after a five-year exposure to the pregnancy risk[10] and found that the primary infertility rate for women seeking a child in these countries investigated was on average 1.9%, and the secondary infertility rate was 10.5% in 2010. Results of their research in table 5 shows that in 2010, among child-seeking Iranian women 20–44 years of age who were exposed to the risk of pregnancy for 5 years, 2.5% (95% uncertainty interval 1.3%, 4.3%) were unable to attain a live birth (primary infertility). Out of women who had had at least one live birth and were exposed to the risk of pregnancy, 6.2% (3.3%, 10.7%) were unable to have another child (secondary infertility). Although their results indicate a rather low infertility rate in Iran, it is important to note that an infertility measure based on ability to become pregnant (rather than having a live birth) may show different levels of infertility, and using an exposure period shorter than the five years would produce higher rates of infertility. For instance, Akhondi et.al (2013) used data from a 2011 national survey of Iranian women aged 20-40 years to investigate the prevalence of infertility. They interviewed 17,187 women with the mean age of marriage of 20.1 years to figure out their fertility history. They define, primary infertility as

10 Inability to conceive within two years of exposure to pregnancy is the epidemiological definition of infertility recommended by the World Health Organization. Also, a typical clinical definitions of infertility is a failure to achieve a clinical pregnancy after 12 or more months of trying (WHO, 1975; WHO, 2001).



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an inability to conceive after one year of unprotected intercourse, and by that definition they found a relatively high primary infertility rate of 20.2 percent in Iran.

Unfortunately, existing studies have not estimated the effect of infertility on Iran's TFR. Since the evidence is mixed on the magnitudes of Iran's fertility rate, it is at least possible that this has been an important factor behind the trend toward lower TFR.

### 3.3 Regulation Costs: Rise in Contraceptive Prevalence Rate

The contraceptive prevalence rate (CPR) is a key factor influencing the TFR in many developing countries like Iran. Bongaarts et al. (2012) explained that 15-17 percentage points increase in the contraceptive prevalence rate is required to reduce the TFR by one birth per woman. The United Nation data for 2014 in Figure 15 also indicate a negative relationship between the contraceptive prevalence rate and TFR. A greater decrease in the CPR relates to a larger TFR decline (Figure 16).

As Figure 17 shows, the CPR in Iran, regardless of the government's family planning policy, has always had an upward trend over the last four decades. However, in the early 1990s, when the national anti-natal family planning policy was restored, the CPR accelerated. In 1989, Iran's Health Ministry launched a campaign across the country to introduce contraceptives - pills, condoms, IUDs, implants, tubal ligations, and vasectomies-and provided free or subsidized condoms and other contraceptives to families (Moore, 2007). In the meantime, the High Judicial Council declared that sterilization of men and women was not against the Islamic principles or existing laws, which increased the desirability and acceptability of sterilization as a method of family planning (Roudi-Fahimi, 2002). The government's attempts in promulgating contraception



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within families, especially in rural areas, and increasing its accessibility has been considered as one of the main reasons for the sharp decline in Iran's TFR (Aghajanian and Mehryar,1991a). However, Figure 17 shows that even in the absence of family planning policy, during the years 1979 to 1989, roughly 50 percent of Iranian couples were using some form of contraception, implying that the law cannot undo knowledge.

The main contribution of the 1989 family planning restoration on the TFR was to narrow the rural-urban CPR gap. Figure 18 indicates that in 1977, when there had been an active family planning program for over a decade in Iran, 37 percent of married Iranian women aged 15 years and older used a contraceptive, 53.8 percent in urban areas and 19.9 percent in rural areas. In 1989, when there had been no official program for over a decade, contraceptive prevalence was 64 percent in urban areas and 31 percent in rural areas. One decade after reviving the family planning program, in 2000, contraceptive prevalence increased 13 percent in urban areas and 36.2 percent in rural areas.

Table 6 indicates that the jump in the total CPR in the early 1990s had been mainly in the form of modern methods of contraception. However, despite the convenience of modern methods provided by the government after 1980, a considerable portion of couples still use traditional methods including withdrawal and the rhythm method to avoid pregnancy (Erfani, 2012). Among 158 countries investigated by the United Nation, Iran with 21.77 percent of prevalence of traditional contraception is the 15th country in the world. Erfani (2012) found that among birth limiters, those with higher levels of education and/or economic status are more likely to use withdrawal rather than modern contraceptives. Moreover, women's age and education was positively associated with the likelihood of using withdrawal rather than modern methods.



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Although the important role the government played to increase the CPR in rural areas cannot be overlooked, regarding the facts that the CPR in Iran has always increased including the years that the government followed a pro-natal family planning policy and prevalence of traditional methods of contraception, this hypothesis shows that especially in urban areas contraception is just an endogenous choice and not a causal effect.

## 4. Conclusion

This paper briefly has explained what TFR determinants are in a country and how a change in those determinants effects the country's birth rate. The TFR determinants has been broken down into three broad categories: determinants effecting demand for children, determinants effecting supply of children, and the regulation cost. After a short review on the major events, including the recession, war, and the political revolutions, which have occurred over the last couple of decades in Iran, this paper unravels the possible causes of the country's sharp TFR decline. What distinguishes this paper from existing papers on this topic is that they glossed over the causes of decline in fertility with a demographic viewpoint and focused more on factors affecting the supply of children: factors like age at the first marriage, and the marriage and divorce rate. In this paper there is an additional consideration mainly focused on the economic variables which affect demand for children.

On demand side, I found that the GDP growth rate and its distribution could have influenced the TFR fluctuations, e.g. the effect of real per capita GDP on women's fertility rate could be explained by the Easterlin Relative Income Theory. Moreover, a high inflation rate and a rapidly increasing housing price index are in line with the lower number of births in the country. However,



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the inflation rate and the housing price index could also affect number of births indirectly through the marriage postponement. Another cost of having a child is the opportunity cost that women pay to bear and rear a child. Since child rearing is mainly a female-intensive, a more educated woman will pay more to have a child than a less educated woman. Iran's data indicates an increasing women's educational level over the years that the country has been experiencing a lower fertility rate. However, since Iran has one of the lowest women's labor force participation rate in the world, higher opportunity cost of having a child in form of the time that women scarify could not provide a strong explanation for a lower country's TFR. Another possible factor which could explain the TFR trend in Iran is the declining child mortality rate over the last several decades. The Oaxaca decomposition technique shows that despite of the noticeable rural to urban migration, only very small part of change in the country's TFR is due to urbanization and it is mainly because of change in region-specific birth rate, but they could also have been caused by the same factors that caused the decrease in fertility.

On supply side, national data shows that over the last couple of decades Iran has been experienced a higher age at the first marriage, a lower marriage rate, higher divorce rate, a relatively high infertility rate. Direction of each of these changes in a country like Iran, in which having a child out of wed-lock is illegal, could be a likely explanation of a lower total birth rate.

Finally, any imbalances between demand and supply in the child market could be adjusted either by contraception costs or infertility treatment costs. By the end of 1980's, as a result of an anti-natal family planning policy, the government provided the nation with free contraceptive means even in far reaching rural areas at the same time that the TFR was decreasing. Thus, this coincidence led many observers to the conclusion that this widespread decline in fertility is



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inherently connected to the government family planning policy. Undoubtedly, the government policy decreased cost, either money or time, of contraception and made a proper environment to decrease the fertility by increasing households' knowledge of the means of regulating fertility, but as this paper has shown there are many other factors which all together pushed the fertility down.

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**Appendix**

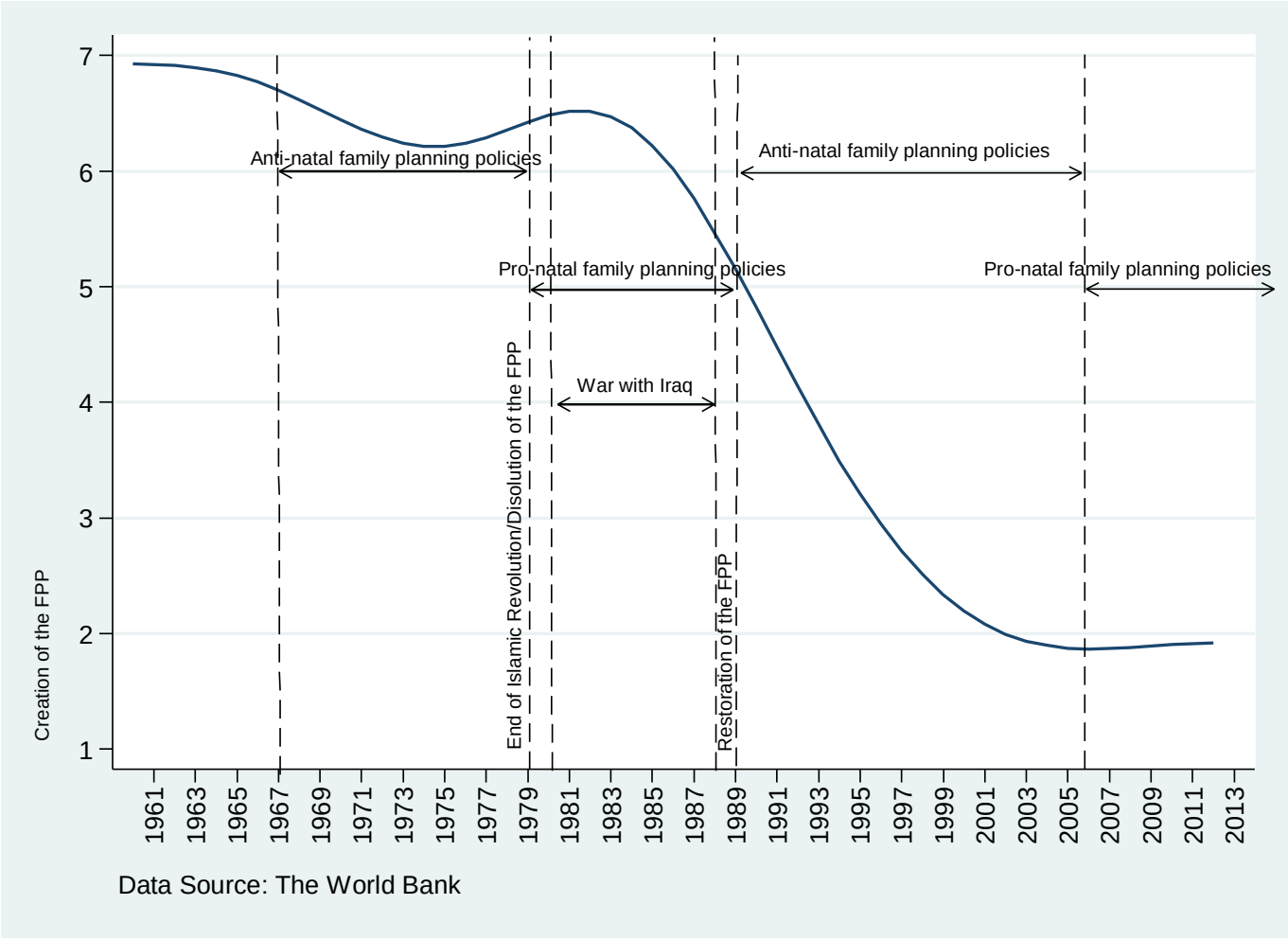


Figure 1: Trend of the TFR and the National Family Planning Policies in Iran



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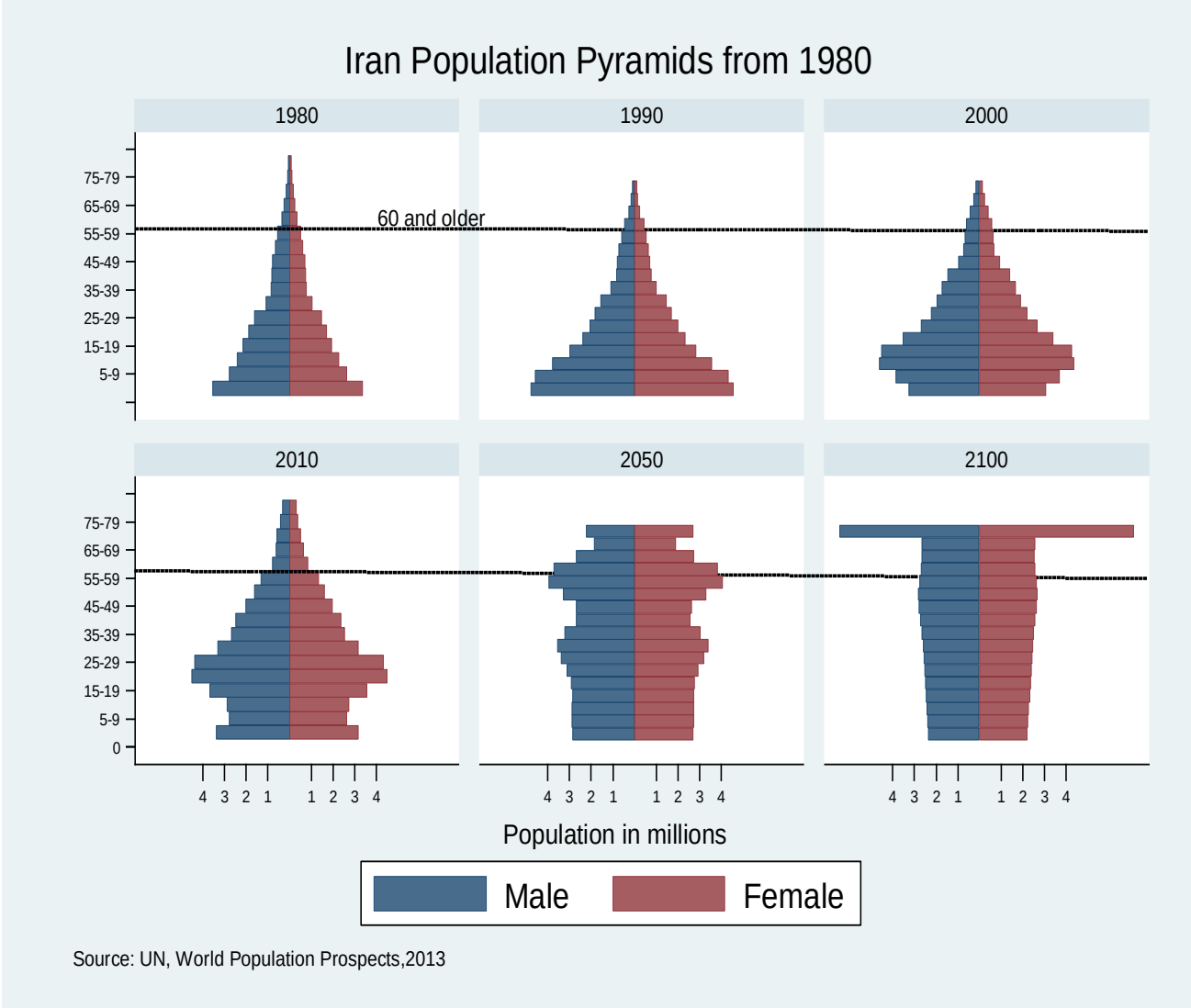


Figure 2: Age distribution patterns, Iran1980-2100

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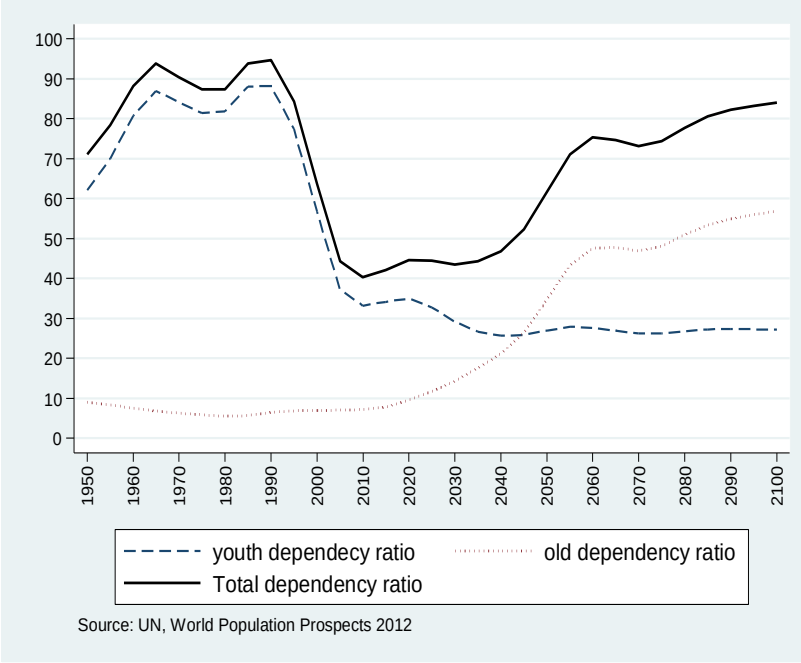


Figure 3: Age Dependency Ratio, Iran

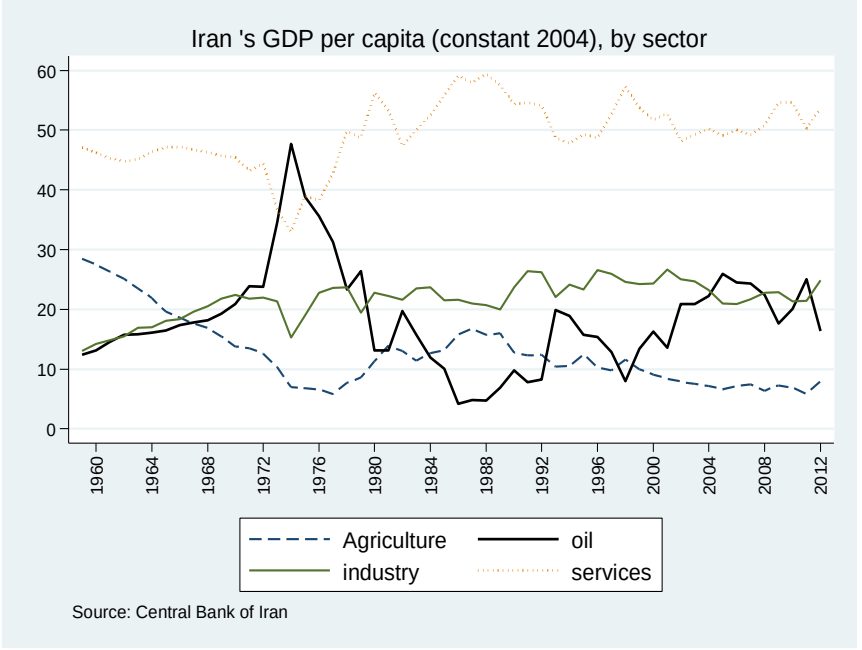


Figure 4: Economic sectors' shares of real GDP per capita



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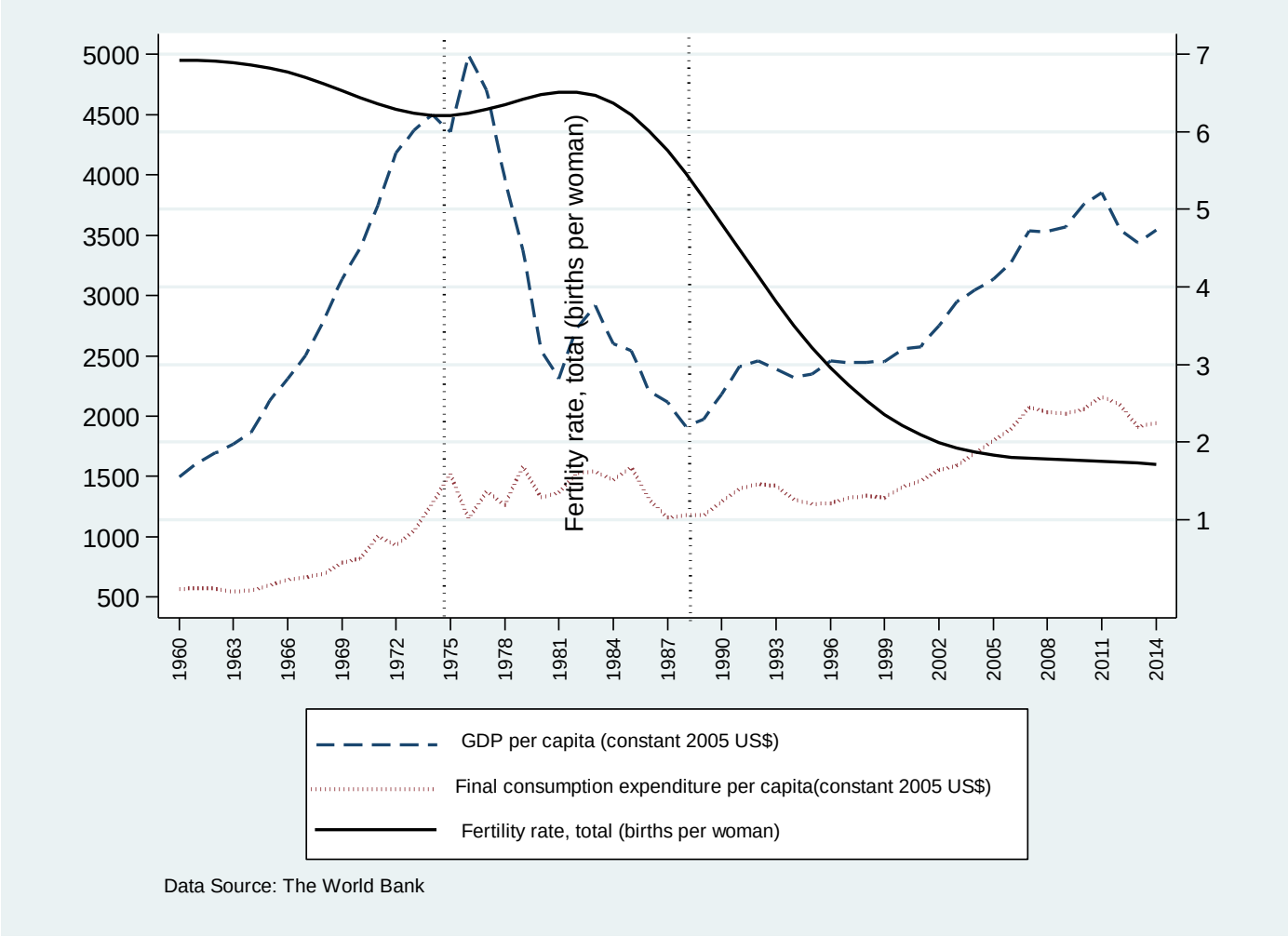


Figure 5: Per capita GDP, per capita final consumption, and TFR in Iran

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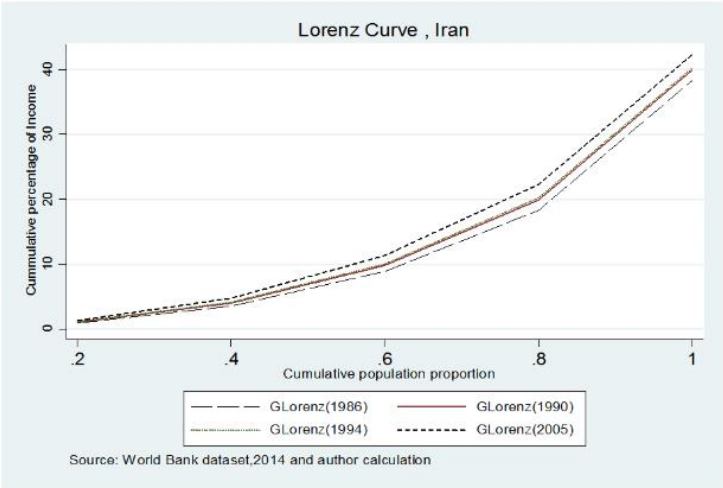


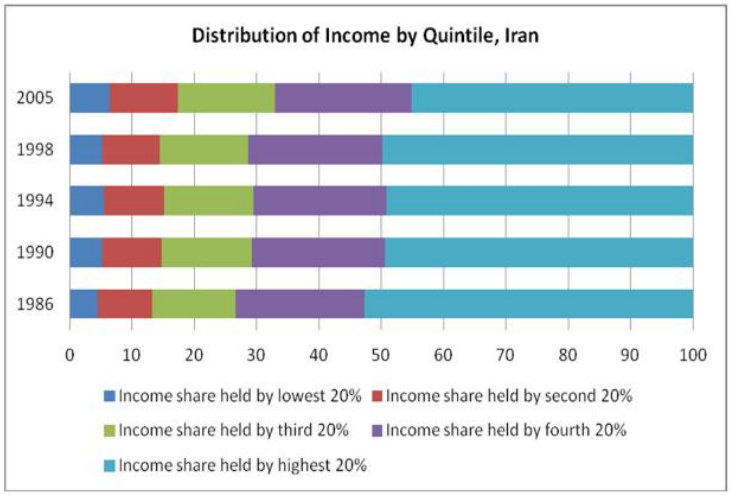


Figure 6: Income Inequality in Iran



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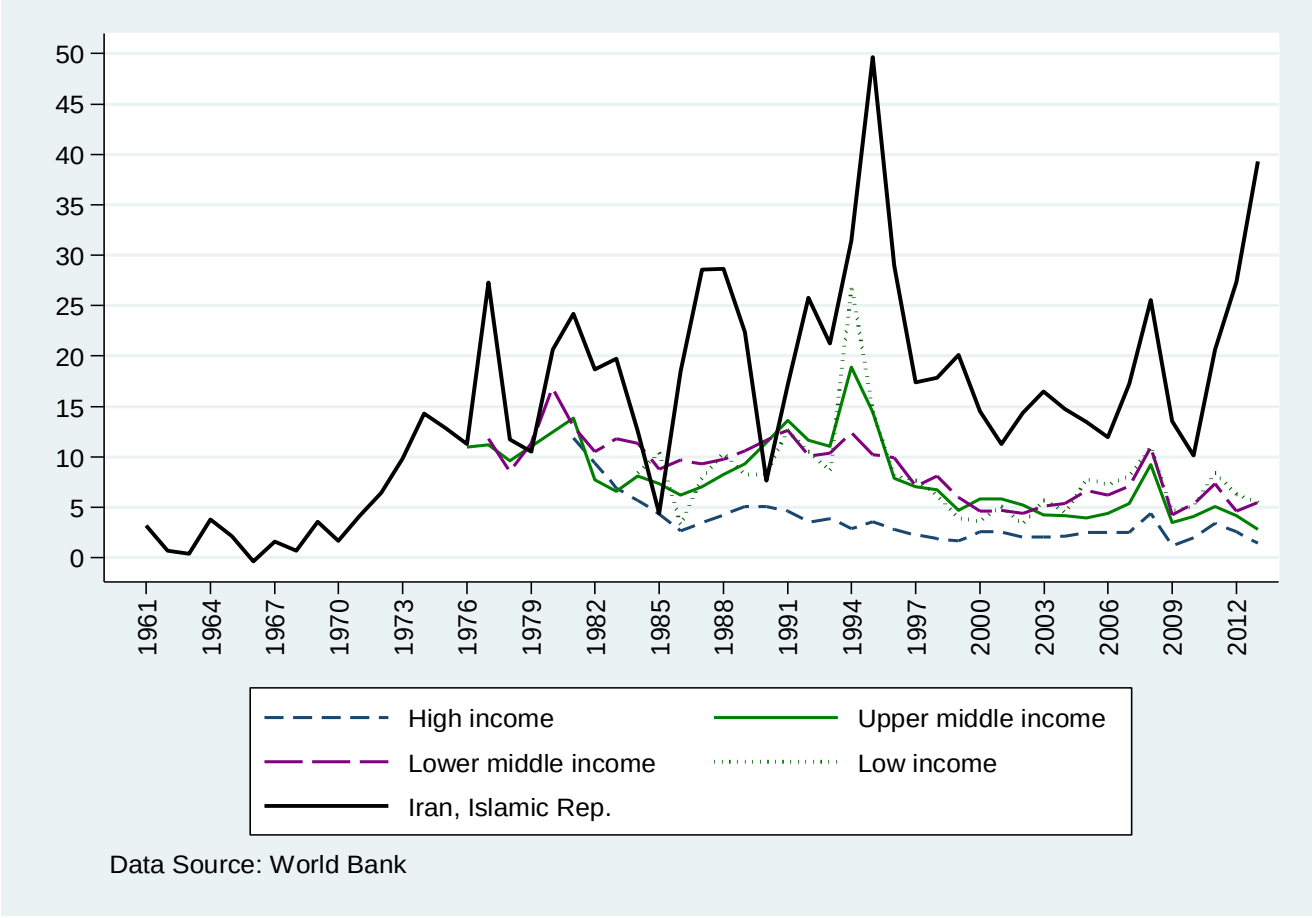


Figure 7: Inflation, Consumer Price Index

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Table1: Distribution of annual consumption expenditures of Urban households by expenditure type, Iran

| Expenditure types\| year | Total household consumption expenditure (%) | | |
|---|---|---|---|
| | 1992 | 2002 | 2012 |
| **Total** | **100** | **100** | **100** |
| Food, beverages, cigarette | 34.4 | 27 | 26.6 |
| Cloths and foot wear | 9.6 | 6.2 | 4.5 |
| Housing and rent | 28.2 | 27.3 | 32.9 |
| Furniture, house appliances | 6.8 | 6 | 4.5 |
| Health | 3.9 | 5.1 | 5.5 |
| Transportation | 7.8 | 14.1 | 9.4 |
| Communication | 0.6 | 1.2 | 2 |
| Entertainment and culture | 1.5 | 3.6 | 2.3 |
| Educational service | 0.8 | 1.6 | 2 |
| Various goods and services[11] | 6.4 | 7.9 | 10.3 |

Source: Central Bank of Iran, 2012

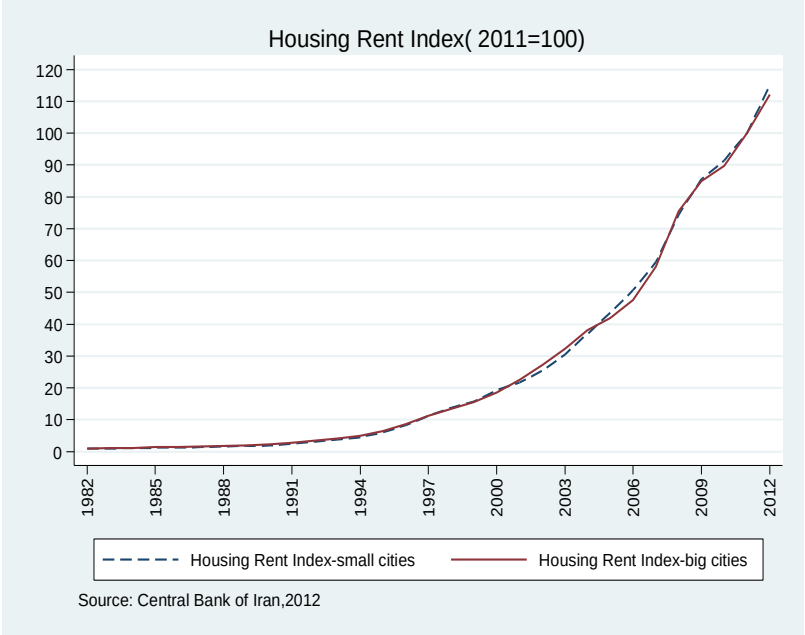


Figure 8: Iran's Housing Rent Index

[11] It includes, restaurant, food service, and hotel



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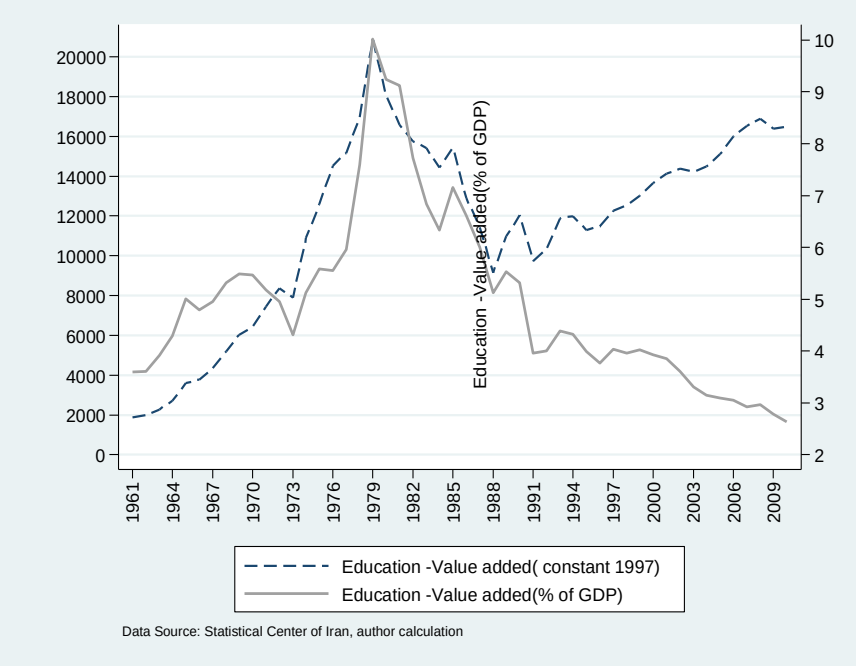


Figure 9: Change in value added of education

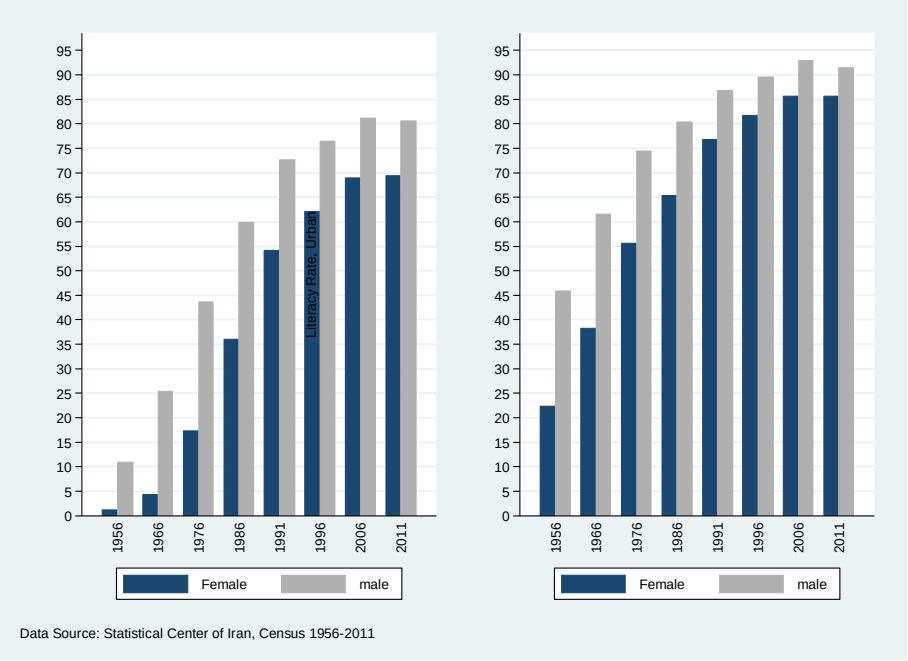


Figure 10: Iran's Literacy rate, by region

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Table 2: Some indicators of the Welfare of men and women in Iran

| | 1976 | | 1992 | | 2002 | | 2012 | |
|---|---|---|---|---|---|---|---|---|
| | Female | Male | Female | Male | Female | Male | Female | Male |
| Youth literacy rate, (% of population ages 15-24) | 42.3 | 70.9 | 81.2[12] | 92.4 | 90.6 | 95.5 | 97.7 | 98.3 |
| Adult literacy rate, (% of population ages 15 and above) | 24.4 | 48.2 | 56.2 | 74.3 | 70.4 | 83.5 | 79.2 | 89.3 |
| School enrollment, Primary (% gross[13]) | 76.6 | 119.1 | 105.1 | 114.5 | 98.2 | 102.9 | 105.2 | 106.6 |
| School enrollment, Secondary (% gross) | 33.9 | 57.5 | 49.7 | 65.7 | 75.7 | 80.2 | 83.4 | 89 |
| School enrollment, Tertiary (% gross) | 2.6 | 6.2 | | | 19.1 | 19.1 | 55.2 | 55.1 |
| Labor force participation rate for ages 15-24 | | | 12 | 58.5 | 14.5 | 53.1 | 13.1 | 48.6 |
| Labor force participation rate for ages 15 and above | | | 10 | 79.3 | 15.9 | 73.7 | 16.4 | 73.1 |

Data Source: The World Bank

12 Literacy rates are the statistics for 1991.

13 This is a Gross enrollment ratio: the total enrollment in primary education, regardless of age, expressed as a percentage of the official population of primary education age. GER can exceed 100% due to the inclusion of over-aged and under-aged students because of early or late school entrance and grade repetition.



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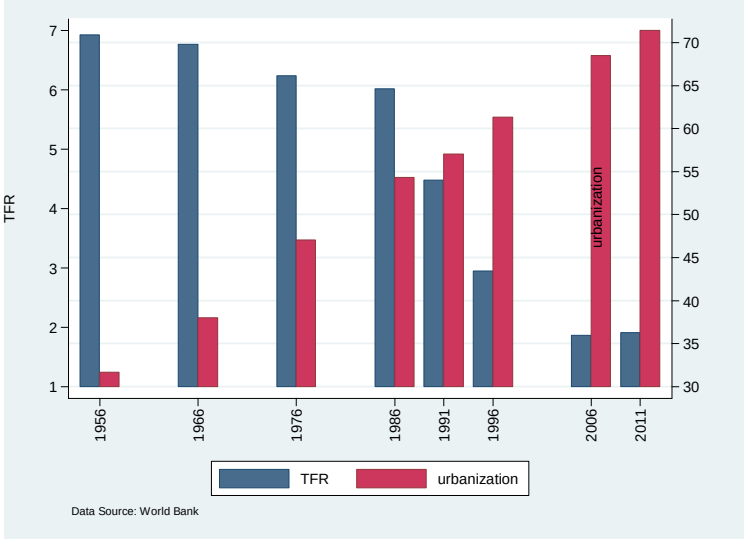


Figure 11: Trends of TFR and Urbanization Rates, Iran

Table 3: Blinder-Oaxaca Decomposition of TFR by region

| Time Interval | Total Change in TFR | Change in TFR due to | |
|---|---|---|---|
| | | Change in urbanization | Change in region-specific fertility |
| 1972-1982 | 0.76 | -0.16 | 0.92 |
| 1982-1992 | -2.63 | -0.14 | -2.49 |
| 1992-2002 | -2.14 | -0.09 | -2.05 |
| 1986-2006 | -3.81 | -0.14 | -3.67 |

Data Source: Abbasi et.al (2006) for region's birth rate; the World Bank for urbanization with Author calculation



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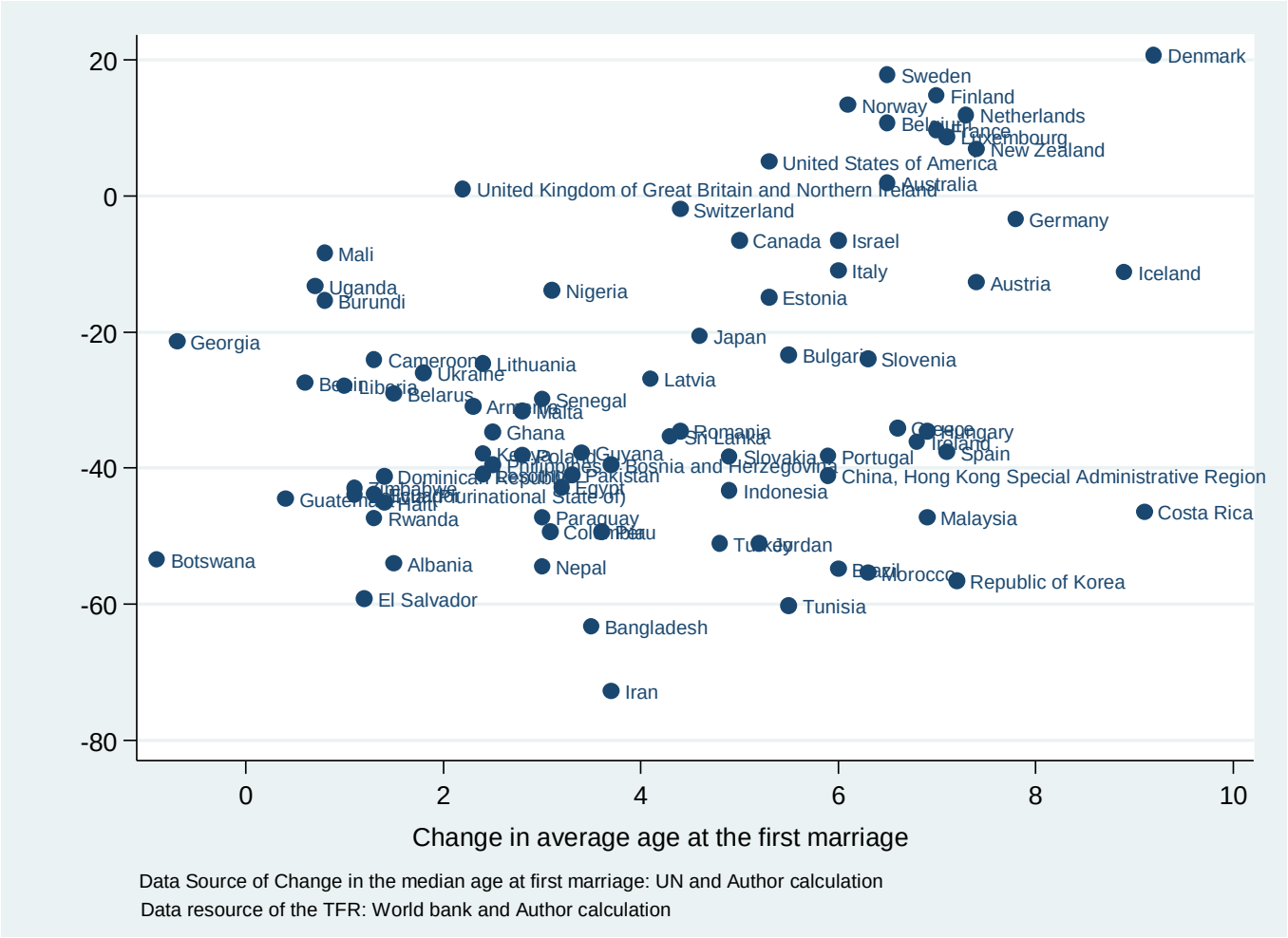


Figure 12: Correlation of change in fertility and change in the average age at first marriage, 1980-2010

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Table 4: Average age at first marriage in Iran

| Year | Rural | | Urban | | Country | |
|---|---|---|---|---|---|---|
| | Female | Male | Female | Male | Female | Male |
| 1956…… | 19.3 | 24.3 | 18.5 | 25.7 | 19 | 24.9 |
| 1966…… | 17.9 | 24.4 | 19.0 | 25.6 | 18.4 | 25.0 |
| 1976…… | 19.1 | 22.7 | 20.2 | 25.1 | 19.7 | 24.1 |
| 1986…… | 19.6 | 22.8 | 20.2 | 24.4 | 19.9 | 23.8 |
| 1991…… | 20.8 | 23.5 | 21.1 | 24.9 | 20.9 | 24.4 |
| 1996…… | 22.3 | 24.6 | 22.5 | 26.2 | 22.4 | 25.6 |
| 2006…… | 23.4 | 25.5 | 23.3 | 26.5 | 23.3 | 26.2 |
| 2011…… | 23.0 | 25.8 | 23.6 | 27.1 | 23.4 | 26.7 |

Data Source: Statistical Center of Iran, Census data 1956-2011



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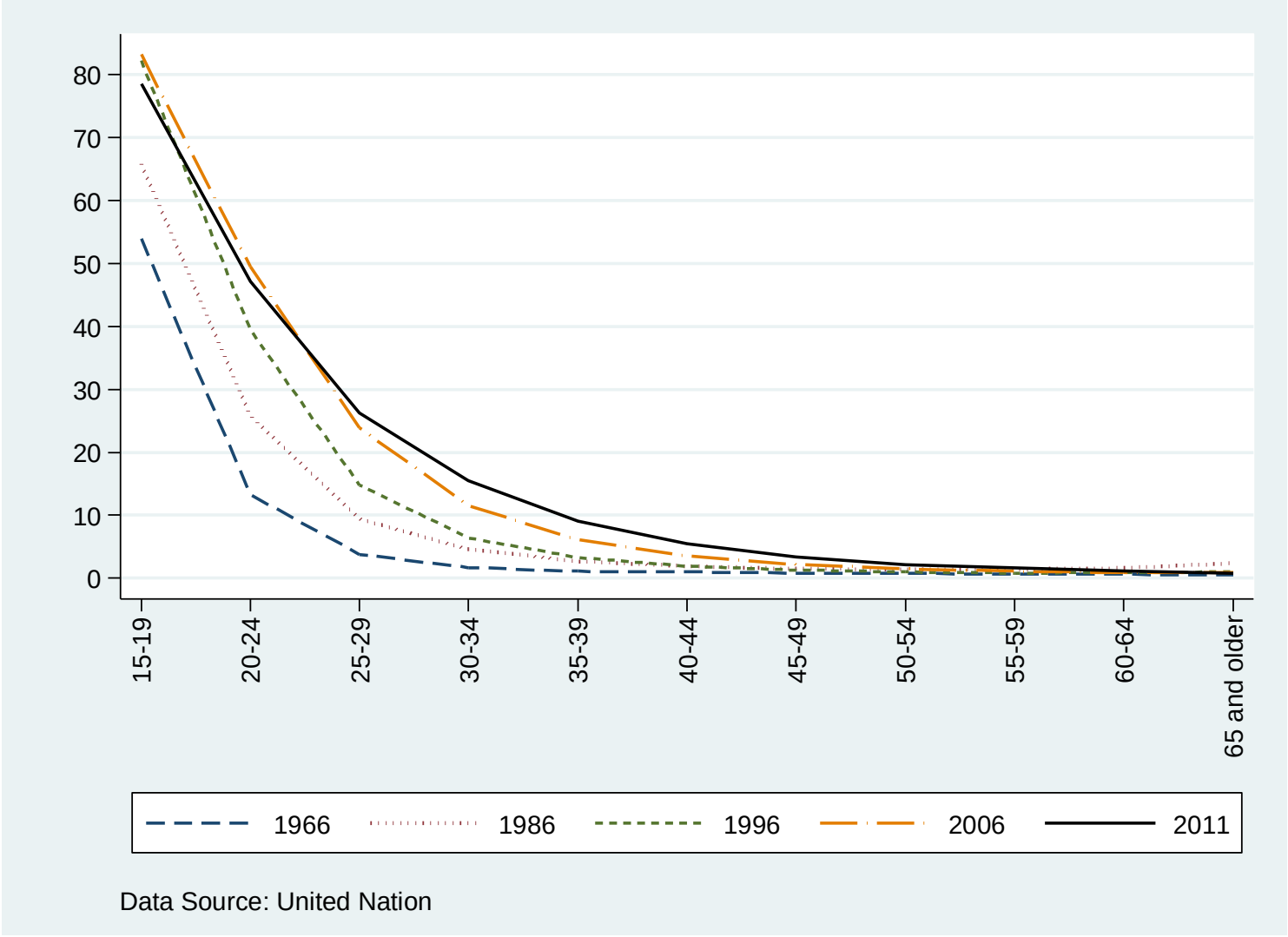


Figure 13: Probability of never being married for Iranian women

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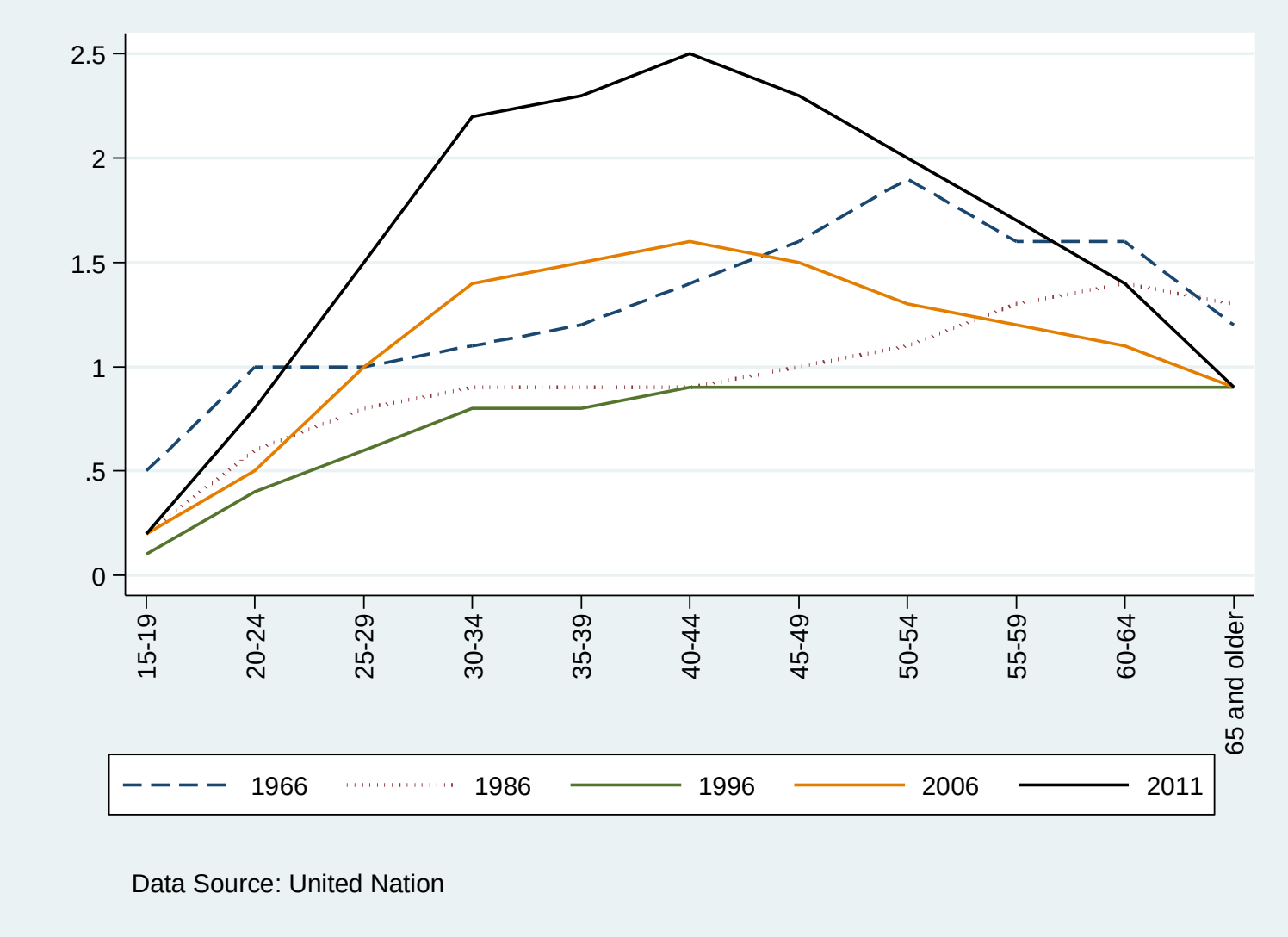


Figure 14: Probability of being divorced for Iranian women

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Table 5: Prevalence of infertility in Iran among women exposed to the risk of pregnancy

| Year | Total population, women aged 20-44 years | Age-standardized prevalence of primary infertility | | | Age-standardized prevalence of secondary infertility | | |
|---|---|---|---|---|---|---|---|
| | | Estimate | Lower 95% uncertainty interval | Upper 95% uncertainty interval | Estimate | Lower 95% uncertainty interval | Upper 95% uncertainty interval |
| 1990 | 8,488,443 | 2.6% | 1.4% | 4.3% | 6.7% | 3.7% | 11.4% |
| 2010 | 17,100,000 | 2.5% | 1.3% | 4.1% | 7.2% | 3.9% | 12.4% |

Source: Maya N. Mascarenhas et al. (2012)



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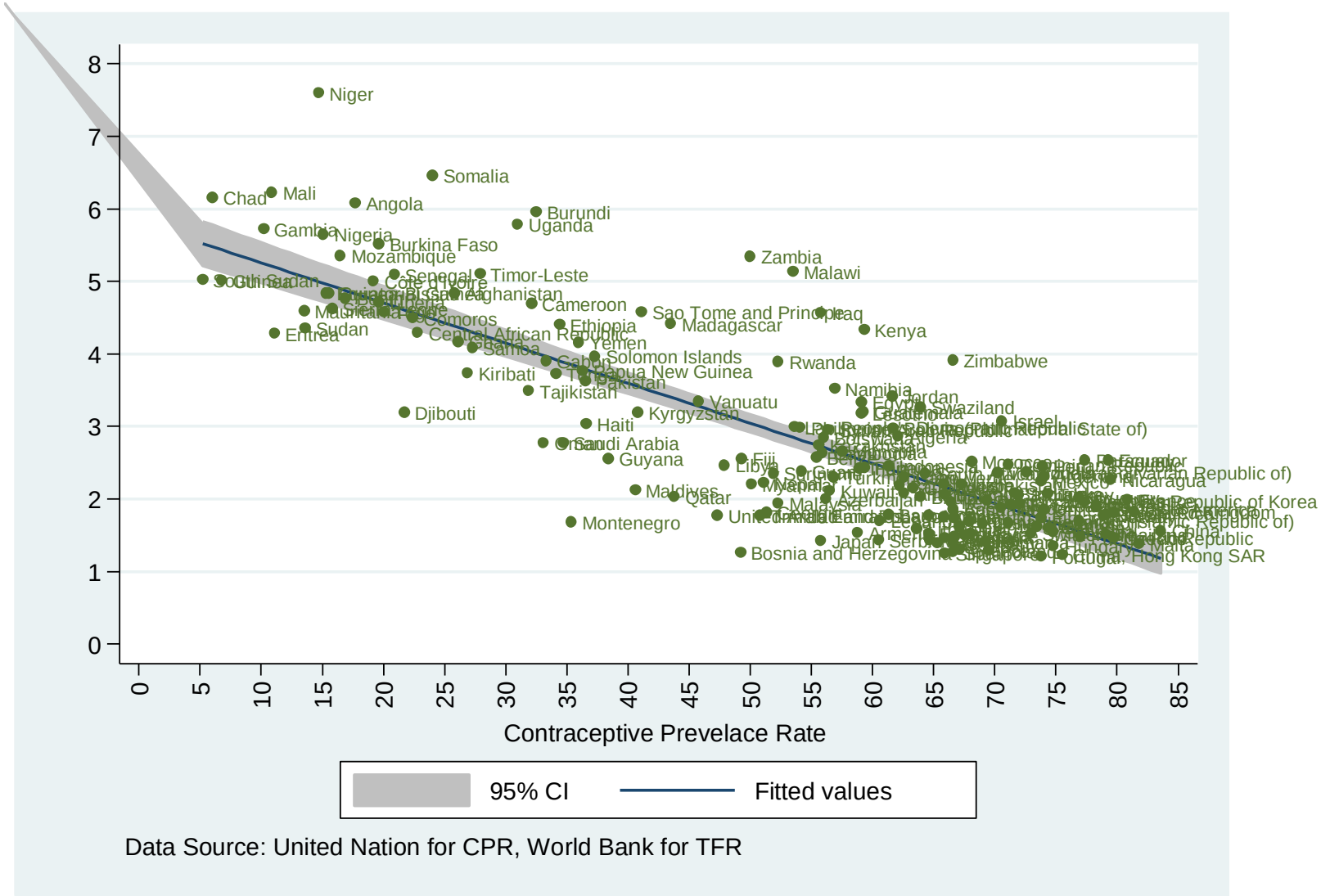


Figure 15: Total Fertility Rate and Contraceptive Prevalence Rate across countries in 2014

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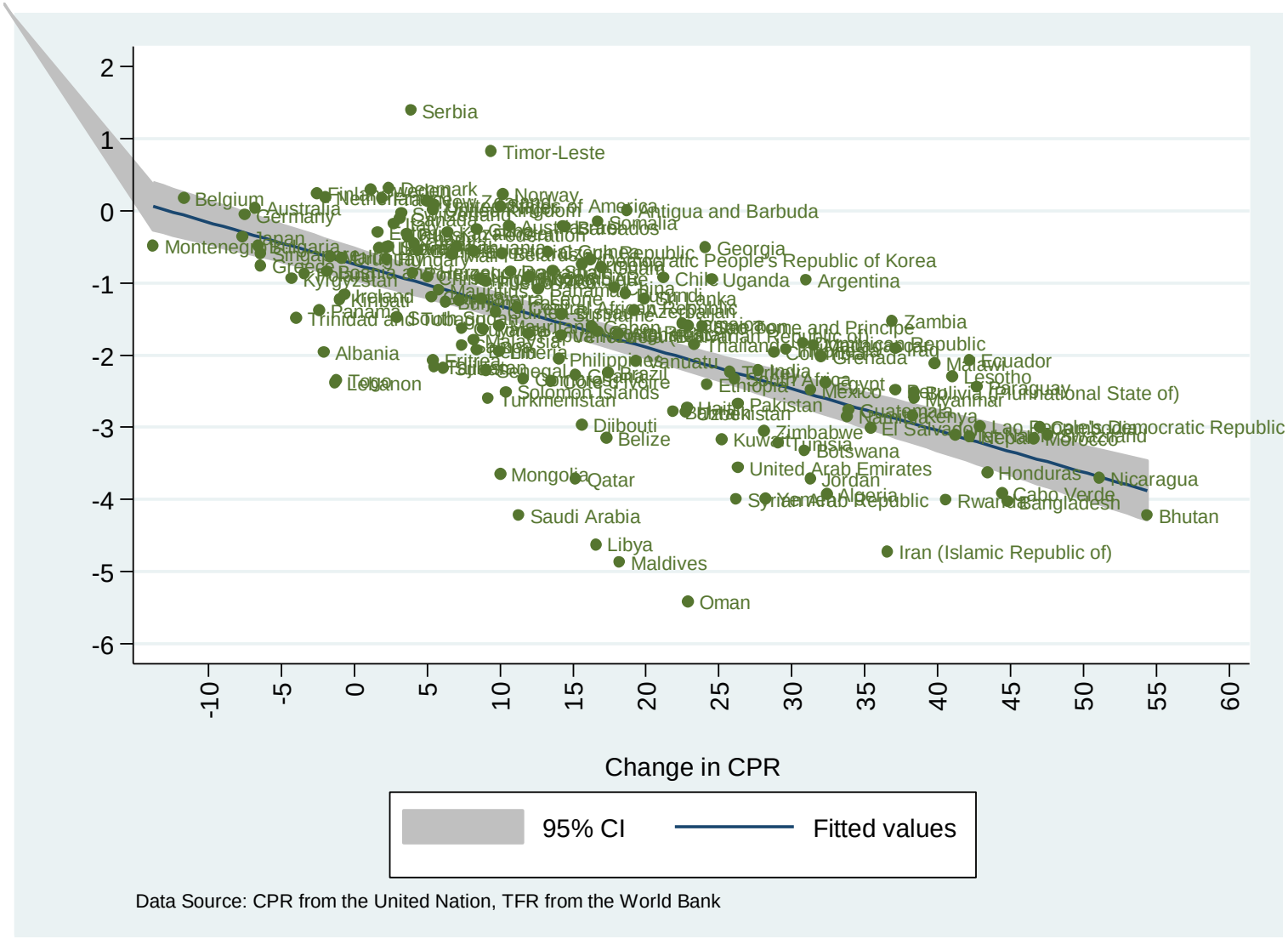


Figure 16: Change in the Countries' Total Fertility Rate and Contraceptive Prevalence Rate from 1980-2010



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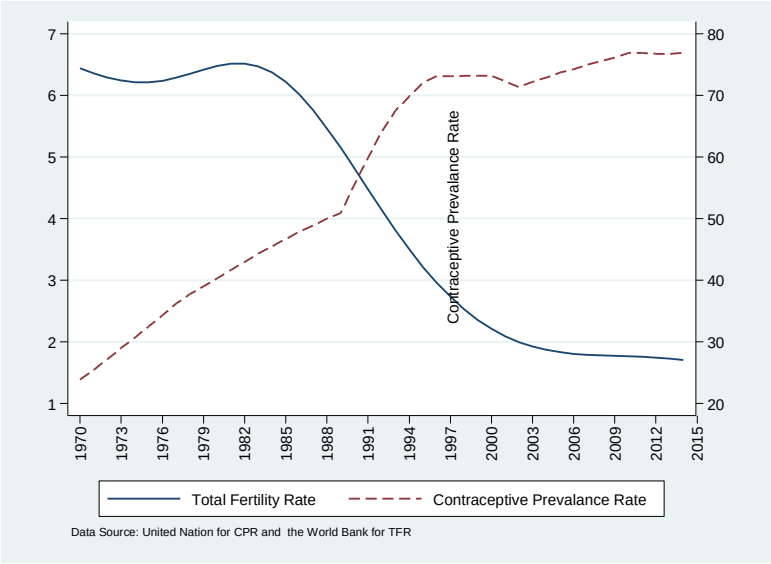


Figure17: Trends of the TFR and Contraceptive Use by Married Iranian Women

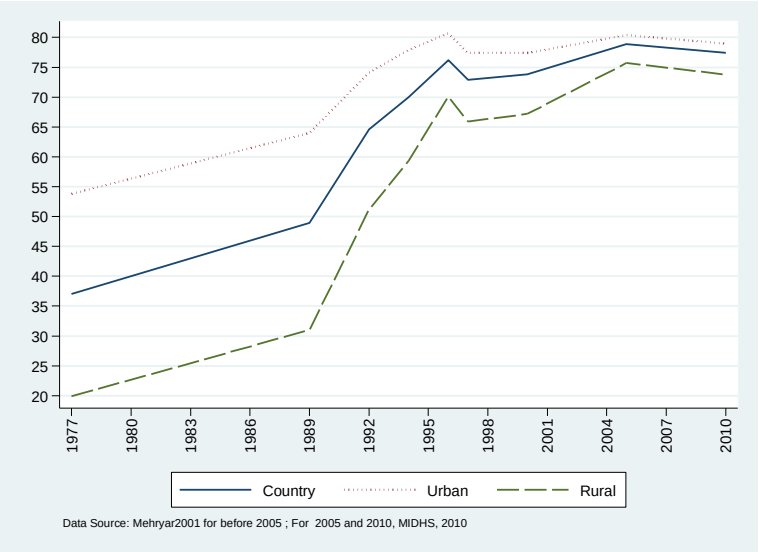


Figure18: Trend of CPR in Iran, by Region



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Table 6: Proportion of married women aged 15-49 using different methods of contraception

| Year | 1989 | | 1992 | | 1994 | | 1996 | | 2000 | | 2010 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | Urban | Rural | urban | Rural | Urban | Rural | urban | Rural | urban | Rural | urban | Rural |
| Pill | 19.0 | 17.0 | 20.1 | 26.1 | 19.2 | 25.9 | 19.0 | 25.8 | 16.5 | 21.9 | 12.8 | 20.4 |
| Condom | 8.0 | 3.0 | 8.0 | 4.2 | 8.1 | 4.7 | 6.6 | 4.3 | 7.2 | 3.6 | 15.8 | 9.0 |
| IUD | 6.0 | 1.0 | 10.0 | 3.1 | 10.7 | 3.9 | 11.0 | 4.7 | 10.2 | 5.3 | 8.3 | 7.7 |
| Tubectomy | - | - | 7.7 | 7.4 | 11.4 | 10.6 | 14.4 | 15.7 | 16.1 | 18.9 | 13.4 | 15.9 |
| Vasectomy | - | - | 1.3 | 0.3 | 1.7 | 0.5 | 2.2 | 0.8 | 3.5 | 1.3 | 3.5 | 1.3 |
| Injection | - | - | - | - | 0.4 | 0.6 | 1.2 | 4.2 | 1.3 | 5.5 | 2.2 | 6.5 |
| Norplant | - | - | - | - | - | - | - | - | 0.3 | 0.7 | 0.0 | 0.1 |
| All Modern | 33.0 | 21.0 | 47.1 | 41.1 | 51.5 | 46.2 | 54.4 | 55.5 | 55.2 | 57.2 | 55.9 | 60.9 |
| Traditional | 27.0 | 8.0 | 27.0 | 10.4 | 25.2 | 10.2 | 24.2 | 9.6 | 21.7 | 9.7 | 24.4 | 13.4 |
| Other | 4.0 | 2.0 | - | - | 1.1 | 2.9 | 2.1 | 5.0 | 0.5 | 0.3 | 0.5 | 0.2 |
| Total | 64.0 | 31.0 | 74.1 | 51.5 | 77.9 | 59.3 | 80.7 | 70.1 | 77.4 | 67.2 | 80.8 | 74.6 |

Data Source: For 1992-2000, Mehryar2001; For 2005 and 2010, MIDHS, 2010



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## Chapter2 : The effect of the government's family planning policies on women's fertility rate in Iran


### Abstract

In the mid-1980s the Total Fertility Rate (TFR) in Iran began to plummet, and in less than 20 years the country experienced a striking 69 percent decrease in fertility. Since this decrease in the TFR coincided with the restoration of the national anti-natal family planning policy, some existing studies credit this policy for the decline in the TFR. However, the TFR may also have been affected by other notable changes in women's socioeconomic characteristics, including their age, education, personal income, and family income. In this paper, I use repeated cross-sectional microdata from Iran's Households Income and Expenditure Survey (HIES) over the years 1984-2014 to estimate the impact of the government's family planning policies on fertility among women aged 17-35, focusing mainly on a general anti-natal policy instituted in 1989 and a reform of the welfare system in 1993. Results indicate that together these policies decreased annual birth rates by 15 percent, with even larger effects in rural areas. Since Iranian law forbids births out of wedlock, I also investigate the policies' effects on the marriage rate and the marital fertility rate. I find that the policies mainly operated through the former channel – especially in rural areas, where the government's family planning policies account for only 3 percent of the decrease in the marital fertility rate. While the 1989 family planning policy drove the decrease in the marital fertility rate in urban areas, increases in education played a larger role in rural areas.



Keywords: Family planning policies, marriage, birth rate, women's education, repeated cross-sectional data. J13 - Fertility; Family Planning; Child Care; Children; Youth





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## 1. Introduction

Iran experienced a sharp decline, 69 percent, in Total Fertility Rate (TFR) from 1982 to 2002. Generally, such a decline only occurs over a span of 40 years in most other developing countries (Figure 1). What distinguishes Iran's declining fertility rate from these other countries is not only how quickly the rate fell, but also the fact that the TFR started to decrease when the Islamic pro-natal government came to power. After the Islamic Revolution of 1979, the government abolished the current anti-natal family planning programs and instead encouraged its citizens to marry early and have many children. In the decade that followed, Iran experienced a high population growth rate, which in 1989 led to the government returning to a national anti-natal family planning policy. The 1989 measures affected all families by encouraging them to have at most two children, mandating birth control counseling for all couples before marriage, and providing free contraceptive devices at public health centers. In 1993, the government further decreed that for every fourth child or more born after 1993 those families would not receive any additional food coupons, paid maternity leave, or any other kind of social welfare subsidy. The government implemented the child support limits policy until 2010, when the continued decline in TFR put the nation at risk of having an aging population in the near future. Thus, the government was forced to revert, once again, to a pro-natal family planning policy in 2013.

Some scholars have argued the sharp decline in Iran's TFR since 1989 was mostly due to the government's anti-natal family planning policies (Aghajanian, 1995; Hoodfar and Assadpour, 2000; Mirzaie, 2005). In addition to examining the government's family planning policies, others scholars have also correlated the decline in TFR with women's socioeconomic conditions such as their literacy rates, levels of education, contraceptive prevalence rates, average marriage age, and residency in rural/urban areas (Abbasi-Shavazi et al., 2009; Saadat et al., 2010). In 2010, Salehi-



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Isafahani was the first to evaluate the impact of the government's family planning policies for decreasing the rural fertility rate in Iran. After 2010, other studies began to analyze the impact of birth spacing and women's age of exposure in rural areas on TFR (Modrek and Ghobadi, 2011; Hashemi and Salehi-Isafahani, 2013). However, throughout all of the existing literature, little attention has been paid to TFR in urban areas. In 1982, 51 % of the country's population lived in urban areas, by 2013 that number increased to 73%. Because of variation in their socioeconomic structures, women in urban areas have a consistently lower TFR than women in rural areas (United Nations, 2001). Therefore, we cannot overlook the role that urban areas may have played in decreasing the country's TFR. Moreover, previous studies have treated the 1989 national anti-natal family planning policy and the1993 child support limits policy as one and the same without considering their premeablity in different types of families. Educated women living in urban areas were supposed to be more responsive to the national anti-natal family planning policy, while illiterate women especially who lived in rural areas were more subject to the child support limits policy.

In this paper, I use repeated cross-sectional household data from the years 1984 to 2014 to measure the impact of the national anti-natal family planning policy and child support limits policy distinctly on declining total fertility rates in both rural and urban areas. Additionally, I investigate the separate but interconnected roles that women's literacy rates, levels of education, personal income, family income, number of previous children, and changes in the country's inflation rate have had on birth rates. Since having your own child in Iran takes place only within marriage, I distinguish the effects of the government's family planning policies and other major factors on the total fertility rate and their effects on the marital fertility rate by investigating a marriage model.



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My findings indicate that the national anti-natal family planning policy was more effective in decreasing the country's birth rate than the child support limits policy, with a larger effect in urban areas. Unlike the homogenous effect of the national anti-natal family planning policy on areas' birth rates, child support limits policy affected rural areas different from the urban areas. It had a negative impact on the rural fertility rate, versus a positive but statistically insignificant one on the urban fertility rate. Moreover, these two anti-natal policies had heterogeneous effects on literate and illiterate women. While the national anti-natal family planning policy decreased literate women's fertility rate, child support limits policy decreased illiterate women's probability of giving birth. Indeed, these two policies were complementary.

The results show that the government's anti-natal policies were a more important factor in decreasing the fertility rate in rural areas than changes in women's literacy rates and their education. In contrast, changes in women's literacy rates and education decreased the urban fertility rate one and a half times more than the policy did. Among non-policy determinants of women's fertility, women's personal income has had a negligible effect, suggesting a smaller income effect than the substitution effect. Changes in country's inflation also have not influenced the birth rate a lot, possibly because Iranians have grown to expect high inflation in any event.[1]

The remainder of this paper is organized as follows. Section 2 is the historical background of the TFR and family planning policies in Iran as well as previous empirical studies in this regard.

[1] Considering the method of sampling in the data set I used, I couldn't check how changes in urbanization may have participated in lowering the fertility rate in Iran. However, using the World Bank urbanization data and regional fertility rate from Abbasi Shavazi et al. (2009), the Oaxaca decomposition indicates that despite a 14 percent increase in urbanization from 1982 to 2002, the change in women's probability of giving birth due to change in urbanization is 4 percent, and 96 percent is due to changes in region-specific birth rates.



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Section 3 describes the data and the methodology used in this study. The fourth section explains the empirical results derived. In section 5, I estimate how well the model describes Iran's falling TFR and separate the total fertility rate from the marital fertility rate by estimating a marriage model. The last section is the conclusion.

## 2. Background

As Figure 1 shows the TFR in Iran was relatively high at 6.7 births per woman (bpw) in 1966. This rate was similar to those of most other developing countries of the time.[2] Apart from those located in Sub-Saharan Africa, all developing countries have experienced a considerable decrease in the TFR over the last five decades. By the Twenty-First Century some of them had approached the replacement level fertility of 2.1 bpw. What makes Iran different from other developing countries, especially Middle Eastern and North African (MENA) countries, is the speed of the decline. In twenty years, Iran's TFR plummeted from 6.5 bpw in 1982 to 1.9 in 2002, whereas elsewhere the decline unfolded over forty years.

Since the precipitous decline in Iran's TFR coincided with the reintroduction of the anti-natal family planning policy in 1989, some existing literature credits the TFR decline to this policy (Aghajanian, 1995; Hoodfar and Assadpour, 2000; Mirzaie, 2005, Abbasi-Shavazi and McDonald, 2006). In this regard, the similar pattern of the TFR across provinces in Iran (see Figure 2) supports the idea that cause of the rapid decrease in the TFR is something that has affected the entire nation at once; a prime candidate could be the national government's anti-natal family planning policies.

[2] The TFR in all developing countries, except those located in Europe and Central Asia, was roughly 6 bpw in 1966. In developing countries in Europe and Central Asia it was about 3.3.



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However, as Abbasi-Shavazi et al. (2009) stated, the fast drop of Iran's TFR had started in 1984, five years before the policy restoration. Moreover, as we will see in section 2.1, the TFR has decreased steadily for nearly a half-century, even as the direction of the country's fertility approach has changed several times. Thus, in addition to the government's family planning policies, other factors including changes in women's socioeconomic conditions such as their literacy rates, levels of education, personal income, average marriage age, and residency in rural/urban areas likely played considerable roles in the country's fertility drop.

### 2.1 Overview of the family planning policies in Iran

From 1967 to 1979, a national anti-natal family planning policy had been in place in Iran. By the end of the Islamic Revolution in 1979, religious leaders argued that the previous secular regime's anti-natal family planning policy was a tool of western nations to weaken Muslim countries. Therefore, the new Muslim government ceased the current anti-natal program and instead adopted a pro-natal approach by encouraging early marriages and bigger families. However, this pro-natal policy was a form of moral suasion without allocating any official funds. Since giving birth out-of-wedlock is legally and religiously forbidden in Iran, the new government decreased legal marriage age from 20 to 15 for men and 18 from to 13 for women to increase the birth rate.

The year after the Islamic Revolution, Iran was involved in a long war with Iraq for eight years. During the war years, the country experienced an average annual economic growth rate of -1.6 percent; basic commodities were rationed and infants were entitled to an adult-sized portion of subsidized goods (Saadat et al., 2010). This rationing system may well become an unsustainable economic incentive to push families to have more children. When the war ended, Iran with 3.6



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percent annual population growth rate was the fourteenth highest country in the world. Therefore, the government reinstated a national anti-natal family planning policy in 1989. The national anti-natal family planning policy that was an informative policy to promote contraception, encouraged families to have at most two children, to retain birth spacing, and to avoid women from having pregnancies before 18 and after 35. Therefore, pre-marriage family planning counseling classes became mandatory for couples and the government provided all families with free modern contraceptives through the public health centers. Even in remote areas, these services were carried out through the mobile clinics (Vakilian & Mirzaii, 2011). The national anti-natal family planning policy was supported by the clergy at the national and the local levels. In a complementary action, in 1993 the parliament passed further legislation withdrawing food coupons, paid maternity leave, and social welfare subsidies after the birth of the third child for every family. The 1993 child support limits policy on which a particular group of families were affected was dismantled at 2010.

Currently, the reduction of the birth rate that was once crucial to checking rapid population growth, turned out to be an economic and political crisis in Iran. A sharp decline in the TFR threatens the country with serious problems including an aging population, lower working age population, saving rates and production rates. Thus, in order to prevent socioeconomic consequences of the aging population, in 2006 Iran's government started to urge couples to have more children. In this regard, the government introduced a baby bonus scheme in 2009 to encourage larger families. However, the scheme stopped after one year because of budget insufficiency. Eventually, in 2013 the national anti-natal family planning policy was officially curbed and a year later an official national pro-natal family planning policy was implemented. Although the national anti-natal family planning policy officially stopped at 2013, since 2006 the government started to balance the anti-natal policy with some pro-natal approaches. Thus, I



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considered the years 1989-2006 as the years of national anti-natal family planning policy. Also, I considered 2013-14 as the years that national pro-natal family planning policy was implemented. Because over the years of 1980-1988 there was not a cross-sectional variation in the policy, and because a major war happened at the same time, therefore it is not easy to separate the war effect from the policy effect. For a timeline of major events and policies possibly affecting fertility in Iran, see Figure 3.

### 2.2 Previous Empirical Studies

The effects of family planning program in Iran and other developing countries have been investigated in many studies. In a multivariate analysis of developing countries, Bongaarts (1997) found that program efforts do not have a significant effect on wanted fertility, but the level of development significantly decreases it. Miller and Babiarz (2014) review existing empirical studies on the micro-level consequences of family planning programs on fertility and other socio-economic outcomes in developing countries. While some of the studies they review conclude that family planning programs do not have statistically significant effects, others find that family planning programs reduce fertility by 4-20 percent, increase birth intervals by 5-7 percent, raise women's educational attainment by up to 30 percent, and raise children's educational attainment by 5-18 percent.

Only a handful of studies have investigated Iran's fertility policies in particular. The most comprehensive study is by Abbasi-Shavazi et al. (2009), although its main goal is to report the trends and policies, rather than to evaluate explanations. They illustrate that how fast the fertility rate has decreased in all areas of Iran and among women of all ages. They also find the government's anti-natal family planning policies successful in falling the country's birth rate.



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However, they describe some contributors including, rise in women's literacy, higher age of marriage, rural development, and health improvement which made the Iranian family planning program to be so successful in such a short time.

Other studies have focused specifically on the role of one particular feature of Iran's family planning program: rural health houses, health centers in rural areas that after 1989 offered free contraception services to villagers. Salehi-Isfahani et al. (2010) combine data from Iran's Ministry of Health with population census records of 1986 and 1996 to show that health houses contributed to 4 to 20% of the decline in the fertility rate depending on the villages' under-five-year children. They used child-to-woman ratio in each village as a fertility measure. Modrek and Ghobadi (2011) infer the effects of health houses indirectly, by examining the difference in fertility between women who were exposed to family planning at ages when they are more fertile and those who were exposed at more advanced ages. Using data from 2001 HIES, the 2006 Iranian Census, and the location and dates of operation for each rural health house, they find that lifetime fertility was 18 percent lower among women who were first exposed to family planning services between the ages of 20-34 than it was among women who were first exposed after age 40. Using a similar approach, Hashemi and Salehi-Isfahani (2013) report that the presence of a program was associated with a 5-7% increase in birth spacing (Miller & Babiarz, 2014).

Although each of these papers focused on the programs' effects in rural areas, there has also been a corresponding decline in fertility in urban areas. One contribution of the present study is thus to estimate the effects of family planning policy in both rural and urban areas. Moreover, I consider potential differences in the effectiveness of the government policy across different provinces. I also consider the effect of both national anti-natal family planning policy and child



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support limits policy on women's birth rate separately while other studies looked at them as one and the same.

## 3. Data and Model of Childbirth Description

### 3.1 Data description

The data used in this paper come from the 1984-2014 *Household Income and Expenditure Survey* (*HIES*), an ongoing annual survey that has been conducted by the Statistical Center of Iran for more than 30 years. *HIES* provides a comprehensive range of statistics related to each household's finances, as well as demographic information on each household member's sex, age, marital status, education level, labor force status, etc. In the 30 years of data that I use, 495,268 households were interviewed, 49 percent of which are located in urban areas compared to 51 percent in rural areas.[3]

Despite the extensive data that *HIES* provides, *HIES* is a repeated cross-sectional survey, whereby independent samples of households are randomly observed over time. Thus, to estimate the parameters which characterize the dynamics of each woman's fertility, I have constructed a pseudo-panel for each interviewed woman. A birth history for each individual woman can be derived from the ages of the children living in her household, assuming all children are alive and living with the family at the time of the survey. I only consider women aged 17-35 because children in Iran often leave their families around the age of 18, either for marriage, education, or military service. Restricting the data to women aged 17 to 35 does not account for those living children

[3] The survey uses stratified sampling and divides the sample by province and urban–rural location to ensure representative estimates at those levels.



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who were born when their mother was under 17 and who left the household by the time of the survey. A mother's deceased children are also not included, but this should not cause significant measurement error because the child mortality rate is not too high in Iran.[4] In those households in which more than two generations live together, I do not match daughters-in-law with their children to avoid creating a new measurement error. However, over the last 30 years only 6.5 percent of married women lived with their in-laws.

Unlike the women's birth history, it is not simple to estimate previous values of some control variables that affect a woman's fertility rate (e.g., their personal income and education levels or their husband's income) for the years before the survey date. In most cases, there is little choice but to assume that a woman's characteristics have not changed between age 17 and the age at which she was surveyed. For example, I have assigned a woman's educational level in the years before the survey to the same level as it is listed on the survey. For the husband's income variable, which is generally the family's primary source of income, I found the family's income decile in the area in which each family lived at the time of survey and assumed that decile was the same for the years before the survey. An alternate interpretation of this procedure is that the household's position in the local income distribution at the time of the survey is a good representation of its position in the local permanent income distribution. I also predicted a woman's pre-survey income based on their socioeconomic characteristics including: the labor force statue, type of employment,

[4] The child-under-five mortality rate decreased from 82.5 per 1000 births in 1984 to 16.8 per 1000 births in 2013 (World Bank data).



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age, literacy, education, province in which they live, whether they live in a rural area or in an urban area, a time trend, and the lag of inflation.[5]

The summary statistics for five selected years of women in the sample are presented in Table 1. The top lines show that the fertility rate of women aged 17-35 has been declining rapidly. In just over 29 years the average number of births per woman decreased from 4 to 0.3 in rural areas and from 3 to 0.4 in urban areas. The average age of women who had been married at least once has followed a similar pattern of growth in rural and urban areas. Since 1997, the average age of a married woman, which had only increased slightly until then, started to increase noticeably. The marriage rate has also decreased by roughly 16 percent in both areas. A mother's average age at the time she gave birth to her first child indicates that Iranian women are having children at an older age.

This decrease in fertility may be explained in part by several other economic trends between 1984 and 2013, especially those involving women's literacy, levels of education, and labor force participation. During this time, the literacy rate among women living in rural areas skyrocketed by an astonishing 66.5 percent, while the literacy rate gap between rural and urban areas shrunk by 37.3 percent. The percentage of women who had at least a high school level of education also has increased sharply in both urban and rural areas, respectively from 28.0 to 70.0 percent and from 3.6 to 36.2 percent. The labor force participation rate for women who live in rural areas had always been greater than the rate for women in urban areas, which in part is attributed to the number of family businesses in rural areas. Still, participation was growing in both areas until the final year

[5] Contrary to labor income which is predictable, there is no data to predict historical non-labor income for women and their husbands.



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reported in the table, and it seems likely that the reduction in 2013 reflects the sharp downturn in the Iranian economy during that year rather than a structural break.

### 3.2 The Model

This paper uses a binary choice model to estimate the effect of the government's family planning policies on women's probability of giving birth. The model is expressed as:

$$\Pr\left(B_{i_{(t)}s} = 1 \middle| X'_{i_{(t)}s}\right) = F(X'_{i_{(t)}s}\beta) \quad (1)$$

$$i_{(t)} = 1_{(t)}, 2_{(t)}, \dots\dots, N_{(t)} \ , \qquad s = 1,2, \dots., T$$

Where $B_{i_{(t)}s}$ is a dependent variable that takes either 1 if $i^{th}$ woman living at time $t$ $(i_{(t)})$ decides to have a child at time $s$ or 0 otherwise. F(.) is assumed to have a logistic distribution. This model is identical to the latent variable model:

$$I_{i_{(t)}s} = X'_{i_{(t)}s}\,\beta + e_{i_{(t)}s} \quad (2)$$

$$B_{i_{(t)}s} = \begin{cases} 1 & if \quad I_{i_{(t)}s} > 0 \\ 0 & otherwise \end{cases} \quad (3)$$

Where $e \sim F(.)$ and $I_{i_{(t)}s}$ is an index function of the propensity to reproduce.

$X'_{i_{(t)}s}$ is a vector of observed explanatory variables that affect a woman's fertility decision: dummy variables representing the government's family planning policies, a woman's age, age squared, level of education, personal income, personal income's interaction with time intervals[6],

[6] I assume that a woman's recent income is a more accurate indication of her permanent income than is the previous years' income.



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family income, family income's interaction with the woman's age at the time of survey,[7] a dummy variable for giving birth in the preceding year, number of previous children, number of previous sons, a dummy variable for the years that the country was at war, change in inflation, and time trend.

The government family planning policies considered in this model are the 1989-2006 national anti-natal family planning policy, the 1993-2010 child support limits policy, the 2009 baby bonus scheme, and the 2013-2014 national pro-natal family planning policy. The national anti-natal family planning policy and child support limits policy were supposed to decrease the fertility rate while the baby bonus scheme and the national pro-natal family planning policy were aimed at increasing the fertility rate. However, since the country experienced a recession in 2013 and 2014, there is not yet enough information to distinguish the policy's effect from the recession's. Therefore, I will not interpret the national pro-natal family planning policy's coefficient. Similarly, as the baby bonus scheme was only in place for a year and it was not administratively successful, I will not interpret the baby bonus scheme's coefficient.

Because of cultural differences between rural and urban areas, I expected that the government's family planning policies have affected a family living in rural areas differently than a family living in urban areas. Even within a given area, family planning policies affect women differently according to their level of literacy and their age. Therefore, I included all of the government's family planning policy dummy variable interactions with the explanatory variables of a rural dummy, a literate dummy, and a woman's age. However, since the child support limits policy mainly affected families with three children or more, I added this policy's interaction with

[7] Family income for older women is a good proxy for their lifetime income than for youngers.



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the number of previous children as a new explanatory variable to the model. The probability of giving birth changes as a woman ages, as women in their twenties are more likely to give birth. Thus, I have categorized women into five age groups: 17-20, 21-24, 25-28, 29-32, and 33-35.

Women's literacy rate and their level of education are two other variables that affect the fertility rate by affecting both the opportunity cost of giving a birth and effectiveness of the contraception. Thus, women with higher educational levels are supposed to have a lower fertility rate. In this study, women are classified into four groups based on their educational achievements: women with primary education, guidance school education, high school education, and college education. Women with the same educational level but different ages have different fertility behavior; older women are more experienced and more likely to be successful in controlling their fertility, and younger women are less likely to use contraception effectively (Schmidt, 2008). Also, women from different birth cohorts who have the same educational level also have different fertility behaviors. A woman's higher education in previous cohorts indicated a higher socioeconomic level of her family. Therefore, I interacted women's education with both their age and birth cohorts. Women are clustered into 4 groups based on the year they were born: those born in 1959-68, 1969-78, 1979-88, and 1989-98.

I introduced a dummy variable that indicates if a woman gave a birth in the preceding year. I assume that giving birth in the previous year negatively affects a woman's probability of giving birth in the following year because a mother's body needs time to heal. The number of children (and particularly the number of sons) a woman already has may also negatively affect her demand for a new birth. Women from different cohorts who have the same number of children display different fertility behavior because of their difference in the desired number of children. In addition, families' attitudes about having a son has changed over time, so I also included



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interactions of each number of previous children and the number of sons with women's birth cohort.

War may decrease the TFR because of involuntary spousal separation, postponement of new marriages, or because of economic hardships. However, war could increase TFR because of limited birth control devices and family planning services and prevailing pro-natal ideologies. Although war affects the whole country at once, I expect to see a higher birth rate in provinces which are most involved in the war. Because of both higher mortality rates in those provinces and those provinces' cultural desire to have more children (especially more sons). I allowed the war effect to differ across provinces. Also, inflation may decrease the fertility rate, either because of higher cost of child-rearing or due to decreasing consumers' confidence.

Finally, in a pseudo-panel, individual histories are not available for inclusion in the model, therefore we can use the cohort sample mean instead of individual observations as an explanatory variable (Collado, 1997). I also included area-level fixed effects, $\gamma_k$, and province-level fixed effects, $\mu_j$, to control for all area and province-specific variables including level of socioeconomic development, religion, ethnicity and other cultural norms that could confound the estimates.

## 4. Empirical Results

Table 2 shows the estimates of the logit coefficients from the model of total fertility arising from changes in the women's socioeconomic characteristics and the government's family planning policies using a region and province fixed effect specification. Most of the coefficients are statistically significant. However, since the multitude of interactions makes the raw logit coefficients difficult to interpret, the Tables 3-5 report mean marginal effects of the most important



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explanatory variables. Table 3 displays the marginal effects of the government anti-natal policy broken down by different factors. It shows that the national anti-natal family planning policy has decreased Iranian women's probability of giving birth by 11 percent over the years 1984-2013. This effect in urban areas is larger: the probability of giving birth for women living in urban areas decreased by 14 percent, compared to 9 percent in rural areas.

The national anti-natal family planning policy also affected literate women differently from illiterate women. Although the policy decreased literate women's total fertility considerably, it had a positive effect among illiterate women. The difference in the effects by women's literacy also differs somewhat by the area of residency. In rural areas we see a smaller negative affect of policy on literate women and a larger positive affect on illiterate women compare to the urban areas. A more detailed look points out that among literate women, in both rural and urban areas, women with more children will respond to the policy more efficiently, which could reflect their experience. The national anti-natal family planning policy is more effective in reducing fertility as women's age goes up.

Giving a birth could be due to an unwanted pregnancy, either for an ineffective use or the nonuse of contraceptives. Religious and traditional familial institutions in rural areas may result in psychosocial factors associated with contraceptive decision making, including contraceptive knowledge, attitudes, and self-efficacy.[8] Attitude and self-efficacy are significantly related to intended contraceptive use. (See Bogale et al. (2010), Hidarnia et al. (2009), and Sangi-Haghpeykar et al. (2006).) As a result of implementing national anti-natal family planning policy,

[8] Perceived self-efficacy is concerned with people's beliefs in their ability to influence events that affect their lives.( Bandura, 2010 )



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families in both areas had equal access to the contraceptive services. Although economic factors and access to the family planning services are important in promoting contraceptive prevalence rate, disparities in contraceptive knowledge, attitudes[9], and use resulted in different reproductive behavior in different areas (Beekle, 2006). Over the years 1989-2010, coincided with the implementation of the national anti-natal family planning policy, the contraceptive prevalence rate[10] increased from 31 percent to 75 percent in rural areas. Among several contraceptive methods, the pill is the most popular contraceptive method in rural areas, but the last Iran Demographic and Health Survey (IDHS) reported that only 51.5% of women taking the pill used it correctly (Hidarnia et al., 2009). Ehsanpour et al (2011) explain that most unintended pregnancies occur when contraceptive methods are discontinued or used non-continuously or inappropriately.

Table 3 also shows that the anti-natal family planning policy has a greater effect on older women. Abbasi-Shavazi et al. (2013) expressed that younger Iranian women use more temporary methods of birth control, like the pill and traditional methods, while among women above age 30 tubectomy, a secure permanent method of birth control, is the most common. Using permanent methods of birth control after age 30 is more common in rural areas than the urban areas. Older women are more likely to have a greater number of previous children, which makes preventing pregnancy more serious. As they age, couples get more experienced in contraception.

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[9] Considering of the prevailing female methods of contraception in rural area, it is more those likely to believe that birth control use is the responsibility of women.

[10] Contraceptive prevalence rate is the percentage of women who are currently using, or whose sexual partner is currently using, at least one method of contraception, regardless of the method used. It is usually reported for married or in-union women aged 15 to 49.(WHO)



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Marginal effects of the child support limits policy are broken down by several factors display in Table 4. It shows that unlike the national anti-natal family planning policy, the child support limits policy mostly affected illiterates and women living in rural areas. Since this policy mostly affected families who desired to have more than three children, women in rural areas and illiterates were more subject to this policy. Moreover, as Kohler (2001) states social interactions affect women's fertility behavior: women's contraceptive use and effectiveness are determined by their friends' and neighbors' experience through social learning. Since in rural areas, more women were involved in this policy, social interactions were more dominant. The child support limits policy not only decreased the birth rate of women who already had 3 children, but also it had a great discouraging effect on women with one and two children. This policy decreased probability of giving birth of women with more than three children in urban areas slightly. This could show that women who already had more than three children had desired to have more children so that the policy couldn't change their decision.

Table 5 shows marginal effects of the non-policy variables on women's fertility decision. The increase in literacy rates decreased women's propensity to reproduce by 8 and 10 percent in rural and urban areas respectively. Changes in education had quite similar effects in both areas. As expected, women with a primary education are 28 percent more likely to give birth than women who graduated from high school. Among different levels of education, women with college degree have the lowest fertility rate. Generally, more-educated women have higher rates of contraceptive use and they are more likely to rely on effective methods than their uneducated counterparts (Martin, 1995). Education affects the fertility rate by affecting marriage duration and net family income, either because more educated women are more likely to be employed and earn higher income or because they marry men with higher income (Sathar et al., 1993). Women with no



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previous children are 69 percent less likely to give birth than women who already have a child. It could indicate that women with no children are not willing to have a child yet or that they cannot have a birth for a reason of infertility or being single. Propensity to reproduce decreases by around 45 percent for women who already had more than one child, compared to women who had one child. Having a son decreases women's probability of giving another birth by 11 percent. Relative income of a family compared to the income of other families living in the same area also affects women's decision to procreate. Putting families from the lowest income decile aside, families with a greater relative income have a lower fertility rate. A woman in a rural area has 10 percent higher fertility rate than a woman living in an urban area. War increased women's probability of giving birth by 2 percent, possibly because of the prevalence of pro-natal ideologies after the revolution and rationing system of food and necessary goods.[11] Changes in inflation did not affect women's birth decisions.

## 5. How well does this model explain the trend of fertility?

### 5.1 Factors affecting the Total Birth Rate

Figure 4 indicates that the country's mean birth rate has decreased from 19.4 births per hundred Iranian women aged 17-35 over the years 1984-1988 to 3.6 births in the years 2009-2013. Applying a quasi-Oaxaca decomposition, I tried to figure out how related factors may contribute in the annual birth rate decline during those three decades. Table 6a represents some back-of-the-envelope estimates of related factors' effects on the declining total birth rate. The main factors that

[11] Infants received a same portion of subsidized goods as adult did.



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could explain women's total birth rate are changes in women's education and income, the change in their age distribution, the number of their previous children, and the government's family planning policies. However, number of previous children reflects in part indirect effects of the other variables, through their effect on prior fertility.

The government's family planning policies played an essential role in creating such a trend. The national anti-natal family planning policy and the post-1993 fertility disincentives predict a 15 percent decrease in the country's annual birth rate, more than all of the other observable categories together. Although the effectiveness of the national anti-natal family planning policy on Iranian women's annual birth rate is roughly three times greater than the effect of child support limits policy, these policies together had a similar effect over rural and urban areas. However, the former reduced birth rates more in urban areas and the latter was more effective in rural areas.

Table 6b shows that the literacy rate improvement predicts an additional 8.7 percent reduction of the country's annual birth rate. According to HIES, the literacy rate of women aged 17-35 years old has increased by 43.7 percent from 1984-88 to 2009-2013, which predicts that the fertility rate would fall by 8.7 percent of 43.7 percent, or 3.8 percent. Similarly, women with higher levels of education have a lower probability of giving birth, which is not surprising considering their higher opportunity cost of having a child. For example, as compared to women with high school education, those with college education are 46 percent less likely to have a birth. On the other hand, the fraction of women with higher levels of education has been increasing over time. Hence, the 18.50 percent increase in the fraction of women aged 17-35 with a college education predicts an 8.6 percent decrease in annual birth rate. All-in-all, the change in women's educational attainment reduced fertility by 7.3 percent. The largest component is associated with the increase in college education, both because there has been a large increase in the share of women who



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graduate from college and because that level of education is associated with a large decrease in fertility. Results suggest that changes in the education distribution had an asymmetric effect on birth rates over the areas. The noticeable negative effect on birth rates in urban areas, in contrast with a positive effect in rural areas, is mainly because of the lower levels of education in rural areas than urban areas. In less developed areas, education has a positive effect on fertility at the lower end of educational range (Martin, 1995). The slightly higher fertility among women with a few years of schooling is a by- product of the particular system of relationships between education and the proximate determinants of fertility at the early stages of the fertility transition (Martin, 1995).

Finally, the change in women own real incomes over this era explains virtually none of the gap. The negligible effect of women's income on the annual birth rate comes from the fact that their real income has decreased by 3.8 percent over the last three decades. In addition, the low Iranian female labor force participation rate (presented in table 1), and its decreasing trend over the last three decades, indicates that women's income in Iran cannot be a strong determinant of the fertility decision. This negligible effect also may indicate that the substitution effect resulted by the change in women's real income is compensated by its income effect.

The number of children that a woman had previously affects her decision to have a new birth. Table 5 shows that the probability of having a child among women with no previous child is much less than among women with one previous child. Also, the probability of having a child for women who already have 2 children or more is about 40 percent less than among women with one child. Considering the 39 percent increase in the share of women with no previous children and 40 percent decrease of women aged 17-35 who had more than 2 previous children, the annual birth rate decreased 16 percent in the country. However, this is quite possibly because many women



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with zero kids had not married yet. If so, the coefficient is less a causal effect than a proxy for marriage.

Changes in all of the included variables in table 6a predict 41.9% of the 81.5% decline in the country's mean birth rate over the years 1984-88 and 2009-2013.[12] This is 51.4 percent of the actual change, thus 49.6 percent of the decrease in birth rate is explained by either behavioral change (the change in the coefficients) or by factors we have not observed. The model also can explain 59% decline of the mean birth in urban areas and 43.8% in rural areas.

In addition to factors like the government's family planning policies and women's education, marriage rate plays a key role in Iran's total birth rate fluctuations. Iran is a country in which births must occur within marriage. Thus, having no previous children could be either because of not being married yet, because of being infertile, or because the woman is postponing her fertility. Thus, the probability of giving birth can be decomposed as,

$$pr\left(B_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right) = pr\left({B_{i_{(t)}s}}^{M}=1\middle|X'_{i_{(t)}s}\right)\times pr\left(M_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)$$

$$+pr\left({B_{i_{(t)}s}}^{NM}=1\middle|X'_{i_{(t)}s}\right)\times\left(1-pr\left(M_{i_{(t)}s}=0\middle|X'_{i_{(t)}s}\right)\right) \quad (5)$$

Where $B_{i_{(t)}s}$ is a dummy variable which takes 1 if woman $i$ interviewed at time $t$ has decided to give birth at time $s$. ${B_{i_{(t)}s}}^{M}$ is a dummy variable which takes 1 if the woman $i$ has been married at time $s$ and decided to give birth. $M_{i_{(t)}s}$ is a dummy variable takes 1 if woman $i$ is married. ${B_{i_{(t)}s}}^{NM}$ is a dummy variable which takes 1 if woman $i$ is not married and has given birth.

[12] I do not focus on the "unexplained" portion of the gap because of the difficulty in interpreting results.



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Since $pr\left(B_{i_{(t)}s}{}^{NM}=1\middle|X'_{i_{(t)}s}\right)$is almost zero in Iran, then

$$pr\left(B_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)\ =pr\left(B_{i_{(t)}s}{}^{M}=1\middle|X'_{i_{(t)}s}\right)\times pr\left(M_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right) \quad (6)$$

Hence, with a decomposition technique, I separate change in the TFR into two parts: the decrease in TFR due to a lower propensity to marry and the decrease in TFR due to a lower marital fertility rate.

$$\frac{\partial pr\left(B_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}}=\frac{\partial pr\left(B_{i_{(t)}s}{}^{M}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}}\times pr\left(M_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)+\frac{\partial pr\left(M_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}}\times$$

$$pr\left(B_{i_{(t)}s}{}^{M}=1\middle|X'_{i_{(t)}s}\right) \quad (7)$$

$$\frac{\partial logpr\left(B_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}}=\frac{\partial logpr\left(B_{i_{(t)}s}{}^{M}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}}+\frac{\partial logpr\left(M_{i_{(t)}s}=1\middle|X'_{i_{(t)}s}\right)}{\partial X'_{i_{(t)}s}} \quad (8)$$

### 5.2 Factors affecting probability of being married

Women's probability of being married changes due to variables including their literacy rates, education, age, area of residence, and the government's family planning policies at ages they decide their time of marriage. Since marriage must occur before giving birth in Iran, and the main purpose of this paper is to estimate the effect of the government's policies on women's fertility rate, with a logit model I estimate the probability of marriage. In this estimation, I want to find out how the government's family planning policies may affect the marriage decision of women who were 17-19 years old at the time of each policy. Table 7 shows the estimates of the logit coefficients



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from the model of marriage, and tables 8-10 display the mean marginal effects of the key explanatory variables affecting women's marriage decision.

Table 8 demonstrates that women who were 17-19 years old when national anti-natal family planning policy had been active were 7 percent less likely to marry than women who were older at that time. Rural women's marriage decision was influenced by the national anti-natal family planning policy more than urban women's. Literate women adjusted their marriage decision according to this policy much more than illiterate women. Women younger than 20 (especially in rural areas) have mainly postponed their marriage as a result of national anti-natal family planning policy. Table 9 shows how child support limits policy might affect women's marriage decision. The child support limits policy decreased probability of marriage by about 7 percent in both rural and urban areas and at the country level. Unlike the national anti-natal family planning policy in which literate women responded more, child support limits policy mainly influenced illiterate women's marriage decision, especially those who lived in rural areas. Like the national anti-natal family planning policy, the child support limits policy affects the probability of marriage less as women age. Table 10 reports marginal effects of the non-policy variables on women's marriage decisions. It shows that a literate woman is 12 percent less likely to get married than an illiterate woman. This gap is wider in urban areas than rural areas. Among literate women, the joint distribution of marriage and education is similar in both rural and urban areas, so women with less than high school education are more likely to be married than women with high school education and women with college education are less likely than women with high school education. Eventually, the probability of marriage goes up as women age; rural women are 16 percent less likely to be married than women in urban areas; war has had a positive effect on marriage and propensity to marry slightly has decreased as time goes.



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Figure 5 indicates that the marriage rate for women aged 17-35 has decreased 37 percent during the last 30 years. This number is quite similar in both rural and urban areas. As section 5.1, I use a quasi-Oaxaca decomposition to figure out how related factors may affect the marriage rate. Tables 11a and 11b represent some back-of-the-envelope estimations of related factors' effect on declining the marriage rate. They indicate that 7.5 percent decrease in rural marriage rate is due to the government's family planning policies; while in urban areas, the literacy rate improvement and higher education could explain 21.4 percent of decrease of the region's marriage rate. The model could thus explain respectively 11, 75, and 48 percent of actual change in the marriage rate in rural, urban, and the whole country.

Putting the last two sections of 5.1 and 5.2 together, it is obvious that the national anti-natal family planning policy has decreased the probability of marriage and the TFR in both rural and urban areas. Since the effect of national anti-natal family planning policy on marriage is small, thus, the national anti-natal family planning policy affected the TFR through decreasing the marital birth rate. Child support limits policy decreased both the marriage rate and the TFR in rural areas. Since the effect of policy on marriage is less than on the TFR, so the child support limits policy decreased the marital birth rate. However, this effect is opposite in urban areas. A lower marriage rate as a result of child support limits policy coincided with a higher TFR. Higher literacy rate decreased the TFR mainly through lowering the marriage rate specially in urban areas. Higher levels of education had had an opposite effect on probability of marriage in rural and urban areas. In rural areas, education has affected the TFR mainly through lowering marital fertility rate, while education has effected the TFR in urban areas with decreasing the marriage rate.



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## 6. Conclusion

In this paper, I have investigated Iranian women's demand for giving birth between the years 1980 to 2013. By controlling for women's socioeconomic conditions influencing their demand for child-bearing, I identified different patterns among rural and urban women. Results show that two separate but consistent post-revolution family planning policies in 1989 and 1993 worked as complements at the country level. While one mostly influenced the total birth rate of literate women in urban areas, the other affected illiterate women's more, especially those living in rural areas. Similarly, women's educational achievement and higher literacy rate had heterogeneous effects: a 19 percent decrease in the total birth rate in urban areas came from women's higher levels of education, while in rural areas education's share of the total fertility drop is only 3%. This paper's findings indicate that the rural birth rate has fallen by 17 percent as a result of both the national anti-natal family planning policy and child support limits policy, which lies within the range of estimates found by Salehi-Isfahani (2010). In addition to that, the results imply a 14% negative effect of those policies on birth rates in urban areas.

Giving a birth out-of-marriage is not a case in Iran. Thus, the birth rate enquiry dose not lead to reliable results without the marriage rate investigation. Therefore, in order to find out the effect of the government's family planning policies on the TFR, I moved one step back to check the effect of the government's policies and women's socioeconomic characteristics on their likelihood of marriage. Almost all of the investigated variables negatively affected the marriage rate in both areas; among all of them the 17% negative effect of women's education on their marriage rate in urban areas and its 9% positive effect on rural areas are noticeable.



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Finally, I could find the impact of the most effective key variables including the government's family planning policies, and education on women's demand of a birth. The marital birth rate which is the total birth rate adjusted with marriage rate. Among observed variables 1989 national anti-natal family planning policy in urban areas and national anti-natal family planning policy and education in rural areas were the main reasons of married women's lower propensity to give birth. This fining is consistent with those from Hashemi and Salehi-Isfahani(2013) which have shown a stronger negative effect of the education than program effect on rural women fertility rate.

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## Appendix

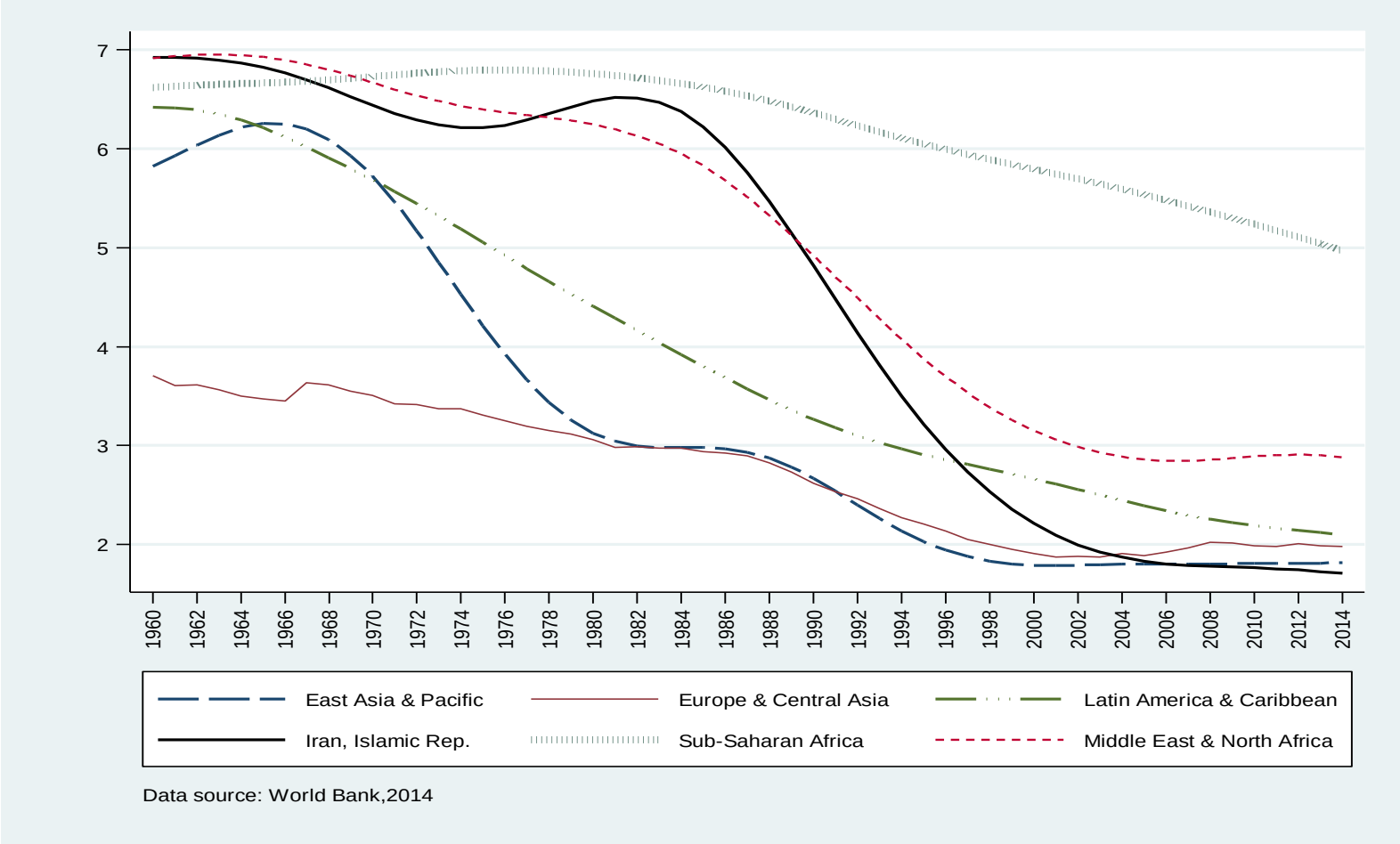


Figure 1: Trend of the TFR in developing countries



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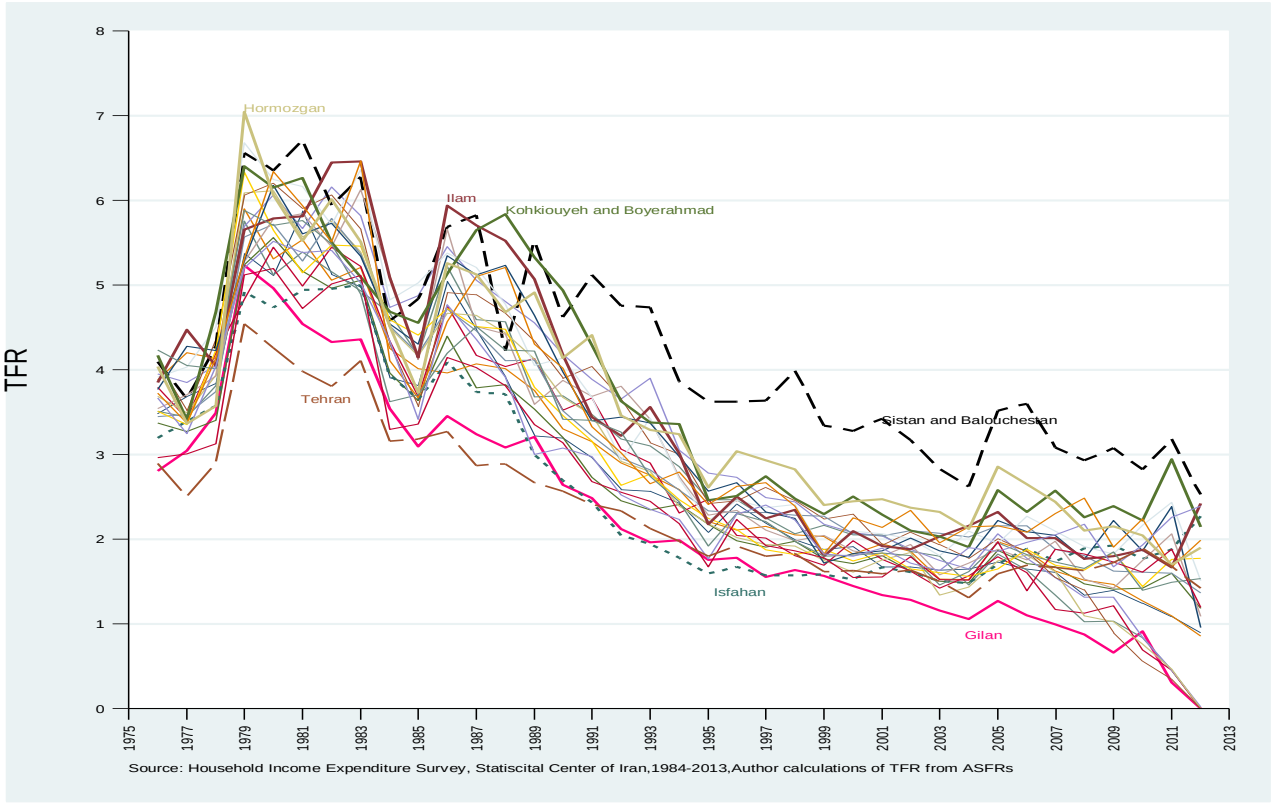


Figure 2: TFR[13] trends of women aged 17-35 years old at the provincial level on Iran, 1975-2013

13 Total fertility rates in Figure 2 are age-specific fertility rates (ASFRs) of women aged 17-19, 20-24, 25-29, and 30-35 years old calculated by using HIES data from 1975-2013 .

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**1967:** Initiation of the anti-natal family planning policy.

**Early 1979:** Islamic Revolution. Suspension of anti-natal policy and propagation of pro-natalist ideology.

**1981–88:** Iran-Iraq War.

**1989:** Anti-natal policy reinstated. Goal: reduce population growth rate to 2.3 percent by 2011 (TFR of 4 bpw).

**1991-92:** Budget allocates 3.6 billion Rial (in 2010 prices) over two years to anti-natal family planning policy.

**1993:** New law withdraws food coupons, paid maternity leave, and social welfare subsidies after the third child.

**1997:** Change in country's political climate. President Khatami wins the presidential election due to unprecedented support from many youth and women, who hoped to witness democratization[14].

**2006:** Iran's president, Mahmoud Ahmadinejad, defended an increasing population growth rate and called for a baby boom to almost double the country's population to 120 million.

**2009:** Introduction of a baby bonus scheme[15] as a means of increasing country's fertility rate.

**2010:** welfare restrictions on forth child and more was repealed.

**2012:** Iran's Supreme Leader, Ali Khamenei, warns that the country's population is aging and suggests that the number of Iranian citizens should be at least doubled (The Guardian, 2015).

**2013:** Budget for population control eliminated. Maternity leave extended from six months to nine, plus new two-week paternity leave.

**2014:** Legislation bans permanent forms of birth control. Punishments initiated for those encouraging contraceptive services and abortions. (Washington Post, 2014)

Sources: Moore (2007) for 1966 -1989, Roudi-Fahimi (2002) for 1993, Fairbanks (1998) for 1997

Figure 3: Time Line for Family Planning in Iran

14 During his electoral campaign, he proclaimed that "women should be active in all social, political and economic activities and efforts should be made to do away with male supremacy"

15 Under the new scheme, each child born in the current Iranian year, would receive a deposit of 10 million Rial(approximately 1000 $US) in a government bank account. They will then continue to receive another 1 million Rial(approximately 100$US) every year until they reach 18. Parents will also be expected to pay matching funds into the accounts. However, the payment stopped after 1 year because of budget insufficiency.



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Table 1: Summary statistics of key variables for women aged 17-35 during 1984-2013

| Year | 1984 | | 1989 | | 1997 | | 2005 | | 2013 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban | Rural | Urban |
| Births per 100 women | 21.8 | 17.8 | 18.5 | 14.6 | 9.0 | 8.1 | 6.6 | 5.9 | 1.8 | 2.0 |
| Fertility rate | 4.0 | 3.0 | 3.6 | 2.6 | 1.7 | 1.5 | 1.3 | 1.1 | 0.3 | 0.4 |
| Average age\| ever-married | 22.6 | 22.6 | 22.5 | 22.9 | 22.9 | 22.9 | 24.4 | 24.4 | 27.1 | 27.6 |
| Percentage of ever-married women[16] | 78.4 | 77.0 | 68.7 | 70.1 | 61.1 | 63.5 | 52.6 | 56.1 | 62.7 | 61.4 |
| Average of mothers' age at first birth | 19.7 | 20.1 | 19.8 | 20.1 | 20.3 | 20.6 | 21.2 | 21.3 | 23.6 | 23.8 |
| Literacy rate | 25.0 | 67.8 | 36.3 | 72.5 | 73.0 | 91.5 | 84.0 | 95.4 | 91.5 | 97.0 |
| Education- high school and above | 3.6 | 28.0 | 4.3 | 32.8 | 13.2 | 48.7 | 25.6 | 60.6 | 36.2 | 70.0 |
| Labor force participation rate | 19.5 | 16.4 | 22.2 | 12.1 | 26.0 | 15.0 | 23.2 | 18.1 | 15.8 | 16.9 |
| Number of observations | 8,368 | 10,843 | 4,476 | 4,196 | 8,924 | 8,317 | 12,021 | 10,608 | 12,689 | 12,721 |

Data Source: Computed from Iran's HIES, 1984-2013



16 Because of lack of data, the Marriage Rate of the years 1985 and 1990 were used for the years 1984 and 1989 in both areas.

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Table 2: Selected logistic regression estimates: predicting probability of the birth by women aged 17-35 between 1984 and 2013

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| Anti-natal Policy | 0.36*** | 0.04 | Rural Dummy | 0.09*** | 0.01 |
| × Rural Dummy | 0.07*** | 0.02 | | | |
| × Literate Dummy | -0.17*** | 0.02 | Literate Dummy | -0.02 | 0.02 |
| × Rural Dummy × Literate Dummy | -0.06*** | 0.02 | × Rural Dummy | 0.07*** | 0.01 |
| × Age | -0.02*** | 0.00 | | | |
| | | | Number of previous children Dummy | | |
| Pro-natal Policy | -1.14*** | 0.31 | No child | 0.12*** | 0.04 |
| × Rural Dummy | -0.44* | 0.24 | One Child | - | - |
| × Literate Dummy | -0.35* | 0.20 | Two children | -0.38*** | 0.05 |
| × Rural Dummy × Literate Dummy | 0.26 | 0.25 | Three children | -0.75*** | 0.06 |
| × Age | 0.04*** | 0.01 | More than three children | -1.02*** | 0.08 |
| | | | × Age | | |
| 1993 Child support limits | -1.80*** | 0.05 | No child | -0.06*** | 0.00 |
| × Rural Dummy | -0.09*** | 0.02 | One Child | - | - |
| × Literate Dummy | 0.04* | 0.02 | Two children | 0.00* | 0.00 |
| × Rural dummy × Literate Dummy | -0.01 | 0.02 | Three children | 0.01*** | 0.00 |
| × Number of previous children Dummy | | | More than three children | 0.02*** | 0.00 |



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Table 2: Selected logistic regression estimates: predicting probability of the birth by women aged 17-35 between 1984 and 2013-countinued

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| No child | 1.17*** | 0.06 | | | |
| One Child | - | - | Cohort Dummy | | |
| Two children | 0.79*** | 0.07 | Women born in 1959-68 | 0.78** | 0.31 |
| Three children | 1.79*** | 0.09 | Women born in 1969-78 | 0.37 | 0.31 |
| More than three children | 2.52*** | 0.12 | Women born in 1979-88 | 0.40 | 0.31 |
| × Age | 0.06*** | 0.00 | Women born in 1989-98 | -0.06 | 0.37 |
| × Number of previous children Dummy×Age | | | × Age | | |
| No child | -0.02*** | 0.00 | Women born in 1959-68 | -0.03*** | 0.01 |
| One Child | - | - | Women born in 1969-78 | -0.01 | 0.01 |
| Two children | -0.04*** | 0.00 | Women born in 1979-88 | -0.01 | 0.01 |
| Three children | -0.07*** | 0.00 | Women born in 1989-98 | 0.03* | 0.02 |
| More than three children | -0.10*** | 0.00 | | | |
| | | | Number of previous children | 0.06*** | 0.01 |
| 2009 Baby bonus scheme | 0.13 | 0.13 | × Cohort Dummy | | |
| × Rural Dummy | -0.05 | 0.10 | Women born in 1959-68 | -0.01 | 0.01 |
| × Literate Dummy | -0.17* | 0.09 | Women born in 1969-78 | -0.04*** | 0.01 |
| × Rural Dummy × Literate Dummy | 0.10 | 0.10 | Women born in 1979-88 | -0.07*** | 0.01 |
| × Age | 0.00 | 0.00 | Women born in 1989-98 | -0.47*** | 0.03 |
| Log of Women's Real Income | -0.01*** | 0.00 | Total son | -0.01 | 0.01 |



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Table 2: Selected logistic regression estimates: predicting probability of the birth by women aged 17-35 between 1984 and 2013-countinued

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| × Time interval | 0.00*** | 0.00 | × Cohort Dummy | | |
| | | | Women born in 1959-68 | -0.04*** | 0.01 |
| Family Income Decile Dummies | | | Women born in 1969-78 | -0.10*** | 0.01 |
| 0 | -6.87*** | 0.05 | Women born in 1979-88 | -0.18*** | 0.01 |
| 1 | 0.20*** | 0.05 | Women born in 1989-98 | -0.25*** | 0.05 |
| 2 | 0.19*** | 0.05 | | | |
| 3 | 0.19*** | 0.05 | | | |
| 4 | -0.01 | 0.05 | Education | | |
| 5 | - | - | Primary | 1.04*** | 0.34 |
| 6 | -0.14*** | 0.05 | Guidance School | 0.85** | 0.42 |
| 7 | -0.30*** | 0.05 | High School | - | - |
| 8 | -0.49*** | 0.05 | College | 0.77 | 0.64 |
| 9 | -0.71*** | 0.05 | × Age | | |
| × Time interval | | | Primary | -0.03*** | 0.01 |
| 0 | 0.19*** | 0.00 | Guidance School | -0.04** | 0.01 |
| 1 | 0.00 | 0.00 | High School | - | - |
| 2 | 0.00 | 0.00 | College | -0.03 | 0.02 |
| 3 | 0.00 | 0.00 | | | |
| 4 | 0.00 | 0.00 | Age Dummies | | |
| 5 | - | - | 17-20 | 0.24*** | 0.01 |



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Table 2: Selected logistic regression estimates: predicting probability of the birth by women aged 17-35 between 1984 and 2013-countinued

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| 6 | 0.00** | 0.00 | 21-24 | 0.10*** | 0.01 |
| 7 | 0.01*** | 0.00 | 25-28 | - | - |
| 8 | 0.01*** | 0.00 | 29-32 | 0.24*** | 0.01 |
| 9 | 0.02*** | 0.00 | 33-35 | 0.24*** | 0.03 |
| Change in inflation | 0.00*** | 0.00 | Age | 0.86*** | 0.01 |
| War | -0.08*** | 0.02 | $Age^2$ | -0.02*** | 0.00 |
| Year | -0.05*** | 0.00 | Number of birth in the preceding year | 3.03*** | 0.20 |
| | | | × Age | -0.35*** | 0.02 |
| | | | × $Age^2$ | 0.01*** | 0.00 |
| Constant | 80.01*** | 1.61 | | | |
| Pseudo $R^2$ = | 0.1745 | | | | |
| n = | 5,031,580 | | | | |

Data Source: Computed from Iran's HIES, 1984-2013

Note: Other non-reported controls include dummy variables province of residence and their interactions with war, interaction of woman's birth cohort with her education, interaction of woman's birth cohort with her education and her age . * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are clustered by individual woman.



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Table 3: Marginal effect of the NANFPP on the annual births of women aged 17-35,1984-2013

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| NANFPP | -0.09*** | 0.01 | -0.14*** | 0.01 | -0.11*** | 0. 01 |
| By literacy | | | | | | |
| Literate | -0.14*** | 0.01 | -0.15*** | 0.01 | -0.15*** | 0.01 |
| Illiterate | 0.06*** | 0.00 | 0.01 | 0.02 | 0.03** | 0.01 |
| By number of previous children | | | | | | |
| No child | -0.09*** | 0.01 | -0.13*** | 0.01 | -0.11*** | 0.01 |
| One Child | -0.09*** | 0.01 | -0.13*** | 0.01 | -0.11*** | 0.01 |
| Two children | -0.11*** | 0.01 | -0.17*** | 0.01 | -0.14*** | 0.01 |
| Three children | -0.09*** | 0.01 | -0.17*** | 0.01 | -0.13*** | 0.01 |
| More than three children | -0.08*** | 0.01 | -0.16*** | 0.01 | -0.11*** | 0.01 |
| By literacy and Number of previous children | | | | | | |
| Literate-No child | -0.12*** | 0.01 | -0.13*** | 0.01 | -0.13*** | 0.01 |
| Literate-One Child | -0.12*** | 0.01 | -0.14*** | 0.01 | -0.13*** | 0.01 |
| Literate-Two children | -0.16*** | 0.01 | -0.18*** | 0.01 | -0.17*** | 0.01 |
| Literate-Three children | -0.18*** | 0.01 | -0.20*** | 0.01 | -0.19*** | 0.01 |
| Literate-More than three children | -0.20*** | 0.01 | -0.22*** | 0.01 | -0.21*** | 0.01 |
| Illiterate -No child | 0.09*** | 0.01 | 0.02 | 0.02 | 0.06*** | 0.01 |



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Table 3: Marginal effect of the NANFPP on the annual births of women aged 17-35,1984-2013-countinued

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| Illiterate -One Child | 0.06*** | 0.01 | -0.01 | 0.02 | 0.02* | 0.01 |
| Illiterate -Two children | 0.03*** | 0.01 | -0.04** | 0.02 | 0.00 | 0.01 |
| Illiterate -Three children | 0.02 | 0.01 | -0.05*** | 0.02 | -0.02 | 0.01 |
| Illiterate -More than three children | -0.01 | 0.01 | -0.07*** | 0.02 | -0.03*** | 0.01 |
| By literacy and age | | | | | | |
| Literate-17-20 | -0.07*** | 0.01 | -0.09*** | 0.01 | -0.08*** | 0.01 |
| Literate-21-24 | -0.13*** | 0.01 | -0.14*** | 0.01 | -0.13*** | 0.01 |
| Literate-25-28 | -0.18*** | 0.01 | -0.19*** | 0.01 | -0.19*** | 0.01 |
| Literate-29-32 | -0.24*** | 0.01 | -0.26*** | 0.01 | -0.25*** | 0.01 |
| Literate-33-35 | -0.31*** | 0.01 | -0.32*** | 0.01 | -0.31*** | 0.01 |
| Illiterate -17-20 | 0.13*** | 0.02 | 0.07*** | 0.02 | 0.10*** | 0.02 |
| Illiterate -21-24 | 0.07*** | 0.01 | 0.01 | 0.02 | 0.04*** | 0.01 |
| Illiterate -25-28 | 0.02 | 0.01 | -0.04** | 0.02 | -0.01 | 0.01 |
| Illiterate -29-32 | -0.03** | 0.01 | -0.10*** | 0.02 | -0.07*** | 0.01 |
| Illiterate -33-35 | -0.09*** | 0.02 | -0.16*** | 0.02 | -0.12*** | 0.02 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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Table 4: Marginal effect of the CSLP on the annual births of women aged 17-35,1984-2013

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| CSLP | -0.08*** | 0.01 | 0.01 | 0.01 | -0.04*** | 0.01 |
| By literacy | | | | | | |
| Literate | -0.06*** | 0.01 | 0.02*** | 0.01 | -0.02** | 0.01 |
| Illiterate | -0.15*** | 0.01 | -0.11*** | 0.02 | -0.14*** | 0.01 |
| By number of previous children | | | | | | |
| No child | 0.08*** | 0.01 | 0.18*** | 0.01 | 0.13*** | 0.01 |
| One Child | -0.27*** | 0.01 | -0.17*** | 0.01 | -0.22*** | 0.01 |
| Two children | -0.30*** | 0.01 | -0.20*** | 0.01 | -0.25*** | 0.01 |
| Three children | -0.28*** | 0.01 | -0.20*** | 0.02 | -0.24*** | 0.01 |
| More than three children | -0.35*** | 0.01 | -0.27*** | 0.02 | -0.32*** | 0.01 |
| By literacy and number of previous children | | | | | | |
| Literate-No child | 0.09*** | 0.01 | 0.18*** | 0.01 | 0.13*** | 0.01 |
| Literate-One Child | -0.27*** | 0.01 | -0.17*** | 0.01 | -0.22*** | 0.01 |
| Literate-Two children | -0.30*** | 0.01 | -0.20*** | 0.01 | -0.25*** | 0.01 |
| Literate-Three children | -0.28*** | 0.02 | -0.20*** | 0.02 | -0.24*** | 0.01 |



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Table 4: Marginal effect of the CSLP on the annual births of women aged 17-35,1984-2013-Countinued

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| Literate-More than three children | -0.34*** | 0.02 | -0.27*** | 0.02 | -0.31*** | 0.02 |
| Illiterate -No child | 0.08*** | 0.01 | 0.16*** | 0.02 | 0.12*** | 0.01 |
| Illiterate -One Child | -0.27*** | 0.01 | -0.18*** | 0.02 | -0.22*** | 0.01 |
| Illiterate -Two children | -0.30*** | 0.01 | -0.22*** | 0.02 | -0.26*** | 0.01 |
| Illiterate -Three children | -0.28*** | 0.02 | -0.21*** | 0.02 | -0.25*** | 0.02 |
| Illiterate -More than three children | -0.35*** | 0.02 | -0.28*** | 0.02 | -0.32*** | 0.02 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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Table 5: Marginal effect of non- policy variables on the annual births of women aged 17-35,1984-2013

| Variable | Rural | | Urban | | Nation | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| Literate Dummy | -0.08*** | 0.01 | -0.10*** | 0.02 | -0.09*** | 0.01 |
| Education | | | | | | |
| Primary | 0.28*** | 0.00 | 0.28*** | 0.00 | 0.28*** | 0.00 |
| Guidance School | 0.14*** | 0.01 | 0.13*** | 0.01 | 0.13*** | 0.01 |
| High School | - | - | - | - | - | - |
| College | -0.47*** | 0.01 | -0.46*** | 0.01 | -0.46*** | 0.01 |
| Number of previous children | | | | | | |
| No child | -0.67*** | 0.01 | -0.71*** | 0.01 | -0.69*** | 0.01 |
| One Child | - | - | - | - | - | - |
| Two children | -0.47*** | 0.01 | -0.47*** | 0.01 | -0.47*** | 0.01 |
| Three children | -0.37*** | 0.01 | -0.38*** | 0.01 | -0.38*** | 0.01 |
| More than three children | -0.22*** | 0.03 | -0.23*** | 0.03 | -0.23*** | 0.03 |
| Total son | -0.11*** | 0.00 | -0.12*** | 0.00 | -0.11*** | 0.00 |
| Log of women's real income | -0.01*** | 0.00 | -0.01*** | 0.00 | -0.01*** | 0.00 |



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Table 5: Marginal effect of non- policy variables on the annual births of women aged 17-35,1984-2013-Countinued

| Variable | Rural | | Urban | | Nationwhide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| Family income decile dummies | | | | | | |
| 0 | -1.33*** | 0.01 | -1.33*** | 0.01 | -1.33*** | 0.01 |
| 1 | 0.21*** | 0.01 | 0.21*** | 0.01 | 0.21*** | 0.01 |
| 2 | 0.16*** | 0.01 | 0.16*** | 0.01 | 0.16*** | 0.01 |
| 3 | 0.10*** | 0.01 | 0.11*** | 0.01 | 0.10*** | 0.01 |
| 4 | 0.05*** | 0.01 | 0.05*** | 0.01 | 0.05*** | 0.01 |
| 5 | - | - | - | - | - | - |
| 6 | -0.04*** | 0.01 | -0.04*** | 0.01 | -0.04*** | 0.01 |
| 7 | -0.10*** | 0.01 | -0.10*** | 0.01 | -0.10*** | 0.01 |
| 8 | -0.15*** | 0.01 | -0.15*** | 0.01 | -0.15*** | 0.01 |
| 9 | -0.24*** | 0.01 | -0.24*** | 0.01 | -0.24*** | 0.01 |
| Rural Area | - | - | 0.10*** | 0.00 | - | - |
| War years | 0.02 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 |
| Yearly time trend | -0.04*** | 0.00 | -0.04*** | 0.00 | -0.04*** | 0.00 |
| Change in inflation | 0.00*** | 0.00 | 0.00*** | 0.00 | 0.00*** | 0.00 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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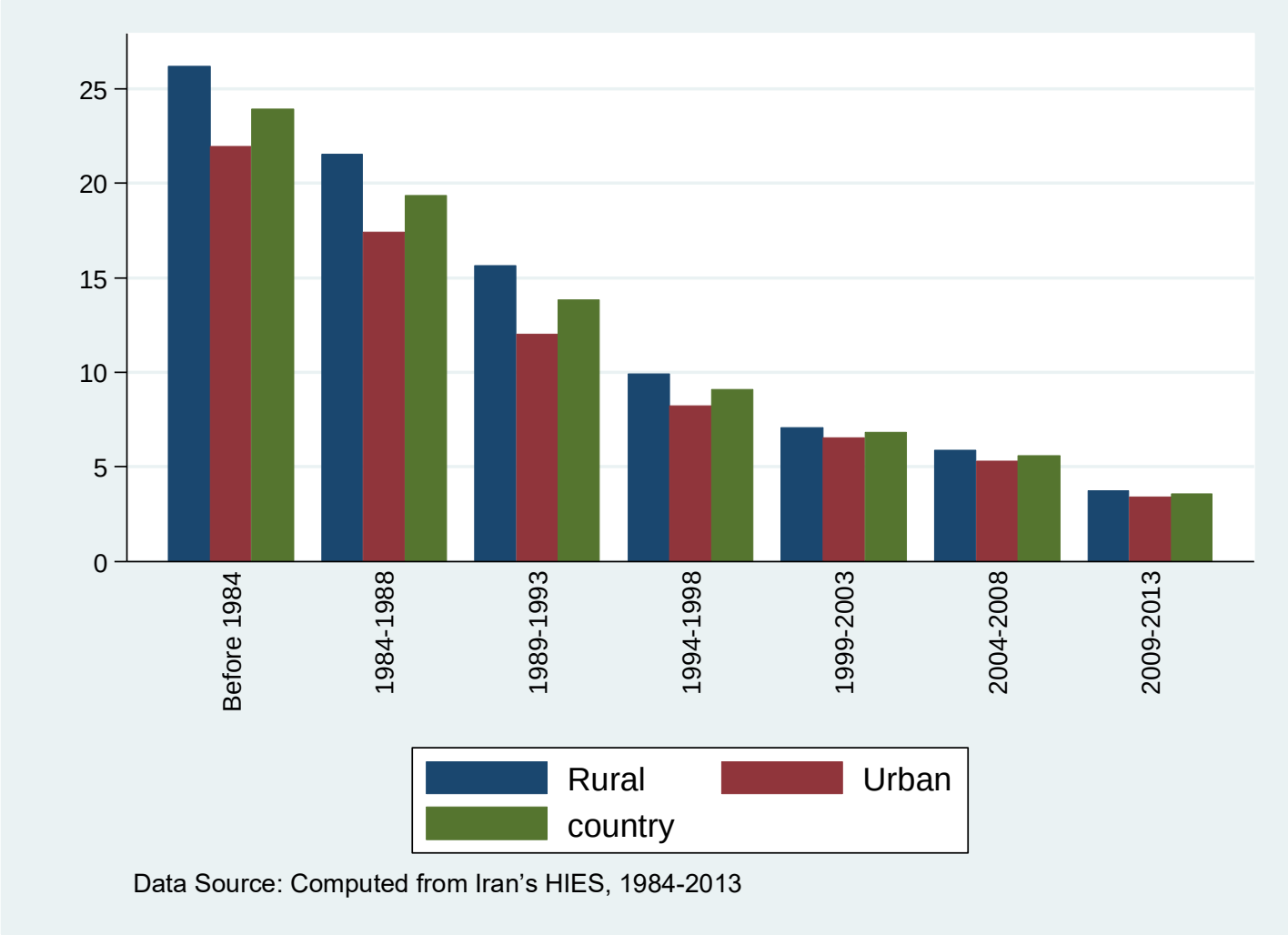


Figure 4: Trend of mean of birth per 100 Iranian women aged 17-35

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Table 6a: Contribution of selected explanatory variables to the gap in actual fertility outcomes of women aged 17-35 between 1984 and 2013

| | Estimated effect on Annual Fertility Rate (percentage change) | | |
|---|---|---|---|
| Variable | Rural | Urban | Country |
| Actual change observed | -82.6 | -80.5 | -81.5 |
| Total change explained by these factors | -36.2 | -47.8 | -41.9 |
| NANFPP | -8.8 | -13.8 | -11.3 |
| CSLP | -8.5 | 0.9 | -3.8 |
| Literacy rate | -4.7 | -2.8 | -3.8 |
| Education | 1.7 | -16.3 | -7.3 |
| Primary | 4.1 | -4.2 | -0.1 |
| Guidance School | 2.3 | 0.6 | 1.4 |
| High School | 0.0 | 0.0 | 0.0 |
| College | -4.6 | -12.7 | -8.6 |
| Women's log Income | 0.0 | 0.0 | 0.0 |
| Number of previous children | -15.9 | -15.8 | -15.7 |
| No child | -25.5 | -28.5 | -27.0 |
| One Child | 0.0 | 0.0 | 0.0 |
| Two children | -1.2 | 2.1 | 0.5 |
| Three children | 3.0 | 4.8 | 3.9 |
| More than three children | 7.8 | 5.9 | 6.8 |

Data Source: Computed from Iran's HIES,1984-2013, using mean marginal effects from tables 3-5



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Table 6b: Explained changes of women's fertility through educational attainment

| Year | Education 1984-1988 | | | Education 2009-2013 | | | Percentage Change in Education | | | Margins | | | Explained change | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Levels of Education | R | U | N | R | U | N | R | U | N | R | U | N | R | U | N |
| Literacy Rate | 28.1 | 67.9 | 49.4 | 89.8 | 96.5 | 93.1 | 61.7 | 28.5 | 43.7 | -0.1 | -0.1 | -0.1 | -4.7 | -2.8 | -3.8 |
| Primary | 22.1 | 29.4 | 26.0 | 36.5 | 14.6 | 25.7 | 14.4 | -14.8 | -0.3 | 0.3 | 0.3 | 0.3 | 4.1 | -4.2 | -0.1 |
| guidance school | 1.6 | 9.7 | 6.0 | 18.4 | 13.9 | 16.2 | 16.8 | 4.2 | 10.3 | 0.1 | 0.1 | 0.1 | 2.3 | 0.6 | 1.4 |
| high school | 3.6 | 24.7 | 14.9 | 24.9 | 36.9 | 30.8 | 21.3 | 12.2 | 15.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| College | 0.2 | 3.2 | 1.8 | 9.9 | 30.9 | 20.3 | 9. 8 | 27.8 | 18.5 | -0.5 | -0.5 | -0.5 | -4.6 | -12.7 | -8.6 |

Data Source: Computed from Iran's HIES,1984-2013, using mean marginal effects from tables 3-5



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Table 7: Selected logistic regression estimates: predicting probability of the marriage by women aged 17-35 between 1984 and 2013

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| NANFPP | -0.19*** | 0.06 | CSLP | -0.08** | 0.04 |
| × Rural Dummy | 0.22*** | 0.02 | × Rural Dummy | -0.05*** | 0.02 |
| × Literate Dummy | 0.12*** | 0.03 | × Literate Dummy | -0.72*** | 0.03 |
| × Rural Dummy × Literate Dummy | -0.26*** | 0.07 | × Rural Dummy × Literate Dummy | 0.07 | 0.06 |
| × Age | | | × Age | | |
| 17 | -0.09 | 0.07 | 17 | -0.16*** | 0.06 |
| 18 | -0.10 | 0.07 | 18 | -0.10** | 0.05 |
| 19 | -0.15** | 0.07 | 19 | -0.06 | 0.05 |
| 20 | -0.11 | 0.06 | 20 | 0.03 | 0.05 |
| 21 | -0.05 | 0.07 | 21 | 0.10* | 0.05 |
| 22 | -0.06 | 0.06 | 22 | 0.05 | 0.05 |
| 23 | -0.09 | 0.07 | 23 | 0.08 | 0.05 |
| 24 | -0.12* | 0.07 | 24 | 0.01 | 0.05 |
| 25 | - | - | 25 | - | - |
| 26 | -0.10 | 0.08 | 26 | 0.01 | 0.06 |
| 27 | -0.17** | 0.08 | 27 | 0.03 | 0.06 |
| 28 | -0.18** | 0.08 | 28 | 0.01 | 0.06 |
| 29 | -0.10 | 0.08 | 29 | -0.06 | 0.06 |



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Table 7: Selected logistic regression estimates: predicting probability of the marriage by women aged 17-35 between 1984 and 2013-countinued

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| 30 | -0.13* | 0.08 | 30 | -0.08 | 0.06 |
| 31 | -0.18** | 0.09 | 31 | -0.10 | 0.07 |
| 32 | -0.05 | 0.08 | 32 | -0.14** | 0.07 |
| 33 | -0.13 | 0.09 | 33 | -0.10 | 0.07 |
| 34 | -0.03 | 0.09 | 34 | -0.15* | 0.08 |
| 35 | -0.26*** | 0.08 | 35 | -0.07 | 0.07 |
| Rural Dummy | 0.35*** | 0.03 | Education | | |
| | | | Primary | 0.39*** | 0.04 |
| Literate Dummy | 0.28*** | 0.05 | Guidance School | 0.64*** | 0.04 |
| × Rural Dummy | -0.02 | 0.05 | High School | - | - |
| | | | College | -1.30*** | 0.04 |
| Year | -0.01*** | 0.00 | War | 0.95*** | 0.10 |
| Age | | | Cohort | | |
| 17 | -3.29*** | 0.08 | 1959-1968 | -0.43*** | 0.08 |
| 18 | -2.61*** | 0.07 | 1969-1978 | -0.70*** | 0.08 |
| 19 | -2.04*** | 0.08 | 1979-1988 | -0.79*** | 0.09 |
| 20 | -1.53*** | 0.08 | 1989-1998 | -0.67*** | 0.09 |
| 21 | -1.26*** | 0.08 | | | |
| 22 | -0.86*** | 0.07 | | | |
| 23 | -0.58*** | 0.07 | | | |



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Table 7: Selected logistic regression estimates: predicting probability of the marriage by women aged 17-35 between 1984 and 2013-countinued

| Variable | Coef. | SE | Variable | Coef. | SE |
|---|---|---|---|---|---|
| 24 | -0.18** | 0.08 | | | |
| 25 | - | - | | | |
| 26 | 0.27*** | 0.08 | | | |
| 27 | 0.44*** | 0.08 | | | |
| 28 | 0.73*** | 0.08 | | | |
| 29 | 0.82*** | 0.09 | | | |
| 30 | 0.88*** | 0.08 | | | |
| 31 | 1.16*** | 0.10 | | | |
| 32 | 1.12*** | 0.09 | | | |
| 33 | 1.13*** | 0.10 | | | |
| 34 | 1.24*** | 0.11 | | | |
| 35 | 1.35*** | 0.10 | | | |
| Constant | 15.57*** | 3.23 | | | |
| Pseudo $R^2$ = 0.3129 | | | | | |
| n = 559,641 | | | | | |

Data Source: Computed from Iran's HIES, 1984-2013

Note: Other non-reported controls include dummy variables province of residence and their interactions with war, interaction of woman's Age with three explanatory variables: area of her residency, education and war. * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are clustered by individual woman.



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Table 8: Marginal effect of the NANFPP on probability of marriage of women aged 17-35,1984-2013

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| NANFPP | -0.11*** | 0.01 | -0.03*** | 0.01 | -0.07*** | 0.01 |
| By literacy | | | | | | |
| Literate | -0.13*** | 0.01 | -0.03*** | 0.01 | -0.08*** | 0.01 |
| Illiterate | -0.03*** | 0.01 | -0.03*** | 0.01 | -0.03*** | 0.01 |
| By Age | | | | | | |
| 17 | -0.22*** | 0.03 | -0.06* | 0.03 | -0.15*** | 0.03 |
| 18 | -0.21*** | 0.03 | -0.07** | 0.03 | -0.15*** | 0.03 |
| 19 | -0.23*** | 0.02 | -0.10** | 0.03 | -0.17*** | 0.02 |
| 20 | -0.17*** | 0.02 | -0.06* | 0.02 | -0.12*** | 0.02 |
| 21 | -0.13*** | 0.02 | -0.02 | 0.02 | -0.08*** | 0.02 |
| 22 | -0.12*** | 0.02 | -0.02 | 0.02 | -0.07*** | 0.02 |
| 23 | -0.11*** | 0.02 | -0.03* | 0.02 | -0.07*** | 0.02 |
| 24 | -0.11*** | 0.01 | -0.04** | 0.02 | -0.07*** | 0.01 |
| 25 | -0.05*** | 0.02 | 0.00 | 0.02 | -0.03 | 0.02 |
| 26 | -0.07*** | 0.01 | -0.02 | 0.01 | -0.05*** | 0.01 |



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Table 8: Marginal effect of the NANFPP on probability of marriage of women aged 17-35,1984-2013-Continued

| Variable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| 27 | -0.08*** | 0.01 | -0.03*** | 0.01 | -0.06*** | 0.01 |
| 28 | -0.07*** | 0.01 | -0.03*** | 0.01 | -0.05*** | 0.01 |
| 29 | -0.05*** | 0.01 | -0.01 | 0.01 | -0.03*** | 0.01 |
| 30 | -0.05*** | 0.01 | -0.02** | 0.01 | -0.03*** | 0.01 |
| 31 | -0.05*** | 0.01 | -0.02** | 0.01 | -0.03*** | 0.01 |
| 32 | -0.02*** | 0.01 | 0.00 | 0.01 | -0.01** | 0.01 |
| 33 | -0.03*** | 0.01 | -0.01 | 0.01 | -0.02*** | 0.01 |
| 34 | -0.02*** | 0.01 | 0.00 | 0.01 | -0.01 | 0.01 |
| 35 | -0.03*** | 0.00 | -0.02*** | 0.00 | -0.02*** | 0.00 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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Table 9: Marginal effect of the CSLP on probability of marriage of women aged 17-35,1984-2013

| ariable | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| CSLP | -0.08*** | 0.01 | -0.07*** | 0.01 | -0.07*** | 0.01 |
| By literacy | | | | | | |
| Literate | -0.05*** | 0.01 | -0.07*** | 0.01 | -0.06*** | 0.01 |
| Illiterate | -0.16*** | 0.01 | -0.10*** | 0.01 | -0.15*** | 0.00 |
| By Age | | | | | | |
| 17 | -0.24*** | 0.03 | -0.26*** | 0.04 | -0.25*** | 0.03 |
| 18 | -0.18*** | 0.03 | -0.19*** | 0.03 | -0.19*** | 0.03 |
| 19 | -0.14*** | 0.03 | -0.15*** | 0.03 | -0.14*** | 0.03 |
| 20 | -0.07*** | 0.02 | -0.07*** | 0.02 | -0.07*** | 0.02 |
| 21 | -0.03 | 0.02 | -0.03 | 0.02 | -0.03 | 0.02 |
| 22 | -0.05*** | 0.02 | -0.05*** | 0.02 | -0.05*** | 0.02 |
| 23 | -0.04** | 0.02 | -0.03** | 0.02 | -0.03** | 0.02 |
| 24 | -0.06*** | 0.01 | -0.05*** | 0.01 | -0.05*** | 0.01 |
| 25 | -0.06*** | 0.01 | -0.05*** | 0.01 | -0.05*** | 0.01 |
| 26 | -0.05*** | 0.01 | -0.04*** | 0.01 | -0.04*** | 0.01 |
| 27 | -0.04*** | 0.01 | -0.03*** | 0.01 | -0.03*** | 0.01 |
| 28 | -0.04*** | 0.01 | -0.03*** | 0.01 | -0.03*** | 0.01 |



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Table 9: Marginal effect of the CSLP on probability of marriage of women aged 17-35,1984-2013-Continued

| | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| Variable | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| 29 | -0.05*** | 0.01 | -0.04*** | 0.01 | -0.04*** | 0.01 |
| 30 | -0.06*** | 0.01 | -0.04*** | 0.01 | -0.05*** | 0.01 |
| 31 | -0.05*** | 0.01 | -0.03*** | 0.01 | -0.04*** | 0.01 |
| 32 | -0.05*** | 0.01 | -0.03*** | 0.01 | -0.04*** | 0.01 |
| 33 | -0.04*** | 0.01 | -0.02*** | 0.01 | -0.03*** | 0.01 |
| 34 | -0.04*** | 0.01 | -0.02*** | 0.01 | -0.03*** | 0.01 |
| 35 | -0.03*** | 0.01 | -0.02*** | 0.00 | -0.03*** | 0.01 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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Table 10: Marginal effect of non- policy variables on probability of marriage of women aged 17-35,1984-2013

| Variable | Rural | | Urban | | Nation | |
|---|---|---|---|---|---|---|
| | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| Literate Dummy | -0.09*** | 0.02 | -0.15*** | 0.02 | -0.12*** | 0.02 |
| Education | | | | | | |
| Primary | 0.44*** | 0.01 | 0.35*** | 0.00 | 0.40*** | 0.00 |
| Guidance School | 0.51*** | 0.01 | 0.41*** | 0.00 | 0.46*** | 0.00 |
| High School | - | - | - | - | - | - |
| College | -0.60*** | 0.02 | -0.49*** | 0.02 | -0.55*** | 0.02 |
| Age | | | | | | |
| 17 | -1.35*** | 0.02 | -1.65*** | 0.05 | -1.49*** | 0.03 |
| 18 | -1.01*** | 0.02 | -1.25*** | 0.02 | -1.13*** | 0.02 |
| 19 | -0.79*** | 0.01 | -0.95*** | 0.02 | -0.87*** | 0.01 |
| 20 | -0.53*** | 0.01 | -0.64*** | 0.01 | -0.58*** | 0.01 |
| 21 | -0.39*** | 0.01 | -0.45*** | 0.01 | -0.42*** | 0.01 |
| 22 | -0.26*** | 0.01 | -0.27*** | 0.01 | -0.27*** | 0.01 |
| 23 | -0.16*** | 0.01 | -0.17*** | 0.01 | -0.16*** | 0.01 |
| 24 | -0.06*** | 0.01 | -0.07*** | 0.01 | -0.06*** | 0.01 |



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Table 10: Marginal effect of non- policy variables on probability of marriage of women aged 17-35,1984-2013-Continued

| | Rural | | Urban | | Nationwide | |
|---|---|---|---|---|---|---|
| Variable | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE | Marginal Effect (dlogy/dx) | SE |
| 25 | - | - | - | - | - | - |
| 26 | 0.06*** | 0.01 | 0.08*** | 0.01 | 0.07*** | 0.01 |
| 27 | 0.09*** | 0.01 | 0.11*** | 0.01 | 0.10*** | 0.01 |
| 28 | 0.14*** | 0.01 | 0.16*** | 0.01 | 0.15*** | 0.01 |
| 29 | 0.16*** | 0.01 | 0.18*** | 0.01 | 0.17*** | 0.01 |
| 30 | 0.18*** | 0.01 | 0.20*** | 0.01 | 0.19*** | 0.01 |
| 31 | 0.21*** | 0.01 | 0.24*** | 0.01 | 0.22*** | 0.01 |
| 32 | 0.23*** | 0.01 | 0.24*** | 0.01 | 0.24*** | 0.01 |
| 33 | 0.24*** | 0.01 | 0.25*** | 0.01 | 0.24*** | 0.01 |
| 34 | 0.25*** | 0.01 | 0.27*** | 0.01 | 0.26*** | 0.01 |
| 35 | 0.26*** | 0.01 | 0.27*** | 0.01 | 0.27*** | 0.01 |
| Rural Area | | | 0.16*** | 0.00 | - | - |
| War years | 0.22*** | 0.01 | 0.21*** | 0.01 | 0.21*** | 0.01 |
| Yearly time trend | -0.00*** | 0.00 | -0.00*** | 0.00 | -0.00*** | 0.00 |

Data Source: Computed from Iran's HIES, 1984-2014

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Standard Errors are computed by Delta method



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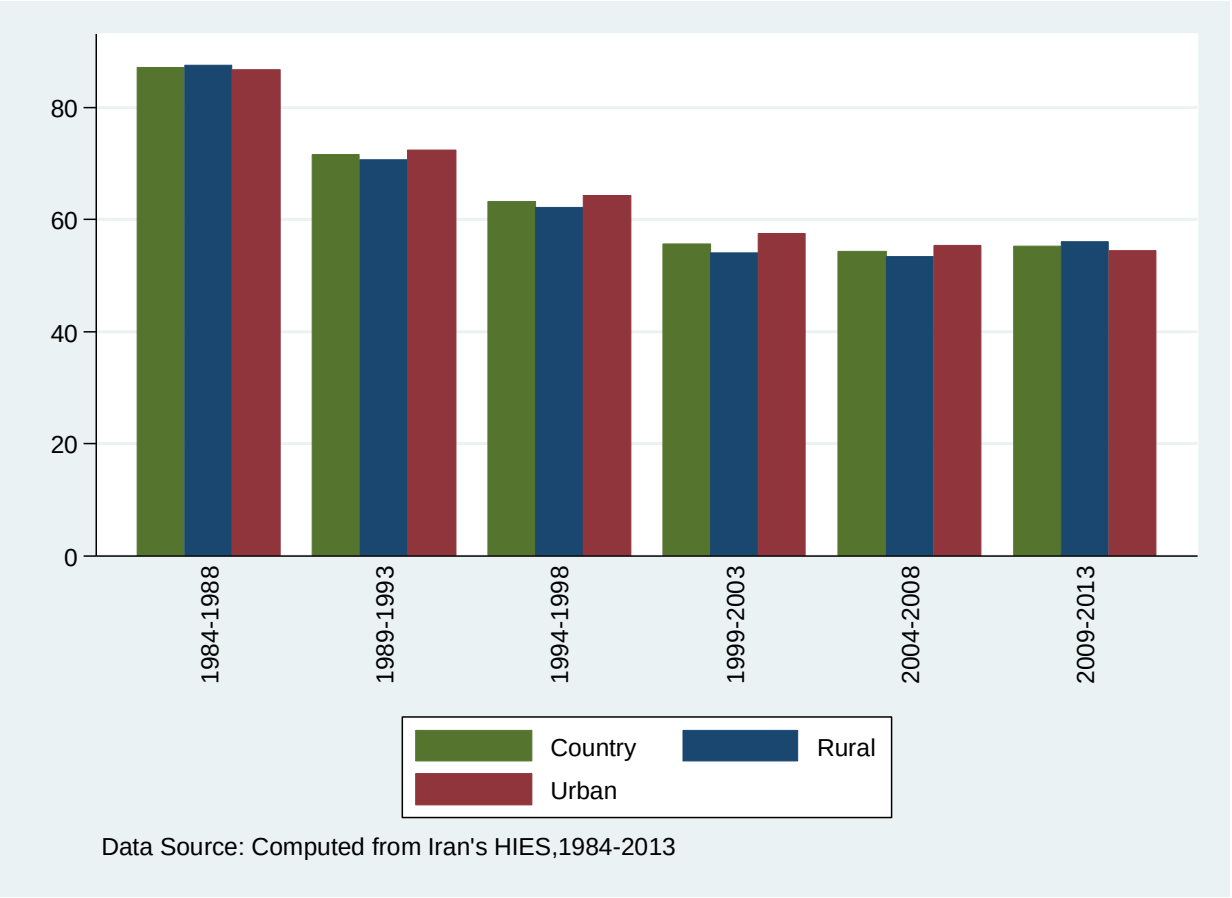


Figure 5: Trend of the marriage rate of Iranian women aged 17-35

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Table 11a: Contribution of selected explanatory variables to the change in actual marriage rate of women aged 17-35 between 1984 and 2013

| Estimated effect on Marriage Rate (percentage change) | | | |
|---|---|---|---|
| Variable | Rural | Urban | Country |
| Actual change observed | -36.0 | -37.2 | -36.6 |
| Total change explained by these factors | -4.0 | -28.0 | -17.7 |
| NANFPP | -0.4 | -0.3 | -0.3 |
| CSLP | -7.1 | -6.3 | -6.7 |
| Literacy rate | -5.5 | -4.3 | -5.2 |
| Education | 9.0 | -17.1 | -5.5 |
| Primary | 6.3 | -5.2 | 0.0 |
| Guidance School | 8.6 | 1.7 | 0.0 |
| High School | 0.0 | 0.0 | 0.3 |
| College | -5.9 | -13.6 | -10.1 |

Data Source: Computed from Iran's HIES,1984-2014, using mean marginal effects from tables 7-10



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Table 11b: Explained changes of women's marriage because of educational attainment

| Year | 1984-1988 | | | 2009-2013 | | | Percentage Change in | | | Margins | | | Explained change | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Levels of Education | Rural | Urban | Nationwide | Rural | Urban | Nationwide | Rural | Urban | Nationwide | Rural | Urban | Nationwide | Rural | Urban | Nationwide |
| NANFPP* | 60.6 | 61.6 | 61.1 | 65.5 | 66.4 | 66.0 | 4.9 | 4.9 | 4.8 | -0.1 | -0.1 | -0.1 | -0.4 | -0.3 | -0.3 |
| CSLP** | 0.0 | 0.0 | 0.0 | 89.0 | 90.0 | 89.5 | 89.0 | 90.0 | 89.5 | -0.1 | -0.1 | -0.1 | -7.1 | -6.3 | -6.7 |
| Literacy Rate | 28.9 | 67.9 | 49.4 | 89.8 | 96.5 | 93.1 | 61.7 | 28.5 | 43.7 | -0.1 | -0.2 | -0.1 | -5.5 | -4.3 | -5.2 |
| Primary | 22.06 | 29.4 | 25.99 | 36.46 | 14.6 | 25.71 | 14.4 | -14.8 | -0.28 | 0.44 | 0.35 | 0.00 | 6.3 | -5.2 | 0.0 |
| guidance school | 1.63 | 9.66 | 5.92 | 18.4 | 13.91 | 16.19 | 16.77 | 4.25 | 10.27 | 0.51 | 0.41 | 0.00 | 8.6 | 1.7 | 0.0 |
| high school | 3.59 | 24.71 | 14.89 | 24.85 | 36.93 | 30.79 | 21.26 | 12.22 | 15.9 | 0.00 | 0.00 | 0.02 | 0.0 | 0.0 | 0.3 |
| College | 0.17 | 3.18 | 1.78 | 9.95 | 30.95 | 20.28 | 9.78 | 27.77 | 18.50 | -0.60 | -0.49 | -0.55 | -5.9 | -13.6 | -10.1 |

Data Source: Computed from Iran's HIES,1984-2013, using mean marginal effects from tables 7-10

* How many percent of women were 17-19 years old when the anti-natal family planning policy was active. ** How many percent of women were 17-19 years old when the child supports limit policy was active.



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**Chapter 3: Second decade, first birth: How access to local 2-year colleges affects Adolescents birth rate in the U.S.**


## Abstract

This paper uses county variation in the number of 2-year schools and state variation in tuition costs over the years 2005-2017 to test whether easier access to local colleges affects teens' birth rate. Data on the outcomes of interest are taken from Center for Disease Control and Prevention (CDC). The difference-in-difference method was used to assess associations between availability and affordability of county-level 2-years schools, and teens' birth rates among counties with population greater than 100,000. Results show that younger teens (15-17) respond to opening a new 2-year school differently from older teenagers (18-19). While the former group increases its birth rate with a marginal elasticity of 0.06, the latter postpones its birth decision with a marginal elasticity of -0.03. Despite their contrary response to the number of schools, all teenagers respond the same to a change in tuition. Teenagers, either younger or older, increase their birth rate if attending a 2-year school is more affordable, with younger teenagers and those living in smaller counites being most sensitive to changes in tuition.


## 1. Introduction

Among the top twenty countries with the highest Human Development Index, the U.S. has had the highest adolescent fertility rate in over the last half-century. Although teens' birth rate has decreased considerably from 39.7 births per 1,000 women in 2005 to 18.8 in 2017, it is still one of the highest in the world. Most recently, the U.S. policy interest has focused on the levers for



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moving teen fertility, including and especially education (Geruso and Royer, 2018). It could be because studies of fertility unanimously proved women's education as a major factor in decreasing fertility rates (Basu, 2002). In addition to the lower fertility rate that comes from the higher opportunity costs of bearing children for educated women, education affects fertility rate by informing women's choices and giving them the confidence needed to act on these choices. Education also decreases women's birth rate by enhancing their marital aspirations and making them revise the type of man they would like to marry and the quality of life they would like to have (Jeffery and Basu 1996, Basu 1999, Behrman and Rosenzweig 2002, Goldin 1992, Jejeebhoy 1995). For such reasons, education is often thought to be an especially important determinant of the fertility of teen girls, who are in the early stages of human capital development and marital relationships.

In line with the effect of education on teenagers' fertility, in this paper I examine whether greater access to local 2-year colleges influences teens' birth rates in the United States. I focus on 2-year colleges because their significantly lower tuition makes postsecondary education more affordable. Moreover, 2-year colleges tend to attract students from the local area, especially those with lower attachment to the educational system, lower educational aspirations, and higher lifetime fertility (Pascarella et. al 1998, Stewart 2003). Another reason of selecting 2-year colleges is that although many studies have revealed a negative relationship between women's higher educational level and their fertility, there are some reasons to suspect the effect of a local 2-year college on teenagers' birth rate could be positive. Teenagers attending a 2-year school could be different from their peers in a 4-year school in genetic endowments, family background, ability, financial capability, and educational and occupational aspiration. As a result of these differences, they are more likely exposed to early motherhood (Pascarella et. al 1998, Stewart 2003). In addition to the



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higher risk of early childbearing, the locality of 2-year colleges could increase teen's birth rates if they decide to stay in their family home to save more money, and in case of pregnancy, they can have their family's help and financial support. Attending a more local school also means they are more likely to maintain existing social contracts, which may raise the likelihood of pregnancy.

There is a little research on the effect of 2-year schools on women's fertility. The main paper in this topic is by Currie and Moretti (2003). They studied roles that opening a 2-year college may play in increasing the health of a woman's child. They found that attending a 2-year school improves the child's health by decreasing the number of children that a woman decides to have. They focused on white women of any ages between the years 1940-1990. What is done differently in this paper is the use of more recent data from 2005-2017 with a focus on teenagers aged 15-19 of different races and ethnicities. To evaluate the effect of opening local 2-year colleges on teenagers' fertility, I use panel data from the 580 most populous U.S. counties and apply a difference-in-difference method.

Results indicate that among teenagers aged 15-17, an increase in the number of local 2-year colleges availability increases the birth rate, with a marginal elasticity of 0.06. However, among teenagers aged 18-19 it decreases the birth rate. Despite the different responses to the number of 2-year schools, both younger and older teenagers will demand a child less often if they must pay more to attend a 2-year. Teen's tuition elasticity of birth changes by age, race, and size of the county they reside. White teenagers' demand for a child is more sensitive to change in 2-year school tuition compared to black teenagers. Teenagers living in small/less populated counties are more sensitive to tuition than those living in big counties. Teens aged 15-17 are more sensitive compared to those aged 18-19.



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This paper has been divided into six sections. Section 2 provides background information on teens' birth rates in the United States and discusses related studies. Section 3 presents several hypotheses about how opening a 2-year college may affect teenagers' birth decision. Section 4 describes the data and empirical strategy. Section 5 examines the empirical data, and the final section concludes with a brief discussion and suggestions for further research.

## 2. Background Information

According to the World Health Organization (WHO), in 2015 maternal causes ranked second among causes of mortality in 15–19-year-old girls globally (WHO 2015). Besides contributing to the health risks, premature motherhood presumably leads to truncated education, remaining unmarried, lower future family income, and larger completed family size (Senderowitz and Paxman 1985, Ferré, 2009). Moreover, teens' child bearing has a negative inter-generational externality on newborns. Studies show that children of teen mothers face inferior socioeconomics outcomes in future including risks of developmental delay, academic difficulties, behavioral disorders, early sexual activity, depression, and becoming adolescent parents themselves (Nord et.al 1992, Hoffman and Maynard 2008, Klein 2005).

Among developed countries, the United States has always had one of the highest adolescent pregnancy rates especially in the early 1990s. In 2005, there were about 10.4 million young women aged 15-19 in the United States who bore 10% of the country's 4.1 million annual births. However, this ratio has been cut in half to 5% by 2017.[1] According to population data released by the Centers

1 If we assume a roughly stable miscarriage rate, teens' birth rate is composed of the rate at which teens become pregnant and the rate of aborting a pregnancy once it happens. During 2006–2015 abortion ratios (abortions divided by live births) decreased among adolescents of all ages,



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for Disease Control and Prevention (CDC), the overall birth rate for females aged 15–19 years in the United States declined by 53 percent from 39.7 births per 1,000 women in 2005 to 18.8 in 2017. The birth rate is falling faster for teens aged 15-17 (63 percent) than for teens aged 18-19 (49 percent).

Table 1 breaks down the U.S. adolescents' birth rate by age, race, and ethnicity. All categories have had a similar decline in birth rates, but teenage birth rates still reflect a wide disparity by race/ethnicity. White teens' fertility rate is as twice as high as the Asian or Pacific Islander teens' and almost half of African Americans'. Hispanic teenagers' birth rate is still two times greater than non-Hispanics', but the gap has been slightly decreasing.

A number of behavioral changes have been cited for the downward trend in the U.S. teen childbearing in general, including delayed initiation of first sex, decreased sexual activity, increases in the use of effective contraception and practices, as well as increases in teen pregnancy prevention programs and expanded access to Medicaid family planning services (Kearney and Levine 2009, Kearney and Levine 2012, Ventura et.al 2014, Abma and Martinez 2017, Matthews and Hamilton 2018). This paper examines how local 2-year and 4-year colleges could influence teens' birth rate in the United States.

### 2.1 Previous Literature

Many studies have revealed a negative relationship between women's higher educational level and their fertility (LeVine 1987, Currie and Moretti 2003, Breierova and Duflo 2004, Osili and Long 2008, McCrary and Royer 2011). In fact, Basu (2002) claims that studies of fertility

suggesting that the declines in U.S. teens' birth rates are driven entirely by declines in pregnancies, not increases in abortion (Jatlaoui et. al 2015, Kearney and Levine 2012). Thus, I focus on teens' birth rate and not the pregnancy rate.



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unanimously agreed on two of the strongest reasons for reduced fertility. One reason is increased gender equality, which enhances women's control over resources and their own lives. The other major factor is education, which may play an even more important role by informing women's choices and giving them the confidence needed to act on these choices (Jejeebhoy 1995).

According to the standard economic theory of opportunity cost, women's higher education decreases their fertility rate because more educated women have higher opportunity costs of bearing children in terms of forgone present and future income. For such reasons, births are often thought to be especially costly for teenagers who are in the early stages of human capital development. Osili and Long (2008) found that increasing female education by one year reduces early fertility by 0.26 births. Education also affects women's fertility rate indirectly by lowering child mortality rate (Breierova and Duflo 2004) and raising women's marital aspirations (Jeffery and Basu 1996, Basu 1999). Attending school modernizes girls' attitudes about the quality of life they would like to have, including their marital life and the type of man they would like to marry (Behrman and Rosenzweig 2002, Goldin 1992). These factors all together result in a lower fertility rate for women with higher education.

However, the fertility-education relationship is not a one-way path. Raising a child sacrifices time and effort which could be spent on education. In case of teenagers, Moore and Waite (1977) report that early childbearing is strongly associated with lower educational attainment, even when other factors associated with school achievement are considered; the young mothers are never able to catch up educationally with their former classmates who postponed childbearing. However, more recent studies (see Hotz et.al 2005) argue that although early childbearing has some adverse consequences on teen mothers in short-run, teen mothers' long-term educational attainment is similar to those of their peers who delayed their childbearing until



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adulthood. Moreover, they find that by their late twenties, teen mothers appear to be better off in some aspects of their lives. Note that this potential reverse causality makes it difficult to establish a causal link between education and fertility.

Rouse (1995) evaluated the effect of community colleges on educational attainment. She found that closer community colleges marginally increase rate of aggregate years of schooling. Shee also stated that more accessible community colleges do not change the likelihood of attaining a bachelor's degree.

Although the adverse impact of education on young women's fertility is well established (Martin 1995, Geruso and Royer 2018), little research has been reported on the effect of 2-year college education on women's fertility. This is unfortunate because there are several reasons to think that 2-year colleges may have a different effect than 4-year colleges, including the simple fact that 2-year colleges tend to attract students from the local area, especially those with lower attachment to the educational system, lower educational aspirations, and higher lifetime fertility (Pascarella et. al 1998, Stewart 2003). The main paper which has investigated the issue at all is by Currie and Moretti (2003), who examined the effects of the openings of 2-year and 4-year college between 1940-1990 to see if women's educational attainment improves the health of their children. They found that women's higher educational attainment due to college availability in the mother's 17$^{th}$ year increased child health by decreasing the women's total fertility, though this was not the primary focus of their study. They only focused on white women of any ages.

In this paper, I use more recent data to explore the effect of college availability on birth rate of girls aged 15-19 more fully by their race. There are several reasons to believe that the relationship between education and teens' fertility may have changed over time, including the



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rapid expansion of number of colleges, increases in the educational attainment of women over the last three decades, changes in sociological and legal aspects of fertility, and changes in the availability, prevalence, and effectiveness of contraceptive methods.

**3. Hypotheses**

The following thought experiment illustrates some ways in which teenagers' fertility may respond to the opening of a new local 2-year college, or more generally, a reduction in tuition. Begin by categorizing teenage girls into four groups defined by their intentions toward attending post-secondary education and type of school. Group A are teenagers who would attend a 4-year college whether a new 2-year college opens or not. Group B consists of students who would attend a 4-year college if access to 2-year colleges did not increase but would instead choose to attend a local 2-year college if it became easier or less expensive to do so. The third group (group C) consists of students who will not attend any type of college unless access increases, but who would attend a 2-year college if one opened locally. Finally, group D includes those who will not enroll in post-secondary education in any event.

Now consider how each of those groups may respond to a new 2-year college in their local area. The change would not change the educational decisions of groups A and D, but it is still possible that their fertility decisions may be affected indirectly. For example, they may become more likely to get pregnant if the local population of young men increases.

The educational decisions of groups B and C would change, however, and it may affect their fertility rates in opposite directions. Establishing more local 2-year colleges will probably decrease fertility in group C for the usual reasons of less current time and higher opportunity cost. On the other hand, switching from a 4-year to a 2-year college may increase group B's birth rate



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for two reasons. First, they will spend less time in school and maybe have a lower opportunity cost of childbirth later on. Second, attending a more local school means they are more likely to maintain existing social relationships that may raise their chance of pregnancy. Note that although women in group B are downgrading their level of education, this decision would still presumably raise their utility, as they are voluntarily choosing this option over 4-year college.

I speculate that the decrease in the fertility of group C would exceed the increase in the fertility of teenagers in group B. Because teenagers in group C are more likely to have lower educational aspirations than group B; and studies show that teenagers with modest educational and occupational aspirations are more likely exposed to early motherhood as they have not much to lose by giving birth (Stewart 2003). However, the locality of educational institution can change all the equations and increases teenagers' fertility if teens decide to stay in their family home after their babies are born and take advantage of family help and financial support (Unger and Cooley 1992, Frost et. al 2001, Geronimus 1997).

In addition to change in number of schools, a change in tuition might affect teenagers birth decision. Lower cost of college attendance will lead to both a substitution effect and an income effect. If the income effect of lowering 2-year schools' tuition overcomes the substitution effect, assuming kids as normal good then teenagers birth rate may go up. Cheaper associate degrees also could increase adolescents' interactions with the opposite sex in a county. It means that not only county's teenagers, either male or female, are less likely to leave the county to attend a college, but also more male and female teenagers may immigrate to the county to take advantage of cheaper associate degrees. Staying in the county could mean still living in their parents' home and keeping their social network, which both increase the probability of being a teen mother. To know about



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the effect of opening a new community college on teens' birth rate, we need to know whom community colleges serve.

### 3.1 Whom do community colleges serve?

In fall 2015, 17.0 million undergraduate students attended degree-granting postsecondary institutions in the United States. The 10.5 million of them (62 percent) enrolled at 4-year institutions and 6.5 million (38 percent) at 2-year institutions (see Table 2).

Students' age structure was slightly different between 2-year and 4-year institutions. In both types of schools, 31 to 32 percent of students were younger than 20. Compared to 4-year institutions, the percentage of students who were in their twenties (54 percent) was 9 percent lower in 2-years schools (45 percent). Apparently, the percentage of students over 30 is 8 percent higher in 2-year institutions (23 percent) than 4-year institutions (15 percent). In both types of institutions, females are in the majority, with 56 and 57 percent of students respectively. Most of the students in 2-year colleges are enrolled part-time. The percentage of part time students at 2-year institutions (61 percent) was more than twice as high as the percentages 4-year institutions (23 percent).

The distribution of U.S. resident undergraduate students (either full-time or part-time) by racial and ethnic groups varied to some extent among 2-year and 4-year institutions. In 2015, 50 percent of undergraduate students at 2-year institutions were White, which was lower than the percentages of White students at 4-year institutions (58 percent). The percentage of students who were Black in both institutions are about the same (13 to14 percent). 24 percent of undergraduate students enrolled in 2-year institutions were Hispanic, but only 14 percent in 4-year intuitions. Indeed, among ethnicities, Hispanics were much more likely to be enrolled at 2-year institutions



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than at 4-year intuitions, while other ethnicities (especially Whites and Asians) enrolled mostly at 4-year institutions.

Since this study asks how local 2-year colleges influence adolescents' fertility, I particularly focus on two age categories: under 18 and 18-19 years old[2] attending postsecondary colleges. Considering the age structure of colleges students shown in table 3, it is noteworthy that 2-year institutions are more popular for students under age 18. Of 1 million undergraduate students younger than 18, 61 percent (0.6 million) chose 2-year institution for a postsecondary education and 39 percent (0.4 million) of them attend 4-year schools. (The majority of students (66 percent) aged 18 and 19 registered in a 4-year institution.) Furthermore, 80 percent of students aged under 18 attended the school part-time and 90 percent of them went to public schools regardless of the school's program (4-year or 2-year). (For students aged 18 and 19, 17 percent of students attended the school part-time, and 79 percent went to the public schools. Males and females under 18 are both are more interested in part-time education than those aged 18 and 19.) Moreover, even if most of those under 18 are not currently enrolled in a 2-year school, their fertility may still be affected by the presence of such a school, either because it represents an option for the future or because it increases the number of young men in the local area.

The cost of education is one of the biggest factors in deciding on whether attending a post-secondary education and at what level. Attending a public 2-year school is the cheapest option, especially if students live with their families. Tuition and fees comprise the main part of cost of education, although they vary across the states.

2 Based on Digest of Education (2015),Table 303.50, only 0.02 percent of students aged under 18 and 0.02 percent of students aged 18-19 attended post-baccalaureate programs in 2015. Thus, I considered (total) fall enrollment for these age categories equivalent to the undergraduate enrollment.



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## 4. Data and Empirical Strategy

### 4.1 Empirical Specification

The empirical analysis uses a difference-in-difference methodology to investigate the effects of local 2-year colleges on teens' birth rates. For county c, state s, year t, the reduced-form model of teens' birth rate is modelled as:

$$TBR_{cs(t+1)} = \delta_1 D_{2cst} + \delta_2 D_{4cst} + \beta X_{cst} + \alpha_c + \tau_t + \gamma_c * t + \mathcal{E}_{cst} \quad (1)$$

where $TBR_{cs(t+1)}$ is the log of teens' birth rate in a county at time t+1. $\tau_t$ and $\alpha_c$ are respectively the year and county fixed effects needed for the difference-in-differences framework, and $\mathcal{E}_{cst}$ is the error term.

The key explanatory variables are $D_{2cst}$ and $D_{4cst}$, which measure accessibility and affordability of 2-year and 4-year colleges. $D_{2cst}$ is a vector describing the 2-year colleges: the number of 2-year schools in a county, a dummy variable indicating the size of those 2-year colleges, a continuous variable indicating the average tuition and fees of 2-year colleges in the state, a dummy variable representing size of the county, and interaction between each pair of those variables. $D_{4cst}$ consists of the same variables for the 4-year colleges. Thus, from equation (1), $\delta_1$ measures the overall effect on teenagers' birth rate of improving 2-year college accessibility (either by increasing the number of colleges or reducing tuition), conditional on other covariates. Similarly, $\delta_2$ measures the effect of increased local access to 4-year colleges on teens' birth decisions.



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$X_{cst}$ are county-specific covariates to control for aspects of the neighborhood context that are not constant over time. Studies show that unfavorable socioeconomic conditions are tightly linked to the subsequent rate of early childbearing; so that young people growing up in disadvantaged socioeconomics circumstances are more likely to have a child during adolescence (Kearney and Levine 2012, Penman-Aguilar et.al 2013, Lindberg and Orr 2011). Thus, I consider the role of some economic covariates, including percentage of people in the county living below the poverty level, the unemployment rate of high school graduates aged 25-64, and log of median monthly housing costs in the model. According to those existing studies, I expect that higher unemployment rates and a greater percentage of people below the poverty level increases teens' birth rate. I also include a set of demographic controls for the racial/ethnic composition of the county population in the model, and the sex-ratio of population aged 15–29.

Finally, the remaining term $(\gamma_c * t)$ is a vector of county specific-time trends. This addresses the possibility that on-going trends in the birth rate may be correlated with changes in the number or cost of colleges. Thus, the effects of new colleges or changes in tuition are identified by the difference between the local birth rates that actually occur in the following year and those that would have been expected if the on-going local trend had continued.

To detect if opening of new 2-year colleges could have different influences on teens based on their age, race, or ethnicity, I estimated the effect of opening a local school on total teen's birth rates (aged 15–19 years), younger teen's birth rates (aged 15–17 years), and older teen's birth rates (aged 18 and 19 years) by their race and ethnicity.



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### 4.2 Data

This paper uses data incorporated from multiple sources. Counties are the units of observation because they are the smallest local units for which number of establishments of 2-year schools and teens' fertility rates are available. Every year, Bureau of Labor Statistics provides data for the annual number of establishment and employment for both 2-year and 4-year colleges.[3] In this paper, I used the annual number of establishments as proxy of the number of colleges in a county from 2005 to 2017. I focused only on public 2-year schools for several reasons: public schools are the object of public policies; marginal students are more likely to go to public schools; the available pricing of the college is more representative of the actual cost for students in public schools; and as table 3 shows, few teenaged students attend private 2-year colleges. However, I used data on both public and private 4-year schools.

Data used for tuition is the average published tuition and fees for public universities in that state, measured in 2012 Dollars. This information comes from the U.S. Department of Education, National Center for Education Statistics, Higher Education General Information Survey (HEGIS) and Integrated Postsecondary Education Data System (IPEDS).

Data on county-level teens' birth rates for the years 2005-2017 was obtained from the Centers for Disease Control and Prevention (CDC). In many cases, rates can be disaggregated by age, race, and ethnicity. However, to assure confidentiality, the CDC has restricted fertility data to counties with a 1990 population greater than 100,000; therefore, this analysis is based on data from the 580 most populous U.S. counties. Moreover, CDC birth data are derived from birth certificates, and as of 2011, all sub-national vital statistics data representing zero to nine (0-9) births/persons

3 I considered both community colleges and technical colleges as 2-year colleges.



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are suppressed to protect personal privacy. Thus, although I suspect teens' birth rate in small counties are more likely to be affected by opening a new college than bigger counties, the birth data availability restriction prevented me from investigating small counties.

Demographic information, including percentage of Hispanic population in a county or share of a specific race from the entire population in a county also came from CDC data. Other data used in the model, including percentage of population below the poverty line, unemployment rate, and median monthly housing cost came from the United States Census Bureau.

## 5. Results

### 5.1 Descriptive Analysis

Table 4 summarizes number of 2-year and 4-year schools in 580 investigated counties by counties' size, population and whether they have ever had a sort of college. Across all counties, 93 of them (16 percent) have never had a public 2-year school during this period, and 125 of them (22 percent) have never had a public 4-year school. Since distance from the school might play a noticeable role for students to prefer a local college, I have broken counties into 10 deciles based on their size in square miles.

Table 4 shows that about 25 percent of counties that fall within the second to the forth decile have never had a public 2-year college, and 30 percent of them have never had a 4-year public school. However, as data shows, almost all investigated counties in this study have had a sort of college. There were only 4 counties that they have never had any sort of colleges in there. As opening a new college in a more populous county may affect birth rate more than a same size county with smaller population, I have categorized counties based on their mean population into



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four quartiles. 58 percent of counites that have never had a public 2-year school falls within the first quartile.

Table 5 reports mean births per 1000 women aged 15-29 by race, ethnicity and county mean size across studied counties. Mean birth rate for Hispanic teenagers is greater than Non-Hispanic ones, especially in early ages of 15-17. Among teenagers with different races, Black teens have the highest birth rate and whites have the lowest. Since the mean birth rate for Native Americans and Asian or Pacific Islanders from the sample I used (table 5) is very different from the mean birth rate of these races in the United States (table 3), I will not interpret any regression coefficients of these two races. Table 5 also shows that teenagers' mean birth rate in counties that have had a 2-year college is about 5 birth per 1000 women higher than those that have never had a 2-year college. Similarly, the mean birth rate of younger teenagers aged 15-17 is about 3 birth per 1000 higher in counties with a 4-year school compare to counties that have never had a 4-year college. However, the data show that having a 4-year college in the county has coincided with a lower mean birth rate among teenagers aged 18-19.

**5.2 Regression Analysis**

In this section, I discuss estimates of the effects of availability of a local 2-year college on the fertility rate of teenagers. Estimated mean marginal elasticities and standard errors from difference-in-difference regressions are displayed in table 6a of the appendix. Findings indicate that it is important to distinguish between the availability and affordability of 2-year schools. While opening a new local 2-year school does not have a statistically significant effect on the fertility rate of teenagers, 2-year schools' tuition and fees inversely affects teenagers' birth decision. However, an insignificant effect of opening a new 2-year college on teenager's birth rate could be



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due to the fact that birth rates of teenagers in small counties, which are more likely to be affected by opening a new college, were censored from the sample by CDC in order to provide privacy.

According to the regression results, the teenagers' 2-year school tuition elasticity of birth rate is -0.27. This effect does not change by ethnicity, but it does by race. White teenagers' demand for a child is more sensitive to change in 2-year school tuition compared to Black teenagers. Results also show that as the size or the population of a county goes up, teenagers' birth decision would be less sensitive to 2-year schools' tuition. The 2-year school tuition elasticity of birth ranges between -0.39 and -0.13 from the smallest counties to the largest ones.

As table 6a shows that opening a new 2-year school in a county has different, statistically significant effects on Hispanic and Non-Hispanic teenagers. Although the effects on each ethnic group are almost equal in size, they are opposite in direction; Higher availability of 2-year schools lowers Hispanic teenagers' birth rate and increases Non-Hispanics' birth rate. Hispanic teenagers' birth decision is also sensitive to the tuition of 4-year schools. More expensive local 4-year schools increase their probability of being a teen mother.

Table 6b breaks down the effect of availability and affordability of 2-year schools on the birth rate of younger teenagers (aged 15-17) and older teenagers (18-19). Both groups respond in the same way to changes in tuition. Both increase their birth rate when they must pay less to attend a 2-year school, especially in smaller and less populated counties. The only difference is that the younger women in any race, ethnicity group, and county size are more sensitive to change in tuition than the older. Despite their same reaction to the tuition, younger teens respond to the change in number of 2-year school in their county differently from the older teens. Increasing the number of 2-year schools' availability positively affects the birth rate of teenagers aged 15-17 and negatively affects birth rate of teens aged 18-19. However, breaking down each age category by their race,



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ethnicity, and size of the county they are living in shows that the effect of 2-year college availability on birth rates is statistically significant only on large and populous counties. Among different demographic groups, the change in the number of 2-year colleges has a statistically significant effect on the birth rate of older teenagers among Whites and Hispanics.

Table 6c represents how school availability and affordability at the time that women were 18 years old may affect their birth decision when they are in their twenties. Results show that opening a new public 2-year school in a county keep decreases teenagers' birth rate (especially for Hispanics) until they will be 24 years old. However, this effect will not last longer and the number of 2-year schools does not have a statistically significant effect on a teenager's birth rate in their late twenties. The only exception is for teenagers living in the second decile county size who will have a higher birth rate between 25-29 if they have had more 2-year colleges around. In addition to 2-year schools, having more public 4-year school around will also affect future birth rate of teenagers living in the smallest county size. Although their current birth rate is not influenced by number of 4-year schools, they decrease their birth rate in their early twenties and postpone it to their late twenties.

Although it is easy to imagine that higher costs of attending school may lead teenagers to postpone their fertility, Table 6c shows tuition of 2-year schools does not have a significant effect on teenagers' future birth rate. Hispanics and Blacks are exceptions, however: more expensive associate degrees decrease both of those groups' birth rates until the age of 24, but they increase Blacks' birth rates in their late twenties considerably. Although tuition of public 4-year schools does not significantly affect teenagers' current birth rates, it positively affects their future birth rates from ages 20 to 29.



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## 6. Conclusion

This study has attempted to reveal the role that local 2-year colleges may play on the birth rate of teenagers. It has brought to light the fact that in case of counties with a 1990 population greater than 100,000, the effect of 2-year schools on teenagers' birth decision is mainly a matter of affordability than availability. Availability of local 2-year colleges affects younger teenagers different from the older. While the birth rate of teenagers aged 15-17 increases with opening a new 2-year college in a county, the birth rate of teenagers aged 18-19 drops. However, either increase or decrease, these effects are too small. The reason of this small effect could back to the size of counites in the data set used.

Despite the small effect of college availability on the birth decision of teenagers, college affordability in form of the change in tuition affects teenagers' birth rate considerably. Although teenagers from all racial/ethnic/ age groups respond the same to the change in tuition, impacts on younger teenagers is greater than older, on white teenagers more than blacks, and on teenagers living in a small size counties more than those living in a big size counties.

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## Appendix

Table 1: U.S. Adolescents' birth per 1000 women, by race and ethnicity

| | 2005 | | | 2017 | | |
|---|---|---|---|---|---|---|
| | 15-17 | 18-19 | 15-19 | 15-17 | 18-19 | 15-19 |
| United States | 21.1 | 68.4 | 39.7 | 7.8 | 35.1 | 18.8 |
| Race | | | | | | |
| White | 18.8 | 64.0 | 36.7 | 7.1 | 33.2 | 17.6 |
| Black | 34.5 | 101.2 | 60.1 | 13.0 | 52.5 | 28.7 |
| Native American | 26.3 | 78.0 | 46.0 | 10.3 | 39.4 | 21.9 |
| Asian or Pacific Islander | 7.7 | 26.4 | 15.4 | 2.5 | 12.5 | 6.6 |
| Ethnicity | | | | | | |
| Hispanic | 45.8 | 124.2 | 76.5 | 13.6 | 52.7 | 28.9 |
| Not Hispanic or Latino | 15.7 | 56.4 | 31.8 | 6.0 | 29.7 | 15.6 |

Data Source: Centers for Disease Control and Prevention



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Table 2: Undergraduate fall enrollment in degree-granting postsecondary institutions in 2015

| Selected student characteristic | | | | Percentage | | |
|---|---|---|---|---|---|---|
| | Total | 4-year | 2-year | Total | 4-year | 2-year |
| **Total undergrad** | 17.0 | 10.5 | 6.5 | 100.0 | 100.0 | 100.0 |
| **Age** | | | | | | |
| under 18 | 1.1 | 0.4 | 0.6 | 6.2 | 3.9 | 9.9 |
| 18-19 | 4.3 | 2.9 | 1.5 | 25.5 | 27.3 | 22.5 |
| 20-24 | 6.7 | 4.7 | 2.0 | 39.5 | 44.4 | 31.5 |
| 25-29 | 1.8 | 1.0 | 0.9 | 10.8 | 9.4 | 13.1 |
| 30-34 | 1.0 | 0.6 | 0.5 | 6.1 | 5.2 | 7.5 |
| over 35 or Age unknown | 2.0 | 1.0 | 1.0 | 11.9 | 9.9 | 15.3 |
| **Sex** | | | | | | |
| Male | 7.5 | 4.7 | 2.8 | 44.0 | 44.4 | 43.4 |
| Female | 9.5 | 5.9 | 3.7 | 56.0 | 55.6 | 56.6 |
| **Attendance status** | | | | | | |
| Full-time | 10.6 | 8.1 | 2.5 | 62.2 | 76.7 | 38.7 |
| Part-time | 6.4 | 2.5 | 4.0 | 37.8 | 23.3 | 61.3 |
| **Race/ethnicity** | | | | | | |
| White | 9.3 | 6.1 | 3.2 | 54.6 | 57.6 | 49.7 |
| Black | 2.3 | 1.4 | 0.9 | 13.6 | 13.0 | 14.4 |
| Hispanic | 3.0 | 1.5 | 1.6 | 17.9 | 14.2 | 23.9 |
| Asian | 1.0 | 0.7 | 0.4 | 6.1 | 6.2 | 5.9 |
| Pacific Islander | 0.0 | 0.0 | 0.0 | 0.3 | 0.3 | 0.3 |
| American Indian/Alaska Native | 0.1 | 0.1 | 0.1 | 0.8 | 0.7 | 1.0 |
| Two or more races | 0.6 | 0.4 | 0.2 | 3.5 | 3.6 | 3.3 |
| Nonresident alien | 0.6 | 0.5 | 0.1 | 3.3 | 4.4 | 1.6 |

Data Source: Digest of Education Statistics, 2016



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Table 3: Fall enrollment in degree-granting undergraduate institutions, 2015

| | Under 18 | 18 and 19 | Under 18 | 18 and 19 |
|---|---|---|---|---|
| **Fall enrollment** | 1.1 | 4.3 | 100.0 | 100.0 |
| 4-year | 0.4 | 2.9 | 38.9 | 66.3 |
| Public | 0.3 | 2.0 | 29.3 | 46.1 |
| Private-nonprofit | 0.1 | 0.8 | 9.2 | 19.1 |
| Private-for profit | 0.0 | 0.0 | 0.4 | 1.1 |
| 2-year | 0.6 | 1.5 | 61 | 34 |
| Public | 0.6 | 1.4 | 61 | 33 |
| Private-nonprofit | 0.0 | 0.0 | 0 | 0 |
| Private-for profit | 0.0 | 0.0 | 0 | 1 |
| Full-time | 0.2 | 3.6 | 20 | 83 |
| Public | 0.2 | 2.7 | 16 | 63 |
| Private-nonprofit | 0.0 | 0.8 | 4 | 19 |
| Private-for profit | 0.0 | 0.1 | 0 | 1 |
| Part-time | 0.8 | 0.7 | 80 | 17 |
| Public | 0.8 | 0.7 | 75 | 16 |
| Private-nonprofit | 0.1 | 0.0 | 6 | 1 |
| Private-for profit | 0.0 | 0.0 | 0 | 0 |
| Full-time | 0.2 | 3.6 | 20 | 83 |
| 2-year | 0.1 | 0.9 | 7 | 21 |
| 4-year | 0.1 | 2.7 | 12 | 62 |
| Part-time | 0.8 | 0.7 | 80 | 17 |
| 2-year | 0.6 | 0.6 | 54 | 13 |
| 4-year | 0.3 | 0.2 | 27 | 4 |
| Female-Full-time | 0.1 | 2.0 | 12 | 46 |
| Female-Part-time | 0.5 | 0.4 | 47 | 9 |
| Male-Full-time | 0.1 | 1.6 | 8 | 37 |
| Male-Part-time | 0.4 | 0.3 | 33 | 8 |

Data Source: Digest of Higher Education, 2015, Tables 303.50 and 303.45.



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Table 4: Number of counties, by type of colleges, size and mean population

| | | Total | Number of counties have ever had a | | | Number of counties have never had a | | |
|---|---|---|---|---|---|---|---|---|
| | | | Public 2-year | Private 4-year | Public 4-year | Public 2-year | Private 4 year | Public 4-year |
| Overall | | 580 | 487 | 549 | 455 | 93 | 31 | 125 |
| By county size | | | | | | | | |
| County decile | mean square mile | | | | | | | |
| 1st decile | 162 | 52 | 49 | 47 | 46 | 3 | 5 | 6 |
| 2nd decile | 358 | 68 | 52 | 66 | 43 | 16 | 2 | 25 |
| 3rd decile | 502 | 64 | 49 | 62 | 48 | 15 | 2 | 16 |
| 4th decile | 599 | 65 | 47 | 61 | 46 | 18 | 4 | 19 |
| 5th decile | 690 | 62 | 52 | 58 | 43 | 10 | 4 | 19 |
| 6th decile | 813 | 58 | 51 | 55 | 44 | 7 | 3 | 14 |
| 7th decile | 927 | 52 | 51 | 48 | 47 | 1 | 4 | 5 |
| 8th decile | 1,170 | 55 | 49 | 52 | 49 | 6 | 3 | 6 |
| 9th decile | 1,725 | 51 | 41 | 48 | 43 | 10 | 3 | 8 |
| 10th decile | 5,810 | 53 | 46 | 52 | 46 | 7 | 1 | 7 |
| By county mean population | | | | | | | | |
| County quartile | mean population | | | | | | | |
| 1st quartile | 138,862 | 219 | 165 | 191 | 146 | 54 | 28 | 73 |
| 2nd quartile | 235,760 | 153 | 123 | 151 | 118 | 30 | 2 | 35 |
| 3rd quartile | 464,340 | 115 | 107 | 114 | 104 | 8 | 1 | 11 |
| 4th quartile | 1,507,755 | 93 | 92 | 93 | 87 | 1 | 0 | 6 |

Data Source: Bureau of Labor Statistics, Quarterly Census of Employment and Wages



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Table 5: County Mean Births per 1000 women aged 15-29, by ethnicity, race, county mean size, year 2005-2017

| | 2005 | | | | 2017 | | | |
|---|---|---|---|---|---|---|---|---|
| | 15-17 | 18-19 | 20-24 | 25-29 | 15-17 | 18-19 | 20-24 | 25-29 |
| Overall | 21.1 | 68.4 | 101.4 | 121.1 | 10.1 | 37.4 | 73.6 | 104.0 |
| Hispanic | 62.4 | 99.7 | 180.7 | 159.5 | 17.6 | 62.7 | 104.9 | 127.0 |
| Non-Hispanic | 16.2 | 57.8 | 89.9 | 114.5 | 8.2 | 33.1 | 67.1 | 100.0 |
| White | 18.4 | 62.0 | 96.5 | 121.7 | 9.0 | 33.7 | 68.1 | 102.7 |
| Black | 37.7 | 109.5 | 135.2 | 113.9 | 15.7 | 61.1 | 102.5 | 112.5 |
| Native American | 169.3 | 268.2 | 152.1 | 254.1 | 20.6 | 67.1 | 90.0 | 91.6 |
| Asian or Pacific Islander | 23.0 | 96.0 | 74.2 | 120.3 | 27.2 | 67.6 | 70.5 | 102.9 |
| 1st decile | 26.8 | 70.1 | 92.4 | 102.1 | 11.7 | 35.6 | 66.5 | 92.0 |
| 2nd decile | 18.3 | 59.0 | 90.5 | 121.0 | 9.4 | 33.7 | 64.8 | 103.9 |
| 3rd decile | 18.3 | 60.4 | 92.9 | 117.3 | 8.9 | 34.0 | 66.8 | 101.0 |
| 4th decile | 17.3 | 59.1 | 92.1 | 122.6 | 9.5 | 36.0 | 72.4 | 107.9 |
| 5th decile | 19.5 | 67.4 | 103.5 | 125.3 | 10.0 | 36.4 | 74.4 | 107.6 |
| 6th decile | 18.5 | 65.1 | 98.6 | 115.9 | 9.2 | 34.8 | 70.6 | 99.8 |
| 7th decile | 22.8 | 73.4 | 106.1 | 123.6 | 10.5 | 39.5 | 78.1 | 106.9 |
| 8th decile | 22.2 | 74.9 | 106.3 | 119.8 | 8.9 | 41.4 | 79.6 | 102.4 |
| 9th decile | 21.2 | 74.1 | 112.3 | 130.5 | 10.7 | 40.4 | 82.0 | 112.3 |
| 10th decile | 25.7 | 80.8 | 119.2 | 132.7 | 12.3 | 42.3 | 81.5 | 106.7 |
| Has a county ever had a 2-year college | | | | | | | | |
| Yes | 21.7 | 69.4 | 101.8 | 120.9 | 10.2 | 37.6 | 73.9 | 103.2 |
| No | 17.8 | 63.1 | 98.9 | 122.4 | 9.5 | 36.1 | 71.8 | 108.0 |
| Has a county ever had a 4-year college | | | | | | | | |
| Yes | 21.1 | 68.2 | 101.2 | 121.0 | 10.0 | 37.1 | 73.1 | 103.6 |
| No | 18.6 | 87.5 | 124.4 | 133.7 | 13.7 | 51.3 | 95.2 | 122.5 |

Data Source: Centers for Disease Control and Prevention

Note. N = 580 counties



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Table 6a: Estimated mean marginal elasticity of county teen's aged 15-19 birth rates with respect to current number of schools and tuition

| | Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| Overall | 0.01 | 0.01 | -0.01 | 0.01 | -0.02 | 0.02 | ***-0.27 | 0.04 | *0.08 | 0.04 | -0.07 | 0.05 |
| Hispanic | ***-0.07 | 0.02 | -0.04 | 0.03 | -0.04 | 0.03 | ***-0.21 | 0.05 | **0.08 | 0.04 | -0.09 | 0.06 |
| Non-Hispanic | ***0.06 | 0.02 | -0.01 | 0.01 | -0.01 | 0.02 | ***-0.20 | 0.06 | 0.05 | 0.06 | -0.01 | 0.06 |
| By race | | | | | | | | | | | | |
| White | -0.01 | 0.02 | -0.01 | 0.01 | -0.01 | 0.02 | ***-0.29 | 0.05 | 0.07 | 0.05 | -0.06 | 0.06 |
| Black | 0.03 | 0.02 | -0.03 | 0.02 | -0.01 | 0.03 | **-0.20 | 0.08 | 0.07 | 0.07 | 0.08 | 0.07 |
| By county population | | | | | | | | | | | | |
| 1st quartile | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | ***-0.35 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 2nd quartile | 0.00 | 0.01 | -0.01 | 0.00 | 0.00 | 0.01 | ***-0.34 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 3rd quartile | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | ***-0.33 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 4rd quartile | 0.01 | 0.02 | -0.02 | 0.02 | -0.02 | 0.03 | ***-0.23 | 0.04 | *0.08 | 0.04 | -0.08 | 0.05 |
| By minimum number of schools | | | | | | | | | | | | |
| 0 | 0.00 | 0.00 | ***-0.00 | 0.00 | 0.00 | 0.01 | ***-0.35 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 1 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | ***-0.32 | 0.05 | *0.09 | 0.05 | -0.08 | 0.05 |
| 2 | 0.01 | 0.03 | 0.01 | 0.01 | -0.01 | 0.02 | ***-0.33 | 0.05 | *0.08 | 0.04 | -0.07 | 0.05 |
| 3 & 4 | -0.02 | 0.03 | 0.01 | 0.03 | -0.01 | 0.02 | ***-0.29 | 0.05 | *0.09 | 0.05 | -0.08 | 0.05 |
| +5 | 0.04 | 0.04 | -0.07 | 0.05 | -0.02 | 0.03 | -0.07 | 0.06 | 0.06 | 0.04 | -0.07 | 0.05 |



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Table 6a: Estimated mean marginal elasticity of county teen's aged 15-19 birth rates with respect to current number of schools and tuition(continued)

| | Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| By County Size | | | | | | | | | | | | |
| 1 | 0.04 | 0.02 | -0.01 | 0.03 | 0.01 | 0.04 | ***-0.39 | 0.06 | *0.09 | 0.05 | -0.09 | 0.06 |
| 2 | -0.01 | 0.03 | -0.01 | 0.02 | -0.02 | 0.06 | ***-0.36 | 0.06 | *0.09 | 0.05 | -0.08 | 0.05 |
| 3 | 0.02 | 0.05 | -0.01 | 0.01 | **-0.14 | 0.07 | ***-0.36 | 0.06 | *0.09 | 0.05 | -0.08 | 0.05 |
| 4 | 0.00 | 0.03 | -0.01 | 0.02 | *0.05 | 0.02 | ***-0.34 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 5 | -0.06 | 0.04 | -0.03 | 0.03 | -0.03 | 0.03 | ***-0.33 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 6 | 0.11 | 0.07 | **-0.05 | 0.02 | 0.04 | 0.06 | ***-0.31 | 0.05 | *0.09 | 0.05 | -0.08 | 0.05 |
| 7 | -0.04 | 0.05 | 0.04 | 0.03 | -0.02 | 0.04 | ***-0.25 | 0.04 | *0.08 | 0.05 | -0.08 | 0.05 |
| 8 | 0.01 | 0.02 | ***0.06 | 0.01 | 0.01 | 0.03 | ***-0.28 | 0.04 | *0.08 | 0.04 | -0.07 | 0.05 |
| 9 | 0.02 | 0.01 | 0.00 | 0.01 | *-0.07 | 0.03 | ***-0.20 | 0.05 | *0.09 | 0.05 | -0.07 | 0.05 |
| 10 | -0.02 | 0.03 | -0.07 | 0.05 | 0.01 | 0.08 | ***-0.13 | 0.03 | 0.06 | 0.03 | -0.07 | 0.04 |

Note: Regression also controls for some county-level demographic and economic covariates including percentage of people living below the poverty level, the unemployment rate, and housing cost.

* significant at 10%

** significant at 5%

*** significant at 1%

Standard Errors are clustered at county levels. Regression is weighted by representative female population to address heteroscedasticity.



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Table 6b: Estimated mean marginal elasticity of county teen's birth rates with respect to age, number of schools, and tuition

| | | | Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | | | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| By Age | | | | | | | | | | | | | | |
| 15-17 | | | ***0.06 | 0.02 | 0.00 | 0.02 | **-0.06 | 0.03 | ***-0.28 | 0.07 | **0.14 | 0.06 | -0.06 | 0.08 |
| 18-19 | | | **-0.03 | 0.01 | 0.00 | 0.01 | 0.00 | 0.02 | ***-0.20 | 0.04 | **0.09 | 0.04 | *-0.09 | 0.05 |
| By age and County population | | | | | | | | | | | | | | |
| 15-17 | 1st quartile | | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | ***-0.36 | 0.09 | **0.15 | 0.07 | -0.06 | 0.08 |
| | 2nd quartile | | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | ***-0.35 | 0.08 | **0.14 | 0.07 | -0.05 | 0.08 |
| | 3rd quartile | | 0.01 | 0.01 | 0.01 | 0.02 | -0.01 | 0.01 | ***-0.35 | 0.08 | **0.15 | 0.07 | -0.06 | 0.08 |
| | 4rd quartile | | ***0.08 | 0.03 | 0.00 | 0.03 | **-0.10 | 0.04 | ***-0.25 | 0.07 | **0.13 | 0.06 | -0.06 | 0.08 |
| 18-19 | 1st quartile | | 0.00 | 0.01 | 0.01 | 0.00 | -0.01 | 0.00 | ***-0.27 | 0.05 | **0.09 | 0.05 | *-0.09 | 0.05 |
| | 2nd quartile | | 0.00 | 0.01 | 0.00 | 0.01 | -0.01 | 0.01 | ***-0.25 | 0.04 | **0.09 | 0.04 | *-0.09 | 0.05 |
| | 3rd quartile | | -0.01 | 0.01 | 0.00 | 0.01 | *-0.01 | 0.01 | ***-0.25 | 0.04 | **0.09 | 0.04 | *-0.09 | 0.05 |
| | 4rd quartile | | **-0.05 | 0.02 | -0.01 | 0.02 | 0.01 | 0.03 | ***-0.17 | 0.04 | **0.09 | 0.04 | *-0.10 | 0.05 |
| By age and County Size | | | | | | | | | | | | | | |
| 15-17 | | 1 | 0.07 | 0.05 | -0.03 | 0.06 | 0.06 | 0.06 | ***-0.41 | 0.10 | **0.15 | 0.07 | -0.06 | 0.09 |
| | | 2 | -0.02 | 0.03 | 0.04 | 0.04 | -0.11 | 0.09 | ***-0.37 | 0.09 | **0.15 | 0.07 | -0.06 | 0.08 |
| | | 3 | 0.02 | 0.10 | 0.00 | 0.01 | **-0.27 | 0.14 | ***-0.38 | 0.09 | **0.15 | 0.07 | -0.06 | 0.08 |
| | | 4 | -0.09 | 0.06 | *-0.05 | 0.03 | **0.05 | 0.03 | ***-0.36 | 0.09 | **0.15 | 0.07 | -0.05 | 0.08 |



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Table 6b: Estimated mean marginal elasticity of county teen's birth rates with respect to age, number of schools, and tuition (continued)

| | | Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| By age and County Size | | | | | | | | | | | | | |
| 15-17 | 5 | -0.01 | 0.06 | 0.02 | 0.09 | *-0.09 | 0.05 | ***-0.34 | 0.08 | **0.15 | 0.07 | -0.05 | 0.08 |
| | 6 | **0.25 | 0.12 | 0.03 | 0.04 | 0.08 | 0.12 | ***-0.33 | 0.08 | **0.16 | 0.07 | -0.06 | 0.08 |
| | 7 | 0.09 | 0.07 | 0.06 | 0.04 | -0.05 | 0.07 | ***-0.26 | 0.06 | **0.14 | 0.07 | -0.06 | 0.08 |
| | 8 | 0.01 | 0.03 | 0.02 | 0.02 | 0.05 | 0.04 | ***-0.30 | 0.07 | **0.13 | 0.06 | -0.06 | 0.08 |
| | 9 | 0.02 | 0.02 | 0.01 | 0.02 | **-0.10 | 0.04 | ***-0.22 | 0.07 | **0.14 | 0.07 | -0.05 | 0.08 |
| | 10 | **0.11 | 0.05 | -0.06 | 0.07 | -0.16 | 0.10 | ***-0.14 | 0.05 | **0.09 | 0.05 | -0.05 | 0.07 |
| 18-19 | 1 | 0.04 | 0.02 | 0.01 | 0.02 | -0.02 | 0.05 | ***-0.29 | 0.05 | **0.10 | 0.05 | *-0.11 | 0.06 |
| | 2 | -0.02 | 0.03 | 0.01 | 0.04 | -0.01 | 0.04 | ***-0.27 | 0.05 | **0.10 | 0.05 | *-0.09 | 0.05 |
| | 3 | -0.01 | 0.03 | ***-0.03 | 0.01 | -0.08 | 0.05 | ***-0.27 | 0.05 | **0.10 | 0.05 | *-0.10 | 0.05 |
| | 4 | 0.04 | 0.04 | 0.03 | 0.03 | 0.01 | 0.02 | ***-0.25 | 0.05 | **0.10 | 0.05 | *-0.09 | 0.05 |
| | 5 | *-0.05 | 0.03 | **-0.04 | 0.02 | -0.01 | 0.02 | ***-0.24 | 0.04 | **0.09 | 0.05 | *-0.09 | 0.05 |
| | 6 | -0.01 | 0.06 | **-0.07 | 0.03 | 0.00 | 0.02 | ***-0.23 | 0.04 | **0.10 | 0.05 | *-0.09 | 0.05 |
| | 7 | -0.05 | 0.07 | 0.06 | 0.04 | -0.06 | 0.05 | ***-0.18 | 0.03 | **0.09 | 0.04 | *-0.09 | 0.05 |
| | 8 | 0.00 | 0.02 | ***0.06 | 0.01 | 0.00 | 0.02 | ***-0.21 | 0.04 | **0.08 | 0.04 | *-0.09 | 0.05 |
| | 9 | 0.02 | 0.02 | 0.01 | 0.01 | -0.01 | 0.03 | ***-0.15 | 0.04 | **0.09 | 0.04 | *-0.09 | 0.05 |



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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | ***-0.15 | 0.04 | -0.05 | 0.05 | 0.11 | 0.07 | ***-0.09 | 0.03 | **0.07 | 0.03 | **-0.09 | 0.05 |
| By race and age | | | | | | | | | | | | | |
| White-15-17 | | 0.04 | 0.03 | 0.01 | 0.02 | **-0.07 | 0.03 | ***-0.30 | 0.09 | *0.13 | 0.08 | -0.02 | 0.10 |
| White-18-19 | | ***-0.05 | 0.02 | -0.01 | 0.01 | 0.01 | 0.02 | ***-0.21 | 0.05 | *0.09 | 0.05 | *-0.10 | 0.05 |
| Black-15-17 | | 0.03 | 0.04 | -0.01 | 0.03 | -0.02 | 0.05 | ***-0.29 | 0.11 | **0.23 | 0.10 | *0.16 | 0.09 |
| Black-18-19 | | 0.03 | 0.02 | *-0.03 | 0.02 | 0.00 | 0.03 | **-0.14 | 0.07 | 0.09 | 0.07 | **0.15 | 0.07 |
| Hispanic-15-17 | | -0.05 | 0.04 | 0.00 | 0.05 | **-0.10 | 0.05 | ***-0.20 | 0.08 | *0.10 | 0.06 | 0.06 | 0.10 |
| Hispanic-18-19 | | ***-0.10 | 0.03 | ***-0.06 | 0.02 | 0.01 | 0.03 | ***-0.20 | 0.05 | *0.08 | 0.04 | **-0.15 | 0.06 |
| Non-Hispanic-15-17 | | 0.05 | 0.06 | -0.01 | 0.02 | -0.02 | 0.04 | ***-0.25 | 0.09 | **0.22 | 0.10 | -0.05 | 0.11 |
| Non-Hispanic-18-19 | | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.02 | ***-0.14 | 0.05 | 0.07 | 0.06 | -0.03 | 0.06 |

Note: Regression also controls for some county-level demographic and economic covariates including percentage of people living below the poverty level, the unemployment rate, and housing cost.

* significant at 10%

** significant at 5%

*** significant at 1%

Standard Errors are clustered at county levels. Regression is weighted by representative female population to address heteroscedasticity.



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Table 6c: Marginal effect of school availability and tuition at the time that women were 18 on current birth rate of women aged 20-29

| | | Change in Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| | 20-24 | **-0.02 | 0.01 | 0.00 | 0.01 | ***0.03 | 0.01 | -0.03 | 0.03 | **0.05 | 0.03 | ***-0.07 | 0.02 |
| | 25-29 | 0.04 | 0.02 | 0.00 | 0.01 | -0.01 | 0.01 | 0.04 | 0.03 | **0.08 | 0.03 | 0.02 | 0.03 |
| 20-24 | Hispanic | ***-0.06 | 0.02 | *-0.02 | 0.01 | **0.04 | 0.02 | ***-0.11 | 0.04 | ***0.08 | 0.03 | ***-0.11 | 0.04 |
| | Non-Hispanic | -0.01 | 0.01 | -0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.03 | ***0.08 | 0.03 | -0.04 | 0.03 |
| 25-29 | Hispanic | *0.08 | 0.05 | *-0.02 | 0.01 | ***-0.08 | 0.02 | 0.04 | 0.06 | **0.11 | 0.05 | 0.08 | 0.06 |
| | Non-Hispanic | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.03 | **0.08 | 0.04 | -0.01 | 0.03 |
| 20-24 | White | *-0.02 | 0.01 | -0.01 | 0.01 | *0.02 | 0.01 | -0.03 | 0.03 | 0.03 | 0.03 | ***-0.08 | 0.03 |
| | Black | 0.00 | 0.01 | -0.01 | 0.01 | 0.02 | 0.01 | ***-0.12 | 0.05 | **0.11 | 0.04 | -0.06 | 0.04 |
| 25-29 | White | 0.03 | 0.02 | 0.00 | 0.01 | -0.01 | 0.01 | -0.04 | 0.04 | *0.07 | 0.04 | 0.05 | 0.04 |
| | Black | 0.02 | 0.03 | -0.01 | 0.01 | 0.03 | 0.02 | ***0.25 | 0.06 | 0.02 | 0.06 | 0.08 | 0.05 |
| 20-24 | 1st decile | 0.00 | 0.01 | ***-0.05 | 0.01 | -0.05 | 0.03 | -0.05 | 0.04 | **0.07 | 0.03 | ***-0.09 | 0.03 |
| | 2nd decile | -0.01 | 0.01 | 0.00 | 0.01 | -0.02 | 0.01 | -0.04 | 0.03 | **0.07 | 0.03 | ***-0.08 | 0.02 |
| | 3rd decile | 0.01 | 0.03 | 0.00 | 0.01 | -0.01 | 0.03 | -0.04 | 0.03 | **0.07 | 0.03 | ***-0.08 | 0.02 |
| | 4th decile | -0.03 | 0.04 | -0.02 | 0.02 | 0.00 | 0.01 | -0.04 | 0.03 | **0.07 | 0.03 | ***-0.07 | 0.02 |
| | 5th decile | -0.02 | 0.01 | 0.02 | 0.01 | **-0.03 | 0.01 | -0.04 | 0.03 | **0.07 | 0.03 | ***-0.07 | 0.02 |
| | 6th decile | 0.03 | 0.06 | -0.02 | 0.01 | 0.01 | 0.03 | -0.04 | 0.03 | **0.07 | 0.03 | ***-0.08 | 0.02 |
| | 7th decile | -0.05 | 0.04 | 0.04 | 0.03 | ***0.08 | 0.03 | -0.03 | 0.02 | **0.06 | 0.03 | ***-0.08 | 0.02 |



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| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 8th decile | -0.01 | 0.02 | -0.01 | 0.01 | 0.02 | 0.02 | -0.03 | 0.03 | **0.06 | 0.02 | ***-0.07 | 0.02 |
| | 9th decile | 0.01 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | -0.02 | 0.03 | **0.06 | 0.03 | ***-0.07 | 0.02 |
| | 10th decile | ***-0.07 | 0.03 | 0.00 | 0.04 | ***0.13 | 0.03 | -0.01 | 0.02 | 0.02 | 0.02 | ***-0.07 | 0.02 |

Table 6c: Marginal effect of school availability and tuition at the time that women were 18 on current birth rate of women aged 20-29 (continued)

| | | Change in Number of Schools | | | | | | Tuition | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2-year-public | | 4-year-Public | | 4-year-Private | | 2-year-public | | 4-year-Public | | 4-year-Private | |
| | | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. | Coef. | S.E. |
| 25-29 | 1st decile | -0.01 | 0.04 | **0.03 | 0.01 | 0.03 | 0.03 | 0.03 | 0.04 | **0.08 | 0.04 | 0.03 | 0.04 |
| | 2nd decile | **0.06 | 0.03 | 0.01 | 0.02 | -0.02 | 0.03 | 0.01 | 0.04 | **0.08 | 0.04 | 0.05 | 0.04 |
| | 3rd decile | -0.01 | 0.03 | **-0.01 | 0.01 | 0.01 | 0.03 | 0.02 | 0.04 | **0.08 | 0.04 | 0.04 | 0.04 |
| | 4th decile | -0.02 | 0.03 | 0.00 | 0.01 | -0.01 | 0.02 | 0.04 | 0.04 | **0.08 | 0.04 | 0.04 | 0.03 |
| | 5th decile | -0.02 | 0.03 | -0.04 | 0.02 | **0.03 | 0.02 | 0.02 | 0.03 | **0.08 | 0.04 | 0.05 | 0.04 |
| | 6th decile | -0.02 | 0.03 | -0.06 | 0.06 | 0.02 | 0.02 | 0.04 | 0.03 | **0.08 | 0.04 | 0.04 | 0.04 |
| | 7th decile | -0.03 | 0.03 | *0.03 | 0.02 | -0.05 | 0.04 | 0.02 | 0.03 | **0.08 | 0.04 | 0.03 | 0.03 |
| | 8th decile | 0.03 | 0.03 | 0.01 | 0.01 | -0.01 | 0.01 | 0.02 | 0.03 | **0.07 | 0.03 | 0.04 | 0.03 |
| | 9th decile | 0.00 | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | **0.08 | 0.03 | **0.08 | 0.04 | 0.02 | 0.03 |
| | 10th decile | *0.21 | 0.12 | 0.01 | 0.04 | -0.06 | 0.04 | **0.04 | 0.02 | **0.08 | 0.03 | -0.03 | 0.03 |

Note: Regression also controls for some county-level demographic and economic covariates including percentage of people living below the poverty level, the unemployment rate, and housing cost. * significant at 10% ** significant at 5% *** significant at 1% Standard Errors are clustered at county levels. Regression is weighted by representative female population to address heteroscedasticity.



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