

Three Essays on Development Economics: Social Capital,
The Cost of the Sanctions and Group-based Inequality in Iran

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ABSTRACT

This dissertation contains three essays on the political economy and economic development in Iran. In the first paper, I investigate the political resource curse. The comprehensive literature on the relationship between democracy and income counts oil-rich countries in Middle East as outliers: the abundance of funds for the states and the absence of effective tax systems hold back the formation of democracy. But democracy is more than a purely political system. Sustainable democracy requires a set of social norms and intra-citizen relationships that is called social capital. Emphasizing the importance of the formation of social capital on the democratization of a society, I use female labor force participation as a proxy for social capital. Using survival analysis, I show that oil revenue delays the formation of the social capital required for the democracy.

In the second paper, I inspect the trend and patterns of group-based inequality in Iran. Inequality among groups can be a source of conflict and instability. Iran is a habitat of ethnic diversity and experiences stable peaceful relationships among its ethnicities, while its neighbors experience many ethnic conflicts. In this study, we compute three measures of group-based inequality for the following outcomes: education, assets, income, and expenditure per capita. The groups are defined based on gender, ethnicity/language (Persian, Azeri, and other ethnic minorities), and region (urban versus rural and capital city versus other places). The data are 23 years of annual Household Expenditure and Income Surveys (HEIS) from 1990 through 2012. Inequality between groups based on religion (Muslim, non-Muslim) and citizenship (Iranian, Non-Iranian) is also studied, using the 2006 census. The analysis of the trend of horizontal inequality reveals substantial reduction in between-group inequalities over the 1990–2012 period. On the other hand, gender based income inequality remains high. The implications and underlying reasons for these results are discussed.¹

The third paper studies one the most serious recent problems facing Iran's economy: the economic cost of the recent US and UN sanctions. This paper measures the economic cost of the U.N. trade and financial sanctions on Iran's economy. While there is a substantial literature studying how sanctions impact the economies of target states, the aggregate economic cost of sanctions remains underexplored. This study provides a new measure of the cost of sanctions at the aggregate level, defined as the gap between Iran's actual GDP and what it would have been without sanctions. Using the synthetic control method of analysis, I replicate Iran's GDP without sanctions. I demonstrate that, while previous sanctions had a negligible impact, Iran's GDP fell markedly following the financial sanctions of 2010.

¹ This paper was supported by UNU-WIDER in Helsinki.

General Audience Abstract

This dissertation contains three essays on the political economy and economic development. The first paper studies the negative relationship between democracy and oil-income. Formation of democracy requires strong role of citizens in governing the society which is called social capital. I show that oil revenue delays the formation of the social capital, and therefore delays democratization. In the second paper, I inspect the trend and patterns of group-based inequality in Iran. Inequality among groups is counted as a source of conflict and instability. Iran is a habitat of ethnic diversity which experiences stability and almost peaceful relationships among its ethnicities, while its neighbors experience many ethnic conflicts. This study shows substantial reduction in between-group inequalities over the 1990–2012 period. On the other hand, gender based income inequality remains high. The third paper measures the economic cost of the U.N. trade and financial sanctions on Iran's economy. I estimate the amount by which Iran's GDP decreased following the financial sanctions of 2010.

Dedication

To memory of my father, Rahim

To my mother, Ziba

To my husband and friend, Mohammad

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Oil, Democracy and Social Capital

Abstract

This paper studies several channels by which oil rent empowers authoritarian governments to remain in power. The main contribution of this paper is to provide evidence for the adverse effect of resource rent on the formation of social capital. Using women's labor force participation rate as a proxy for social capital and a binary index of democracy-dictatorship, I employ survival data analysis on a dataset of all countries from 1960 (or independence) to 2006. The empirical results support the hypothesis that resource rents delay democratization by delaying the formation of social groups. Similar results are produced using other indices of democracy, Freedom House and Polity IV. This inquiry has implications for the study of the resource curse, democracy, and the Middle East.

1.1. Introduction

Studying the relationship between economic development and the political structure of countries has been a hot topic of economics and political science. In last two centuries, economic development improved the standard of living, while political development changed the power structure in many countries. Many countries experienced both economic development and the democratization of government. It looks like there is a general trend that democracy and economic development go together. The exact mechanism that relates economic development to the formation of democracy is unknown, but the correlation is strong, except for the oil producing countries. The resource rich countries have not fitted the general theories and have counted as outliers in many studies. Looking at oil producing countries, we observe that no matter the stage of economic development, most of them are struggling with authoritarian governments. The negative correlation between oil income and democracy generates the inquiry as to how oil delays democratization. In this study, I look for the channels by which resource rent keeps authoritarian government in power and blocks the formation of democracy.

The main hypothesis of this paper is that democracy is shaped by the formation of independent social groups. This is called the group formation effect and is based on arguments by McKenzi and Moore (1970) and Putnam (1994). According to McKenzi and Moore, creation of democracy

in England and France was supported by the formation of an independent bourgeoisie. Putnam emphasizes the idea that the formation of social capital (civic institutions that lie above the family and below the state) generates more democratic governance. According to Ross (2008), the socio-economic dynamics of the oil producing countries do not support the formation of independent social groups. “Dutch disease” literature explains that the rent from exporting natural resources tends to crowd out other exports, especially manufacturing. The early stages of manufacturing demand large numbers of low wage workers. Women are the main low-wage workers. When more women participate in the job market, they develop social lives, exchange ideas, find their voice in society and ask for more rights. As the economy develops, women gain more economic power and social influence, making it possible for them to mobilize politically and gain representation. In oil producing countries, manufacturing expands through the extraction of natural resources and related heavy industries, which are male-oriented. Because of oil rent, men are well-paid, so women enjoy the high level of their husbands’ incomes, decreasing the incentive for women to work. On the other hand, there are not many new jobs encouraging the participation of women in the job market. As the primary source for increased female non-farm labor participation in countries across the globe does not apply in oil-rich countries, the result is less female labor participation, which delays the formation of social capital to inspire equal rights and greater political representation. While group formation is not limited to formation of women-oriented groups, it is a good indicator of the level of group formation in an economy.

Representative government first came about in early modern Europe, when monarchs were compelled to relinquish some of their authority to parliamentary institutions in exchange for consent to new taxes. Thus, an alternative hypothesis says that a comparable process is occurring today: taxation leads to representation, which leads to the formation of democratic government, Ross(2004). In oil producing countries, the main source of income for the government is oil rent, not tax revenue. Therefore, no pressure for representation develops. Moreover, government puts oil income into the economy by providing a high level of public employment and generous public services and by subsidizing consumption goods.

A third hypothesis is repression theory. The natural resource rich countries invest heavily in military resources. Since the country has a large and well-equipped army, citizens know that any

form of a quest for democracy will be suppressed. Therefore, we observe strong authoritarian governments to stay in power without facing serious challenges.

This paper studies survival of the authoritarian regimes by testing these three hypotheses. To the best of the author's knowledge, the social capital hypothesis has not been tested statistically before.

1.2. Literature Review

The idea that taxation tends to produce more representative government is based on a common interpretation of political development in early modern Europe and colonial America. Based on this idea, Cheibub et al. (1996) study the necessary condition for a country to be democratic and conclude that economic wellbeing and growth are among them. But this study excludes the main oil producing countries from its empirical study.

Mahdavy (1970) defines a rentier economy as an economy that relies heavily on rent income. He studies the economy of Iran during the oil boom and shows that the service sector of the economy grows much faster than agriculture and industry. This results in a thriving public sector compared to private production. Beblawi (1987) emphasizes the "social function" of rent: a small group of people involved in the productive sector that yields rent and large proportion of the population involved only in spending it.

Earlier studies of impacts of resource rents on political regimes are in the form of descriptive case studies. Wantchekon (2002) undertook one of the pioneer empirical cross-country studies. Using the measure of natural resource dependency introduced by Sachs and Warner (1999) along with the share of Natural resource exports (including oil and other mineral) in GNP and a polity variable from the Polity IV project, Wantchekon finds empirical support for a positive correlation between resource dependence and authoritarianism. He suggests that resource wealth facilitates the consolidation of an already established authoritarian government and also generates a breakdown of democratic regimes, from a combination of incumbency advantage, political instability, and political repression.

Ross (2001) explores the "Oil Hinders Democracy" claim. He suggests that petrodollars and income from exports of other minerals have different impacts on the development of democracy. He measures the export value of mineral-based fuels (petroleum, natural gas, and coal) and the export value of non-fuel minerals separately, each as a fraction of GDP. A country's regime type is taken from the Polity IV project (with missing values filled by data from Freedom House). In his 2004 work, he tests the "taxation leads to representation" idea, using first a model in which the dependent variable is Tax over Spending, then Tax over Spending and Government Quality simultaneously as dependent variables. He finds no evidence to support the hypothesis of a pure anti-tax model. The results are, however, consistent with the hypothesis that higher taxes relative to government services tend to make states more democratic, which he calls the cost-benefit model. In 2009 he revisited the same question with a modified approach, using a data set introduced by Alvarez and Cheibub. In this data set oil wealth is measured by a new measure of oil rents per capita, which is the country's total rents from oil and gas divided by its midyear population. The oil rents are calculated by taking the total value of each country's annual oil and natural gas production and subtracting country-specific extraction costs, including the cost of capital. This paper provides evidence that oil wealth strongly inhibits democratic transitions in authoritarian states.

Ramsay (2011) creates a simple game to model the relationship between resource income and political freedom. Based on his model, the utility of citizens depends on both their consumption and their level of freedom. As resource rent provides extra income for the governments in rentier states, they are able to substitute consumption for freedom in such a way that utility does not decrease. Using an instrumental variables approach, he estimates the causal effect of shocks to oil revenues on levels of democracy. His results suggest that the effect of oil price shocks is larger than might be expected. His work explains the pro-democratic social unrests of the Arab Spring but provides no explanation of why these efforts are fruitless.

While all explanations theoretically shed light on the mechanism by which oil income has delayed democratization, the results of previous studies are not consistent. The commonly used measures of democracy are highly subjective and controversial. While Freedom House scores and Polity IV are regularly used as measure of political regime, Cheibub et al. (1996) argue that these measures

do not have clear interpretations. They propose a Democracy-Dictatorship index based on their suggested minimalist definition of democracy as contested elections. While the Democracy-Dictatorship index provides a precise measure of political institution, Freedom House scores and Polity IV provide general measures of not only political freedom but also social freedom.

1.3. Methodology

I use a duration model to estimate the effect of oil income on democratization. The outcome of interest is the probability of a democratization in each year. In order to estimate this probability, I use the Democracy-Dictatorship (DD) measure of the political regime. The unit of observation is a country-year, for which it is known whether democratization happened. For some countries, we do not observe the transition to democracy before the final survey year, but one could have occurred after that, so the interval is open. The hazard regression method employed is designed to deal with these censored observations.

I use logistic regression, also known as the *proportional odds model*, which is the common method for estimating discrete-time hazard models.

$$\lambda_{it} = \lambda_t \exp(x_i\beta)$$

The binary democracy outcome each year is modeled as a function of GDP per capita, income tax revenue, tax revenue from goods and services, oil and gas rent, military expenditure and labor force participation by women.

Considering all countries that are not democratic after 1960, I explore the transition from non-democracy to democracy using the Democracy-Dictatorship index proposed by Cheibub et al. (2010). Employing survival analysis, I examine the effects of oil income, taxation, repression and group formation on the probability of democratization. Following Ross's argument about the effects of oil on the labor force participation of women, female labor participation used as a proxy for group formation, to investigate the social capital formation hypothesis.

Other measures of democracy, the Freedom House index and Polity IV are used in a dynamic panel setting to provide statistical support for the importance of female labor participation

1.4. Data

The primary data set is a panel data set for countries from 1960 (or from independence) until 2006. The dependent variable is survival of autocracy, calculated using the Democracy-Dictatorship data set, which provides a binary measure of regime type provided by Cheibub et al. (2010). The main independent variables are oil-gas net income per capita, tax paid per capita, per capita GDP and per capita GDP in first year. I used three measures of the political regime type, Polity IV, Freedom House and the Democracy-Dictatorship data set.

1.4.1. Polity IV

The Polity IV project, compiled by Gurr and Jagers (2012), codes the authority characteristics of states for purposes of comparative, quantitative analysis. It includes constructed annual measures for both institutionalized democracy and autocracy, as many polities exhibit mixed qualities of the two distinct authority patterns. These measures are composite indices derived from the coded values of authority characteristic component variables. The eleven-point Autocracy and Democracy indicators are additive eleven-point scales (0-10). The indicator of democracy (or autocracy) is built by coding of variety of characteristics of the political system including the competitiveness of political participation, the openness and competitiveness of executive recruitment, and constraints on the chief executive. There is no “necessary condition” to make a political system as democracy. Many political systems have mixed authority traits, and thus can have middling scores on both Autocracy and Democracy scales. Therefore, a third indicator, Polity, is derived simply by subtracting the Autocracy value from the Democracy value; this procedure provides a single regime score that ranges from +10 (full democracy) to -10 (full autocracy). During periods of central authority interruption, collapse, or transition, the Democracy, Autocracy, and Polity scores are assigned Standardized Authority Code: scores of -66 (cases of

foreign interruption) are treated as system missing; scores of -77 (cases of interregnum or anarchy) scores of -88 (cases of transition). To facilitate the use of the POLITY regime measure in time-series analyses a simple treatment is applied to convert instances of standardized authority scores to a neutral Polity score of 0 The resulted index is called Polity2 and is used in this research.

1.4.2. Freedom House Scores

Another widely used measure is the freedom house score. Freedom House has been reviewing levels of freedom since 1955; the Freedom in the World survey emerged in its current form in 1972. The Freedom House measure of democracy originates in two seven-point scales: Political rights and Civil liberties. The Political Rights index measures the degree of freedom in the electoral process, political pluralism and participation, and functioning of government. Numerically, Freedom House rates political rights on a scale of 1 to 7, with 1 representing the most free and 7 representing the least free. Countries are assigned a score on each of these scales by experts who consider a checklist of factors. For 2008, this checklist contains 62 items for political rights and 80 items for civil rights. This index measures ideas and behaviors and not a discrete physical quantity. Freedom House distinguishes between constitutional guarantees of rights and those in practice. Therefore, the survey does not rate governments or government performance per se, but rather the real-world rights and freedoms enjoyed by individuals. Thus, the survey ratings generally reflect the interplay of a variety of actors, both governmental and nongovernmental.

The main issue is that the coding rules is not consistent over the years. Also, in view of the type of information necessary to answer the check list questions used for constructing the measure and need for an expert subjectivity is clearly involved.

1.4.3. Democracy-Dictatorship Index

Cheibub, Gandhi and Vreeland (2010) introduce a new data set called Democracy-Dictatorship (DD) that extends the one first published in Alvarez et al. (1996) based on a minimalist

dichotomous measure of a political regime. This data set covers all independent regimes for the post World War II period, until 2008. A regime is classified as a democracy (1) if it meets the requirements stipulated in all of the following four rules, and autocracy (0) otherwise. Note that there is nothing in between. The four rules are:

1. The chief executive must be chosen by popular election or by a body that was itself popularly elected.
2. The legislature must be popularly elected.
3. There must be more than one party competing in the elections.
4. An alternation in power under electoral rules identical to the ones that brought the incumbent to office must have taken place.

The Democracy-Dictatorship (DD) measure of political regime is clear and stark, so that precise information is conveyed by the coding of each observation, and the coding involves no subjectivity, so it is easily reproducible.

1.4.4. Oil Income

This study uses two measures of oil income. One measure is the income from oil and gas as share of total GDP from the World Bank. The other measure of oil income is from the data used in Ross (2010). It is measured as oil rents per capita, which is a country's total rents from oil and gas divided by its midyear population. The oil rents are calculated by taking the total value of each country's annual oil and natural gas production and subtracting country-specific extraction costs, including the cost of capital.

1.4.5. Tax Revenue

There are two main sources of tax revenue: the first one is taxes on income, profits and capital gains, and the second is taxes on goods and services. These data is from the World Bank.

1.4.6. Female Labor Force Participation Rate

Data for the female labor force participation rate is from replication data for Ross (2008) paper.

1.5. Results

This paper provides a framework for investigating the survival of autocracy, using a duration model. Table 1 provides an overview of the variables that can affect the transition to democracy. The results are shown in odds-ratio. Oil rent has significant antidemocratic effect. The two taxes are sources of revenue for governments that are conjectured to have pro-democratic impacts. Table 1 verifies the pro-democratic effects of taxes only for income tax and not for taxes on goods and services. Female labor force participation is a proxy for independent industries, which used as a proxy for social capital. The data verifies its pro-democratic impact. One of the possible obstacles to democratization is the use of military forces by governments to suppress the citizens. The military expenditure variable used to test the "repression effect" of oil income and is significant

Table 1.2, provides the results of the test of the same hypothesis using variables of shares instead of level. Oil rent as percentage of GDP, tax revenue from income tax as a percentage of GDP and government expenditure on military as a percentage of GDP.

In table 1.3, I used seemingly unrelated regressions to identify channel with the most anti-democratic impact. The data supports that rent from oil and gas are significantly decreases female labor participation and taxes on goods and services, also increases the military expenditures. According to table 3, female labor participation is statistically significant with positive impact on democracy. On the second regression oil rent has negative significant impact on female labor force participation rate. Therefore, the most effective channel through which oil income delays democratization.

In Table 1.4 and 1.5, I used other measures of democracy, Polity IV and the Freedom house index. Using panel data analysis and lag of the dependent variable on the right-hand side of the regression,

I explore the three hypothesis of tax effect, repression effect and social capital. Using both indices verify the positive impact of female labor participation on democratization. Only Polity IV supports the tax argument.

1.6. Conclusion

This paper studies the factors helping the authoritarian regime to stay in power. Using variety of statistical model and data, I test the three hypothesis of tax effect, repression effect and social capital formations. The different measures of democracy verify that the female labor participation, used as a proxy for group formation, is an important channel supporting the long standing of authoritarian government in rentier stats. This work provides support for the importance of social capital formation and inclusion of women in social and political arena in democracy building.

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Tables

Table 1.1. Duration Model

Variable	M1	M2	M3	M4	M5
Oil Rent	.862*** (.058)	.181 (.179)	.824*** (.055)	.930*** (.135)	.000 .000
Female LFPR			.971*** (.016)		
Military Expenditure				.720*** (.169)	
Tax on Income		17.554 (26.752)			1.327e+06 (8.355e+06)
Tax on Goods & Services		.417 (.537)			
N	1809	243	1701	578	252
Log-Likelihood	-98.150	-10.978	-101.298	-26.199	-3.104

*p < 0.1, **p < 0.05, *** p<0.01

Table 1.2. Duration Model Using Share Variables

Variable	M3	M4	M5
Oil Income (% of GDP)	0.026** (0.046)		
Female LFP		1.325** (0.181)	
Income Tax (% of GDP)		1.003** (0.001)	
Military Exp. (% of GDP)			0.755 (0.101)**
N	3350	421	1188
Log-Likelihood	-228.69	-21.439	-109.848

*p < 0.1, **p < 0.05, *** p<0.01

Table 1.3. Seemingly Unrelated Regressions

Variable	Coef.	Std. Err.	P > z
D			
Labor Female	0.003**	(0.001)	0.025
Income Tax	0.020**	(0.010)	0.045
Tax from Goods	-0.009	(0.010)	0.385
Military Exp	0.00005	(0.004)	0.989
Constant	-0.259	(0.128)	0.044
Labor Female			
Oil Rent	-2.824***	(0.250)	0.000
Constant	46.491	(1.269)	0.000
Income Tax			
Oil Rent	0.215	(0.0410)	0.000
Constant	11.394	(0.0208)	0.000
Tax Good			
Oil Rent	-0.106	(0.046)	0.021
Constant	12.909	(0.233)	0.000
Military Exp.			
Oil Rent	0.552	(0.0939)	0.000
Constant	1.179	(0.477)	0.013

*p < 0.1, **p < 0.05, *** p<0.01

Table 1.4. Using Polity IV Data Set

Polity IV			
L.polity2	0.654**	0.651***	0.763***
	(0.027)	(0.027)	(0.018)
Oil Rent	0.030	0.027	-0.005
	(0.081)	(0.079)	(0.056)
Tax on Goods	0.111		
	(0.247)		
Income Tax	-0.173		
	(0.238)		
Female LPR	0.141**	0.115*	
	(0.072)	(0.069)	
Tax Rev.		1.190**	
		(0.473)	
Military Exp.			0.008
			0.033
Constant	-6.545	-13.161	0.843
	(3.645)	4.207	0.154
N	737	761	2151

*p < 0.1, **p < 0.05, *** p<0.01

Table 1.5. Using Freedom House Data Set.

Freedom House			
L.FH	0.534*** (0.042)	0.460*** (0.042)	0.571*** (0.037)
Oil Rent	0.001 (0.041)	0.000 (0.041)	0.004 (0.040)
Tax Rev.	-0.250 (0.267)		
GDP per Capita	-0.681 (0.471)	-0.544 (0.432)	
Labor Female	-0.119*** (0.043)	-0.107 (0.044)	
Tax on Goods		-0.152 (0.149)	-0.200* (0.115)
Tax on Income		-0.113 (0.122)	-0.233** (0.102)
Military Exp.		0.006 (0.031)	
Constant	15.559 (2.590)	14.497 (2.651)	8.524 (1489)
N	693	650	817

*p < 0.1, **p < 0.05, *** p<0.01

Group-based Inequality in Iran²

Abstract

In this study, we measure inequality in Iran. We compute three measures of group-based inequality (Group-weighted Coefficient of Variation, Group-weighted Gini, and Group-weighted Theil) for the following outcomes: education, assets, income, and expenditure per capita. The groups are defined based on gender, ethnicity/language (Persian, Azeri, and other ethnic minorities), and region (urban versus rural and capital city versus other places), using 23 years of annual Household Expenditure and Income Surveys (HEIS) from 1990 through 2012. Inequality between groups based on religion (Muslim, non-Muslim), citizenship (Iranian, Non-Iranian) are also studied using the 2006 census. Our analysis of the trend of horizontal inequality reveals substantial reduction in between-group inequalities over the 1990–2012 period. Yet, gender-based income inequality remains high. The implications and underlying reasons for these results are discussed.

2.1 Introduction

Studying inequality is as old as economic science itself. But particularly since the financial crisis of 2008, there has been a resurgence of interest in it, both in the eyes of the public, globally, and in academic circles. The prominence of the “Occupy Wall Street” and “99 percent” movements in the United States, the success of the left in some European countries,³ and the publication of *Capital in the 21st Century* by Thomas Piketty (2013) and its popularity are just a few examples of this resurgence. But most of the interest in inequality is focused on vertical inequality, inequality between the rich and the poor at the country level, with less attention devoted to horizontal inequality, inequality among groups in a society.

² “This is based on a pre-print of an article published in Social Indicators research, 2017. The final authenticated version is available online at <https://doi.org/10.1007/s11205-017-1800-4>”

³ Such as the Podemos in Spain and Syriza (the coalition of the radical left) in Greece.

Horizontal inequality should be particularly important for policy makers, as it can be a predictor of both political instability and development. For example, Stewart and Langer (2008) and Stewart (2000) show that inequality among groups (ethnic, religious, etc.) can predict political instability. This is particularly important in countries with ethnic or religious diversity, such as the countries in the Middle East and North Africa (MENA) region.⁴

Iran is an interesting example of ethnic diversity. According to Alesina et al. (2003), ethnic fractionalization in Iran in 1989 has a score of .6684, while language fractionalization has a score of .7462, and religious fractionalization 0.1152.⁵ The larger these measures are, the more diversity there is. The averages for these three measures in the MENA region are 0.453, 0.330, and 0.346, respectively (Alesina et al. 2003, Table 2.3). Therefore, Iran is ethnically and linguistically more diverse than an average Middle Eastern country (but religiously less diverse). At the same time, the Middle East has the largest of these fractionalization measures in the world after sub-Saharan Africa.

Fearon (2003) constructs an index of cultural fractionalization using structural distance between languages as a proxy for cultural distance between groups. Iran's cultural fractionalization is estimated to be 0.542, which is the second highest in the MENA region. It is interesting that despite the fact that Iran is a highly diverse country, it has not experienced ethnic conflict the way some other countries have. This could be because the ethnic groups in Iran are well-integrated, and group-based inequalities have been low or decreasing over time. Therefore, studying horizontal inequalities in Iran and having a better picture of them is interesting and important for researchers and policy makers alike.

Ethnic conflict is not the only unfavourable consequence of horizontal inequality. Even in the absence of conflict, between-group inequality affects the wellbeing of individuals within groups because the relative wellbeing of a group is an important factor in individual wellbeing. Moreover, between-group inequalities reduce growth potential (Stewart 2005). Stewart also emphasizes the critical importance of horizontal inequality for development and calls it a "neglected dimension of development." Current development analyzes and policies are focused on improving individual

⁴ The region has been in turmoil recently and ethnic divisions were in the centre of the conflict.

⁵ Fractionalization is the most widely used measure of diversity. It is the probability that two individuals who are randomly chosen from the society belong to different groups.

welfare, neglecting the correlation between individual and group wellbeing. But when being a group member results in being discriminated against or disadvantaged, improvement in individual welfare is conditional on improvement in group welfare. For instance, van Staveren and Pervaiz (2017) suggest that it is social exclusion rather than diversity per se that affects economic outcomes.⁶

There have been studies on poverty, vertical inequality, and inequality of opportunity in Iran. But very little has been done on horizontal inequality. Assadzadeh and Paul (2004) examine the changes in the extent of poverty in Iran between 1983 and 1993. They show that both rural and urban poverty increased in the first half of this period, during the Iran–Iraq war, an economic recession, and fall of oil revenues, but they decreased after the war, in the reconstruction period. Salehi-Isfahani (2009) studies the trends in poverty and inequality of expenditure in the 1984–2004 period. He finds that poverty decreased substantially in the long run, compared to the pre-revolution era, while the reduction in inequality of expenditure was negligible in this period. Salehi-Isfahani and Majbouri (2013) use panel data and find substantial income mobility in Iran during 1992-95 period. They also measure transient and chronic poverty and their correlates.⁷ Salehi-Isfahani et al. (2014) study inequality of opportunity in Iran, Egypt, and Turkey and find that inequality in educational achievement is mostly a result of inequality of opportunity. Although the literature provides a picture of vertical inequality and poverty, it is focused on individuals and households. Hence, there is very little known about group-based inequality in contemporary Iran.

To the best of our knowledge, Aghajanian (1983) is the only study discussing inequality among ethnic groups in Iran. Using geographically distinct regions and provinces to identify ethnic communities, Aghajanian compares literacy rates, access to electricity and piped water, occupation in the agricultural sector, urban residency, and poverty rates among Kurds, Azeris, Baluchs, and Persians in 1966 and 1976. The study concludes that even though the country had substantial economic growth due to booming oil prices, inequality among ethnic communities widened during

⁶ Another advantage of studying group-wise inequality measures is that some indices of horizontal inequality can be used to derive indices of vertical inequality (Jayaraj and Subramanian 2006).

⁷ They show that three groups are more likely to be chronically poor: people who live in urban areas, younger individuals, and those living in female headed families.

this period. But this study is about four and five decades ago, and it is silent on important socioeconomic outcomes such as income, expenditure, and educational inequality.

This study is the first comprehensive research on group-based inequality in Iran after the revolution. It is distinguished from the previous work in three ways: first, extensive data sets that cover every year between 1990 and 2012 are used to build a comprehensive picture of variation in group-based inequalities across gender and ethnicity in this period. Moreover, we provide group-based measures of inequality across religion and citizenship for 2006. Second, a wide range of socioeconomic characteristics are examined, including attained years of education, an asset index, individual income, and household per capita expenditure.⁸ Third, we verify the consistency of our grouping methodology by using a unique data set⁹ that includes information on the ethnicity of individuals. In addition, we explain the impact of policies and macroeconomic shocks, inflation, and oil prices on horizontal inequality trends.

The main ethnic groups in Iran are Persians, Azeris, Kurds, Lors, Arabs, Baluchs, Turkmans, Mazanians, and Gilaks. Persians and Azeris form over 70 per cent of the population, while other groups combined constitute less than 30 per cent. For this and other technical reasons further explained in Section 3.3, we study inequality among three main groups: Persians, Azeris, and Others. Each ethnicity has their own language/dialect, and like some European countries such as Belgium, Luxembourg, and Switzerland, language groups match almost perfectly the ethnic groups. Therefore, studying ethnic groups is similar to studying language groups. Persian, however, is the official language, and more than 90 per cent of the population regardless of their ethnicity can speak it. Iran is more homogeneous in terms of religion: nearly 90 per cent of Iranians associate themselves with the Shi'ite branch of Islam (the state religion) and about 10 per cent with various Sunni and Sufi branches of Islam. There are also Christian, Jewish, and Zoroastrian minorities (CIA 2013). Since they are small minorities, we include them together as non-Muslims. Therefore, for this and other technical reasons discussed in Section 3.3, we study Muslims and non-Muslims. Similarly, there is a migrant population in Iran, mostly from Afghanistan. We split the data into Iranians and non-Iranians and study inequality among these two groups. Following Stewart (2000), who argues that other dimensions such as region of residence can be a source of

⁸ The groups and variables are discussed in detail in Sections 3.3 and 4 respectively.

⁹ Socio-economic Characteristics of Households 1992.

group formation, we also study inequality among regions (urban vs. rural and capital vs. other places).

The rest of the paper is organized as follows: the next section gives a brief but substantive overview of the economy of Iran and discusses vertical inequality. Section 3 explains the data and the way groups are defined. Sections 4 and 5 explain our results for the Household and Expenditure Surveys (HEIS) between 1990 and 2012 and the 2006 Census. Section 6 concludes.

2.2 Iran's economy and society in recent decades

Understanding the trends in inequality in Iran requires an understanding of the Iranian economy and its trends. In this section, we look at the Iranian economy in the last five decades and discuss its main characteristics.

The contemporary economy of Iran is intertwined with oil and gas. Being the main export, oil has been a central player in the economy and also in political events. It is and has been a fundamental source of revenue for the government and the main driver of economic growth, and hence, the key source of funding development projects. The booms and busts in the economy have been strongly related to the global price of oil and the production and consumption of oil in Iran.

Figures 1(a) and 1(b) show GDP per capita and annual growth rate of GDP since the 1960s. In the 1950s and 1960s, when the price of oil was stable and low, the government devised development programmes and invested in infrastructure, particularly in urban areas. Electrification and piped water projects, along with road, school, and healthcare facility construction in cities were the main development projects. Moreover, the government pursued an import-substitution policy in this period, which gave birth to heavy and light industries and created economic growth, particularly in urban areas. Since the stock of capital was low in the country, growth rates were significant, as economic theory predicts (Figure 1(b)). But with the sudden and unprecedented rise in the oil prices in the 1970s (Figure 2(a)), particularly due to the Arab embargo and the creation of the Organization of the Petroleum Exporting Countries (OPEC), the government found itself with revenues several times larger than it usually had, and hence it became bolder in adopting short-sighted economic policies; despite warnings from economists. The new revenues were all spent on imports and large and ambitious but low-return projects. As a result, domestic production shrank,

and the economy became highly dependent on oil prices. The economy continued to grow significantly, because of the rise in government expenditure. It was, however, very susceptible to a crash in oil prices, and the booms and busts of this market in general.

The price of oil is not necessarily a good measure of the resources available to the government for two reasons: first, the production of oil has been changing over time, and second, population has been growing over time, shrinking revenue per person. Therefore, the annual revenue from exporting oil per capita is a better measure of the size of resources available to the government over time. This measure is calculated by taking the difference between annual production and consumption of oil, multiplying it by the price of oil and dividing the result by the size of the population. We subtract domestic consumption from total production, because domestic prices are highly subsidized in Iran, and the revenue from domestic consumption is a small fraction of the revenue from oil exports and can be ignored. Figure 2(b) reports this measure. As can be seen, this measure was by far at its peak in the 1970s. Even though in 2010 the price of oil reached and surpassed its levels in the late 1970s, the revenue per capita in 2010 was significantly smaller than in 1970s (see Figures 2.2(a) and 2.2(b)). Therefore, the government in the 1970s was substantially more resourceful than any Iranian government in recent history. An interesting point about the revenue per capita is that its trend mimics that of GDP per capita nicely (compare Figures 2.1(a) and 2.2(b)). This shows clearly how much the Iranian economy is dependent on oil.

With the political instability in the first year after the Islamic Revolution in 1979, as well as the Iran–Iraq war in 1980 along with the subsequent crash in the oil market, the country’s economy was hit hard, and the annual growth rates became low or negative (Figure 2.1(b)). Moreover, the population growth in late 1970s and early 1980s (Figure 2.3(b)) substantially contributed to the reduction of GDP per capita in the 1980s (Figure 2.1(a)). A reconstruction period started after the war in 1989, when many infrastructure projects were designed and implemented, which raised the growth rate to respectable two-digit levels. By 1993, however, government borrowing, particularly short-term debt, rose and oil prices declined below expectations. In late 1993, the government realized that it could not repay its debt. This led to the balance of payment crisis of 1994–95, which brought the economy to a recession and had consequences for households for the following few years. The government had to re-negotiate the terms of its debt and devalue the domestic currency, which raised the prices of imports and caused general inflation (Pesaran 2000). Inflation rose to

about 50 per cent in 1995, the highest the country had seen since the Second World War (Figure 4). The price of oil was at low levels in the second half of the 1990s and the first half of the 2000s. This was a period of economic hardship, which led the government to take measured policies and carefully consider its expenditure and budget. With the continuous rise in oil prices between 2003 and 2008, when oil prices rose to the level of the late 1970s (the highest levels seen since 1864), the new government started to spend more freely. Although prices were at all-time high, resources per person available to the government were substantially lower than what was available to government in the 1970s (see Figure 2.2(b)). The economy grew but became more susceptible to volatility in the oil market.¹⁰

In 2010, the sanctions on Iran became tighter, and eventually the price of oil collapsed in 2011. These events shrank the economy as depicted in Figure 1.

2.2.1 Expansion of infrastructure

One of the aims of the revolutionaries of the Islamic Revolution of 1979 was to serve the poor and the marginalized, particularly in rural areas. Therefore, the governments after the revolution made significant investments in expanding infrastructure to rural areas, even during difficult times such as the Iran–Iraq war. Rural electrification projects in the 1980s and 1990s brought universal coverage to villages by 2000 (see Table 2.1). Similarly, almost all urban households had access to electricity in 1990. Many water projects in rural areas increased access to clean water to 84 per cent in 2000 and 95 percent in 2012. By the 2000s, the main infrastructure projects at the rural level concerned telecommunication and gas pipelines. The share of rural households that had access to piped gas increased to almost 50 per cent in 2012 from just 4 per cent in 2000. Ninety-two per cent of urban households had access to piped gas by 2012. While 1 per cent of rural households had a landline phone in 1990, two-thirds were enjoying one by 2012. In 1990, none of the rural households had a cell phone; by 2012, 81 per cent of them had one.

The consequences of these changes in the economic wellbeing of the rural population were substantial. The percentage of households having a kitchen and bath (two essential facilities that significantly improve wellbeing and health outcomes) increased from 39 percent and 22 percent in

¹⁰ See Hakimian (2014) for a discussion of macroeconomic performance in post-revolutionary Iran.

1990 to 85 per cent by 2012. Ownership of home appliances, such as stoves and fridges (two appliances that substantially increase household productivity), as well as televisions, became universal in rural areas by 2012. All these developments are reported in Table 2.1 for both rural and urban areas. In Section 2.4.2.2 we see how these developments reduced group-based inequality of asset ownership over time.

After the 1979 revolution, all private schools became public, and access to (almost) free education increased significantly (Majbouri 2010). Moreover, a large-scale free adult literacy program was implemented across the country. In addition, the post-revolution governments made significant investments in building educational facilities at all levels of education (primary, secondary, and even tertiary) across the country, in small towns and villages, even during the Iran–Iraq war. In addition to schools, a private non-profit university was founded in 1983, which expanded rapidly across the country by building branches in large and small towns. As a result, there was a substantial increase in educational attainment, particularly for women. Figure 5 shows the increase in average years of education attained for men and women across birth cohorts. As can be seen from the figure, there is a continuous rise in educational attainment for successive birth cohorts.¹¹ This rise was faster for urban women than urban men, so that the gender gap in years of education disappears in urban areas after the 1980 birth cohort. In rural areas, the gap still exists, but attainment rates have been on the rise for both genders. The average female born in 1982 in a rural area has completed the five-year primary education. Later cohorts have had even more education. We will discuss the implications of the expansion of educational infrastructure when we explain the trends in group-based inequality of educational attainment in Section 2.4.2.1.

The limitations for women to enter some fields in college were removed in the early 1990s.¹² By mid-2000s, however, more than 60 per cent of enrolled students in colleges were women. Therefore, by late 2000s, quotas were put on female admission, so that no more than 60 per cent of college students in each year could be female.

Investments in educational facilities were complemented with similar projects for health infrastructure, particularly in rural areas. For example, health clinics were established across the

¹¹ Note that those born after 1974 went to school for the first time after the revolution.

¹² For instance, women could not become agricultural engineers in the 1980s and early 1990s (Keddie 2000).

country, to offer preventative healthcare as well as prenatal care to the rural population. The clinics also provided basic treatments and offered subsidized birth control as well as advising women about fertility prevention methods. They are one of the reasons behind the rapid reduction in fertility rates from 6.5 to 2.2 children per woman between 1985 and the 2000s (Salehi-Isfahani et al. 2010; Abbasi-Shavazi et al. 2009).

Despite the increase in female education and decrease in fertility rates, female labor force participation remained at low levels (Figure 2.6). It is a puzzle why the rates are low and why such significant changes in education and fertility had so little impact on it.¹³ But as we will see in Section 4.2.3, this interesting phenomenon could explain why gender-based inequality in income has been quite large and remains large.

Overall, the post-revolution governments have had policies to develop rural areas, assist the poor and the marginalized population, and reduce inequality between urban and rural areas. Salehi-Isfahani (2009) shows that these policies led to a reduction in absolute poverty, particularly in rural areas. Figure 2.7(a) replicates Salehi-Isfahani's results, using the international absolute poverty line, compiled and utilized by the World Bank, of \$1.90 in 2011 international dollars. As can be seen in Figures 2.7(a) and 2.7(b), absolute poverty substantially decreased in both rural and urban areas and for all ethnic groups. The poverty rates were close to zero by the late 2000s.

2.3 Data

The two main data sets that are used in this study are: 1) Household Expenditure and Income surveys (HEIS) from 1990 through 2012, and 2) the 2006 census (available on IPUMS International). Sections 2.3.1 and 2.3.2 describe these data sets. Section 2.3.3 explains how various categorizations based on ethnicity, religion, and citizenship) were identified in the data.

2.3.1 Household Expenditure and Income Surveys, 1990–2012

The HEIS, available since 1984, is a nationally representative survey, stratified for the urban and rural areas of each province. Only the surveys from 1990 through 2012 are used, as full data for

¹³ Many studies have been done on this issue. See for example Salehi-Isfahani (2005b); Chamlou and Karshenas (2016); Karshenas et al. (2016); Karshenas (2001); Moghadam (2013, 2011, 2000); Esfahani and Shajari (2012); Bahramitash and Esfahani (2011); Bahramitash and Olmsted (2014); and Majbouri (2010, 2015, 2016a,b, 2017).

only these years were available to us. Each year more than 19,000 (in some years up to 36,000) households are selected, and data on basic demographics and very detailed disaggregated information on expenditures and incomes are collected. Demographics include, gender, age, education, marital status, employment status, and occupation. Expenditure information is collected at the household level, while income is at the individual level. Poverty measures can be derived using expenditure per capita. Asset ownership dummies that are available in the data can be used to calculate an asset index. No information on ethnicity, ethnic language spoken by the individual, religion or nationality is collected.

2.3.2 The 2006 Census

The 2006 Census is a nationally representative 2 per cent sample of the census collected in 2006. It contains basic demographic information such as gender, age, education, and occupation, as well as religion, citizenship, and assets owned by the household. Assets are recorded with asset-ownership dummies. Using the principal components method, one can calculate an asset index, which is highly predictive of income deciles in Iran. The religion and citizenship of individuals can be identified in the 2006 census, although it is not reported for all individuals. No information on income or expenditure is collected in this survey.¹⁴

2.3.3 Ethnicity and groups

To study horizontal inequality, the first step is to define the groups. According to Stewart and Langer (2008), there are three conditions for categorizing people into groups. First, group membership is somewhat static, i.e. members are not able to change groups easily. Second, group membership is recognized not only by the person themselves and their group, but also by other members of the society. Third, group membership is meaningful to the individual, for example, it is an important factor in their identity. Group boundaries are mainly formed by ethnic groups. Ethnicity itself does not provide clear cut categorizing rule. Many factors are counted in the

¹⁴ The 2011 census is also available but we did not include the results for that census as they were similar to the 2006 census and did not generate any value added for this analysis. Instead, we use Household Expenditure and Income Surveys which, as described, are significantly more comprehensive than censuses and cover 23 consecutive years. They offer a wealth of data that censuses do not.

classifications of ethnic groups. For example, Chandra (2004), Horowitz (1985), and Htun (2004) suggest skin colour, language, tribe, caste, religion, region, kinship, and other communal identity markers as grouping conditions.

Reviewing Iranian history reveals that it “has always been the host of diverse ethnic groups,” as Amanolahi (2005) explains. Being on the Silk Road, it has been a crossroad for merchants, ideas, and migrants. Over time, eight major ethnic groups have settled in Iran. They are Persians, Azeris, Kurds, Lors, Arabs, Baluchs, Turkmans, Mazanis, and Gilaks. As Amanolahi (2005) explains, biological factors are not the distinguishing features of these ethnicities. Each ethnicity has its own language and region of residence in Iran. Therefore, the region of residence, language, and cultural factors are the main defining features of ethnicity in Iran.¹⁵ In fact, like some European countries, such as Belgium, Luxembourg, and Switzerland, language groups perfectly match ethnic groups. Therefore, in this study we use them interchangeably. Ethnicity is not a basis of social or economic rank in Iran.¹⁶

Each ethnic group speaks not only their own language but also Persian. In fact, more than 90 per cent of the country can speak and understand this language.¹⁷ It is the one official language and has been the formal language, historically.¹⁸ Except for Arabic, Armenian, Azeri and Turkmani (the last two being Turkic languages), the other languages have common roots with Persian.

Those who only speak Persian are the majority of the population (over 50 per cent). Turkic-speaking Azeris are the second largest group. They have been a player in Iranian history since the 11th century and at times have ruled Iran. In particular, they have been significantly influential in

¹⁵ Amanolahi (2005) focuses on ethnicity as a cultural phenomenon; one which ‘encompasses the non-biological aspect of man’.

¹⁶ Gisselquist (2013) argues that ethnic politics are different in societies in which ethnic groups are ranked vs. unranked.

¹⁷ A vast amount of literature is in Persian and every ethnic group have more or less adopted the language. It has been spoken from Tajikistan and Uzbekistan in Central Asia to Afghanistan, and Iran; even in the Ottoman Empire, where Persian was the language of the court. It is not a surprise that Persian is and has been chosen as the formal language, even by Turkic origin Iranian governments.

¹⁸ Iran’s constitution defined Persian as ‘the official language and script of Iran’ while recognizes the minorities’ right to use their language. **Article 15:** The official language and script of Iran, the lingua franca of its people, is Persian. Official documents, correspondence, and texts, as well as text-books, must be in this language and script. However, the use of regional and tribal languages in the press and mass media, as well as for teaching of their literature in schools, is allowed in addition to Persian. **Article 19:** All people of Iran, whatever the ethnic group or tribe to which they belong, enjoy equal rights; and colour, race, language, and the like, do not bestow any privilege.

shaping the economic, social, and political landscape of Iran since the 1500s.¹⁹ Azeris live mostly in north and north-western Iran (east and west Azerbaijan, Ardebil, Zanjan, and Qazvin provinces.)

Kurds or Kurdish people are an old ethnic Iranian group living in western Iran as well as in parts of Iraq, Turkey, and Syria. Many Kurds consider themselves descendants of Medes, one of the three main Iranian tribes (beside Persians and Parthians), who resided in Iran since 1000 BC. Kurds live mostly in (north-)western provinces of Kurdistan, Kermanshah, and parts of west Azerbaijan. But a small group of them have migrated to the Golestan and Khorasan provinces (in the north and north-east) as well. Most Kurds are Sunni Muslims.

Lurs or Lurs speak the Lurish language, which is closest to Archaic and Middle Persian (Coon 2005). They reside mostly in western Iran provinces and share borders with the Kurds in the west and north, Arabs in the south and Persians in the centre and the east. Arabs live mostly in the southern provinces of Khuzestan and Hormozgan. Baluchs speak Baluchi, a western Iranian language (Elfenbein 1988) and live in the south-east, in Sistan and Baluchestan, and practice Sunni Islam. Turkmen speak Turkmani (a Turkic language) and live mostly, along with other ethnicities, in Golestan. Turkmen are also Sunni Muslims.

Neither ethnicity nor the language an individual speaks is asked in most data sets collected by the Statistical Centre of Iran, which is the only official organization in charge of collecting data in the country. These data sets include the HEIS and Census data sets that we use in this study. Therefore, the only identifier of ethnicity in these data sets is the region of residence of the household. Region of residence is a good predictor of ethnicity, since each ethnic group has historically lived in particular regions. Although the borders of these regions are more fluid, and mixing and intermarriage happens, by and large, one can be confident that people living in a certain region belong to a certain ethnicity. In our data sets, we do not have the geolocation of the household. Therefore, we cannot identify the ethnicity of the household using the Geo-Referencing of Ethnic Groups (GREG) data²⁰ that has the geo boundaries of ethnic groups (Weidmann et al. 2010). In the

¹⁹ Safavid dynasty, originally from Azeri parts of Iran, created the first modern Iranian nation-state in 1501, and declared Shi'ite Islam as the state religion. It was a way of distinguishing itself from the Sunni dominated Ottoman empire. Isfahan, a major Persian city in central Iran, was selected as capital, and Persian was the formal language. Turkic origin Qajar dynasty, gained power in 1785, and chose the Persian city of Tehran as the capital. This trend is continued and now Azeris are well integrated into the economic and political system of Iran.

²⁰ Accessible at <https://icr.ethz.ch/data/greg/>

HEIS data sets, until 1998, only the province and urban/rural location of the household is observed. Therefore, the only predictor of location is the province and urban or rural place of the household. The provincial boundaries do not perfectly match the ethnic boundaries. Therefore, one cannot perfectly identify the ethnicity of the household using the data that we have. In other words, if one knows the province of residence of an individual, they cannot perfectly infer which of the eight ethnicities the individual belongs to. But, to minimize the inferential error, we only define three ethnic groups: Persians (which include Shomalies), Azeris, and Others. It is possible to more accurately identify these three groups using the province of residence. Because Persians and Azeris together make more than 70 per cent of the population, it makes sense to combine other, smaller ethnic groups into one group. In a few instances in which a province has mixed ethnicities (like the Tehran province), we take the ethnicity of the majority²¹ (for example, Persians for Tehran). According to our categorization, the Persians, which include Shomalies (Mazanis and Gilakis), reside in Markazi, Gilan, Mazandaran, Fars, Kerman, Khorasane-e-Razavi, Isfahan, Hamedan, Bushehr, Semnan, Yazd, Tehran, Qom, North Khorasan, and South Khorasan.

There is only one data set that can be used to infer ethnicity. Socio-economic Characteristics of the Household (SECH) surveys are nationally representative data sets that ask whether the individual can speak a second language (spoken in Iran).²² Using the SECH data sets for 1992 and 2001 and dividing the sample into three groups: Persians, Azeris, and Others (based on the second language the individual speaks) produces almost identical inequality measures as when we use province of residence to infer ethnicity (see Table 2.2). This further confirms that our method of identifying ethnicity using provinces is robust.

SECH is only available for two years (1992 and 2001); therefore, we cannot produce more results than what is reported in Table 2.2 with this data set. But, as explained, HEIS is available for every year between 1990 and 2012. Therefore, we can estimate inequality measures for every year in this period and analyse the trend in these measures over time with precision. Thus, HEIS is the main source of data in this study.

²¹ We use Iran's Cultural Council (2010) to identify the major ethnic group in each province.

²² SECH data sets are nationally representative panels. Three sets of SECH surveys were collected: 1987–89, 1992–95, and 2001–03. Waves are collected annually. We had the last two panels and used them to compare results with those this study (see Table 2). Attrition is a major issue in these data sets as about 30 per cent of the sample is lost by the third year of these surveys. Therefore, data for the first years of these panels, i.e. 1992 and 2001 are used.

In addition to ethnicity, we estimate inequality based on religion and nationality.²³ The religion and citizenship of individuals can only be identified in the 2006 census, although it is not reported for all individuals. Tables 2.3 and 2.4 have the numbers of observations in each group in the 2006 census: As can be seen, the number of individuals in religions other than Islam is small. The same is true for citizenship. Therefore, we combine non-Muslims into one group and compare them with Muslims. We also combine all non-Iranians into one group and compare them with Iranians.

2.4 Inequality measures over time

This section reports the results for the country-level measures of inequality from 1990 through 2012, using the HEIS surveys. First, the country-level measures are calculated and then the within-country measures across ethnic, gender, and regional groups are estimated.

2.4.1 Country level

Fractionalization and polarization indices are very stable measures over time, unless there is a large change in the share of population of one group vs. another.²⁴ The average fractionalization index measured over ethnic groups in the 1990–2012 period is 0.55. It is about 0.568 in 1990 and declines slowly to 0.532 in 2012 (Figure A1 in the Appendix reports this index over time.) This means there is practically no change in this measure over time.

The polarization index across ethnic groups in the 1990–2012 period has an average of 0.83. It starts 0.846 in 1990 and slowly declines to 0.82 in 2012. In other words, there is little change, if any, in this measure over time (Figure A1 in the Appendix reports this index over time.)

²³ There are multiple ethnic cleavages that are salient and might be studied in Iran. One we are unable to analyze in this paper is the Shi'a/Sunni distinction because we do not have any way to identify Shi'as and Sunnis. The religious sect is not collected in publically available data sets. Using regions to identify Shia's and Sunnis will lead to similar results as those found for ethnicity, because we used regions to identify ethnicities too. The ethnicities measured as "Others" are located in Sunni dominated areas. The two other ethnicities, Persians and Azeris, are Shi'as. Therefore, dividing the sample into Shi'as and Sunnis is like grouping Persians and Azeris into Shi'as and calling "Others" Sunnis. Hence, this seems to provide little value added on top of the analysis for ethnicities which is already offered.

²⁴ Fractionalization index is described in footnote #3. Polarization index is defined based on Montalvo and Reynal-Querol (2005). It is $1 - \sum_{i=1}^n \left(\frac{0.5-p_i}{0.5} \right)^2 p_i$, in which n is the number of groups and p_i is the proportion of group i in the population.

The Gini coefficient for annual income at the country level is calculated over time and reported in Figure 2.8.²⁵

We are also interested in the inequality in the type of occupations various groups have. Occupations can be categorized according to skill level, to high skill, medium skill, and low skill. Legislators, senior officials and managers, professionals, and technicians and associate professionals are considered high-skilled workers. Medium-skilled workers include clerks, service workers and shop and market salespeople, skilled agricultural and fishery workers, crafts and related trades workers, machine operators and assembly-line workers, and different ranks in the armed forces. Elementary occupations are considered low skilled. Since the number of categories for occupational skills is small (here, three), the variable that represent occupational skill will only take three values and will not be continuous. Therefore, measuring the Group-weighted Coefficient of Variation (GCOV), Group-weighted Gini coefficient (GGINI), and Group-weighted Theil index (GTHEIL) may not be very informative.²⁶ Instead, we measure cross-cuttingness and cross-fractionalization.

Cross-cuttingness and cross-fractionalization between gender and occupation are about 0.80 and 0.04 respectively. These measures between ethnicity and occupation are about 0.91 and 0.09 respectively. All these values are stable over time.

2.4.2 Group-based inequalities over time

2.4.2.1 Education

To be consistent with studies of other countries, two samples were used to measure inequality of education, the 25+ and the 15+ samples. It is almost imperative that everyone complete their education by age 25. If a lower age is chosen as a cut-off point (say 18), we do not know how many years of education a person who is a student may eventually achieve and therefore will under-

²⁵ These measures are calculated using the “fastgini” command in Stata.

²⁶ Frances Stewart’s project on horizontal inequalities and conflict draws on these three measures of horizontal inequality: Group-weighted Coefficient of Variation (GCOV), Group-weighted Gini coefficient (GGINI), and Group-weighted Theil index (GTHEIL). In summary, these are extended versions of Coefficient of Variation, Gini coefficient, and Theil index that incorporate between-group inequalities beyond the inequality in the population. Stewart et al. (2010) explore each of these measures in detail. The introduction to this special issue discusses these measures in more detail.

estimate their education level. This under-estimation is more likely to happen for those who are highly educated, and as a result we may under-estimate inequality. On the other hand, there are many countries that experienced substantial increase in educational attainment in the most recent decades. Looking at the sample of age 25+ does not permit one to depict such a change. Moreover, many drop out of school before age 15 and finalize their educational attainment. Therefore, the sample of 15+ should be considered. Since the 15+ sample is more relevant for Iran, the result for the 15+ sample is reported here and the estimates for the 25+ sample are included in the Appendix. Figure 2.9 reports the 2-year moving average of the estimates for group-based inequality in years of education attained across gender, ethnicity, urban/rural, and capital/others (Figures 2.9(a) through (d) respectively.) As the capital is only identifiable in data after 1997, the results for group-based inequality measures between capital and the rest of the country are estimated for the years after 1997 (Figure 2.9(d)).

Figure 2.9(a) depicts the inequality across men and women from 1990 through 2012. As can be seen, all inequality measures (GCOV, GGINI, and GTHEIL) between men and women have been continuously decreasing in this period. This interesting result is consistent with the literature on education in Iran. The increase in educational attainment, particularly for girls, started decades ago. But after the Islamic Revolution of 1979, this rise in educational attainment was faster, especially for girls, for several reasons. One of the aims of the revolutionaries was to improve the conditions of the poor and people who were consistently on the margins of society, particularly people in rural areas and poor neighbourhoods of urban areas. In the decades after the revolution and even during the Iran–Iraq war in the 1980s, there was significant investment in infrastructure of rural areas and small towns. Many projects in electrification, access to clean water, telephone and telecommunication, road building and, as mentioned, school and health facility construction were implemented. The result of these projects was significant expansion of infrastructure across the country, which is shown in Table 2.1 and explained in Section 2.2. Especially, access to schools at all levels (primary, middle school, high school, as well as college and universities) substantially increased since the revolution. As a result, girls, who are less likely to be sent to distant schools, were now more likely to attend schools, which were nearby.

Another development after the revolution was that all private schools became public. For example, the number of public primary schools rose by 60 per cent the year after the revolution (Majbouri

2010). This means that there was a sudden rise in the supply of free education after the revolution. Girls' educational attainment is more responsive to price reductions—demand for educating girls is more elastic than for boys. Parents are more likely to take girls out of school than boys if the cost is high. As a result, after the revolution, parents sent their children, especially girls, to school more.

The third reason for the faster rise in female compared to male education is the gender based segregation of schools. Since schools were gender-segregated after the revolution, conservative families were more likely to send their daughters to school, as schools were considered “safer” for their daughters (Majbouri 2010). The fourth reason is that the teachers' gender, particularly in middle and high schools, was supposed to be the same as the students'. Therefore, female teachers taught female students and male teachers taught male students. The quality of female teachers was higher than male teachers, on average. This was because, as we saw in Section 2.2, female labor force participation in Iran was (and still is) low (about 20 per cent), and there were only a few jobs, such as teaching, that were attractive to women for various reasons.²⁷ Therefore, these jobs attract the top 20 per cent of women who could work and wanted to. On the other hand, many jobs were available as well as attractive to men, and teaching was not necessarily one of their top choices. Therefore, the quality of female teachers was likely higher than the quality of male teachers. As a result, female students received higher quality education than male students and therefore could attain more years of education than their male counterparts. All these explain the consistent decline in inequality of education across men and women between 1990 and 2012, as depicted in Figure 2.9(a).²⁸

The general trends in group-based inequality measures in Figures 2.9(b)–(d) are also downward. This means inequality across ethnicity, urban/rural and capital/others has been reduced since 1990. This reduction can be attributed to the continuous expansion of schooling infrastructure, even at the tertiary level, across the country. In 2012, all inequality measures across ethnic groups are at the same low level as inequality measures across gender. Regional inequalities (urban/rural and

²⁷ For example, according to law, husbands should agree with their wives working. Husbands are more likely to give permission to their wives to work when all of their wives colleagues are women. One of the jobs that offered (and still offers) such a working environment was teaching. All employees in girl's schools were female and hence female teachers had all-female colleagues.

²⁸ For more information on reasons behind the rise of female education in Iran see Keddie (2006) and Salehi-Isfahani (2005a: 286).

capital/others) have been almost halved in this period. Inequality among urban and rural areas is the largest compared to other categories, and this is not surprising, as return to education is different across rural and urban areas and individuals with the highest education migrate to urban areas. Therefore, rural areas will always have lower average education levels than urban areas, not just because they have less access to education (especially tertiary level) but also because of migration. As one can see, the difference between the capital and the rest of the country has always been less than the difference between urban and rural areas, but at the end of 2012 the inequality between the capital and the rest of the country was still larger than the inequality among ethnic groups and between genders.

Overall, one can argue that inequality in educational attainment has been on the decline across all groups and more opportunities are offered to people at the margin in the society. There is only a slight deviation from the trend in years 1992 through 1998 in Figures 2.9(b), (c), and (d). Inequality decreased in 1992 through 1994 and then increased between 1995 and 1998. The likely reason behind the rise in inequality is the minor economic crisis of 1994 and 1995. The fast economic growth after the end of Iran–Iraq war and higher oil prices encouraged the government to borrow more, mostly from international institutions and in the form of short-term debt. But the unexpected fall in oil prices in late 1993 made it very difficult to pay back these debts. This was because the share of short-term debt in total public debt was large in Iran compared to the countries affected by the East Asian currency crisis of 1997–98 (Pesaran 2000). As a result, the government, short in foreign currency, substantially increased the exchange rate, which raised the inflation rate in 1995 to 50 per cent, an unprecedented rate (see Figure 4). Higher prices reduced purchasing power, especially for the poor, and had impacts on households for a few years after this crisis. Since the people on the margin and the poor are more likely to reduce their educational efforts in a crisis, educational inequality increased during the crisis.

2.4.2.2 *Assets*

We do not observe the value of assets that households have in the data. What we observe is whether the household owns a particular durable good or not. Examples of these durable goods are autos, motorcycles, bikes, and household appliances. Since we only have the binary information of whether the household owns a particular durable good or not, we can combine these binary data

for each year into an index, using the principal component method. Hereafter we call this index the asset index.

Note that the principal component method gives us positive and negative values. But the inequality measures requires variables that take non-negative values (zero and above; such as income or expenditure). To turn the asset index into a non-negative variable without changing its distribution, we add the absolute value of the minimum of the index to it. The result is the asset index distribution shifted to the right by the size of the absolute value of its minimum. The minimum of this shifted distribution is zero, and all values are zero or above, but the shape of the distribution and its dispersion do not change.

Since assets are recorded at the household level, it is not possible to estimate inequality measures between men and women. Therefore, only inequality measures across ethnic groups, urban/rural, and capital/others are calculated. Figure 10 shows the results.

As can be seen, inequality in assets has been decreasing. For the results to be comparable and consistent, the basket of assets used to calculate the asset index has remained unchanged over time. In other words, when newer assets like computers, access to internet, and cell phones are reported in the surveys, they are not included in the basket of assets used to calculate the asset index. So the inequality measures shown in Figure 10 are inequality in more basic assets. Therefore, the downward trend in inequality measures indicates that every year more households owned these basic assets, reducing the differences among households every year. Interestingly, there is an increase in inequality between 1994 and 1998 similar to that reported for education. The potential explanation for this increase is the same: the economic crisis of 1994–95, which affected the marginalized population, the poor and the rural population, more.

Some of the assets used to create asset index are public goods, such as access to electricity and clean water. The decreasing trend in inequality between ethnic groups supports the argument by Gisselquist (2014) that ethnic diversity by itself does not ‘lead to poor provision of public goods.’

2.4.2.3 *Income*

In this section, we calculate the inequality measures for income at the individual level. All sources of income, including wages and salaries, business profits, pensions, revenue from renting properties and assets, educational and charity grants, are added up at the individual level. All incomes are annual.²⁹ Figure 11 reports the results.

We use two samples to study inequality of income between men and women. One is a sample of all men and women who earned income, and the other consists of all men and women above age 25, regardless of whether they earned income or not. This is because female participation in the labor market was (and still is) low in Iran (around 20 per cent), and not all working women earned income (some were unpaid family laborers, working in the family business without pay). Therefore, income for the majority of women was zero. This zero female income as opposed to the positive male income creates an unequal bargaining power within the household for women and affects household decisions. Therefore, any inequality measure that ignores women who do not work is ignoring this inequality and underestimating the inequality between the genders. On the other hand, one may argue that some women do not work by their own choice, and including their zero income in inequality measures produces an over-estimate of inequality. Here, we report the results both including and excluding women with no income. Figure 2.11(a) reports inequality measures among men and women who earn income, and Figure 2.11(b) depicts measures among all men and women who are 18 or older regardless of whether they work or not.³⁰

We learn three lessons from the results: First, as expected, inequality is substantially larger in the sample that includes women without income (compare Figure 2.11(a) with 2.11(b)). The measures reported in Figure 2.11(b) are the largest group-based measures of inequality reported in this study. The second lesson is that inequality of income between male and female earners slowly increased in the 1990s as the economy experienced a downturn from the 1994–95 crisis and the bust in the oil market. But in the 2000s, with the significant increase in oil prices, inequality between the genders decreased over time (Figure 2.11(a)). Figure 2.11(b) also shows some reduction in

²⁹ Since sometimes business profits are negative, income can be a negative variable. But only a very small fraction of the sample has negative incomes (around 1 per cent). Those negative incomes are replaced with zero in the sample so that the measures are correctly correlated.

³⁰ Samples used in all sub-figures include people aged 18 and above.

inequality among all men and women between 1990 and 2012. This can be attributed to two factors: 1) boom in the oil market, and 2) a small rise in the share of women who worked for pay during this period, and hence a reduction in the share of women with no income (see Figure 2.6). Inequality across ethnic groups was fluctuating but roughly stable in the 1990–2012 period (Figure 2.11(c)), but it is substantially smaller than inequality between genders. This means that gender inequality is more important than ethnic inequality in this context. The trend in ethnic inequality of income roughly follows the rise and fall of the oil market. When the oil market booms inequality improves.

Figures 2.11(d) and 2.11(e) show inequality across regions. Not surprisingly, inequality between urban and rural areas is larger than inequality between the capital and the rest of the country. These measures generally have a decreasing trend over time, except for a sharp increase in inequality in 2008 and 2009. One possible cause of this was that 2007 through 2009 were drought years in Iran, which could have particularly affected inequality between urban and rural areas negatively.

2.4.2.4 Expenditure per capita

Total expenditure for a household is calculated based on consumption of durable and non-durable goods and services in one month. HEIS data sets provide a very disaggregated and detailed account of all types of expenditure at the household level. Expenditure on non-durable goods, such as food and clothing, is measured for the month prior to each survey. But expenditure on durable goods is measured for the 12 months prior to the survey. Therefore, this expenditure is divided by 12 to get the monthly average. At the end, the total expenditure for the household is divided by the size of the household to get per capita expenditure for the household.

Since the expenditure for men and women is not distinguishable, we cannot estimate inequality between the genders, but inequality across other groups can be calculated. Figure 2.12 shows these inequality measures over time.

The measures of inequality among ethnicities seem to follow oil prices/oil revenue per capita. When the oil prices dipped in 1994 and the economy went into recession, inequality started to rise. It remained high until 2002, when oil prices started to rebound. With the rise of oil prices between

2003 and 2008, ethnic inequality declined. With the collapse of oil prices in 2011, there are signs of rise in inequality.

The inequality between urban and rural areas and between capital and the rest of the country seem to roughly follow the oil market as well. As the oil market booms, inequality declines. Inequality between the capital and the rest of the country has dropped significantly since 2002. This could be due to the rise in the cost of living in all urban areas across the country during the 2000s. The capital city is already at full capacity, and other cities are becoming more attractive than the capital. This has raised the cost of housing in those cities, raising per capita expenditure in them and reducing the inequality between the capital and other cities in the country. More research is required to understand the changes in inequality of expenditure between the capital and the rest of the country.

2.5 Inequality measures based on the 2006 Census

2.5.1 Country level

This section reports the results of the country-level measures of inequality in 2006. This is the only data set which includes religion and citizenship for each individual. Therefore, we use it to estimate between-group inequality for religious and citizenship groups. First, polarization and fractionalization indices for these groups at the country level are calculated, and then the between-group inequality measures are reported. Using the Census data, it is also possible to estimate these indices and measures for ethnicity and gender dimensions in 2006. However, we do not report them here, since they are the same as the estimates using the HEIS data for 2006 that we have already reported in Section 4.

As can be seen from Table 2.5, Iran is very homogeneous in terms of religion and citizenship, because the polarization and fractionalization indices are small. This is because about 99 per cent of the population have the same religion, Islam, and 90–95 per cent are Shi'ite. In terms of citizenship, although the variable of citizenship has missing values, as some non-citizens may

prefer not to report their actual citizenship,³¹ we expect that polarization and fractionalization indices will be small. This is because, according to the largest estimates, only about 2–4 per cent of the population have foreign citizenship.

2.5.2 Inequalities across religion and citizenship

Three measures, Group-weighted Coefficient of Variation (GCOV), Group-weighted Gini coefficient (GGINI), and Group-weighted Theil index (GTHEIL) are calculated, based on gender, ethnicity, religion, and nationality.

2.5.2.1 Education

As discussed in Section 2.4.2.1, two samples were used to measure inequality of education, the 25+ and the 15+ samples. Table 6 reports the results across citizenship and religion.

As depicted, between-group inequalities across both citizenship and religious groups are small and almost identical in both samples. The results show that there is no horizontal inequality on these dimensions, particularly when it comes to religion. Religious minorities are often at least as educated as (if not more educated than) Muslims.

As with education, inequality is very low and almost non-existent between citizens and non-citizens.

2.5.2.2 Occupation

In this section, we study inequality in the job market. We are interested in the inequality in the types of occupations various groups have. As discussed in Section 4.1, since the variable that represents occupational skill will only take three values, measuring GCOV, GGINI, and GTHEIL may not be very informative. Instead, we measure cross-cuttingness and cross-fractionalization

³¹ For example, in fear of deportation.

between occupation on one hand, and religion, citizenship, and gender on the other. Table 8 reports the results.

Interestingly, the high cross-cuttingness values show that there is a lot of overlap between the three occupational skills and religion and citizenship groups. This means that there is almost equality among groups in these dimensions. The overlap is less between men and women, but still substantial.

According to the Census of 2006, less than 13 per cent of all workers above age 18 are women. Going one step further and examining the jobs that are performed by men and women, one observes that more than 30 per cent of high skilled workers are women (Table 9). Meanwhile only 5.8 per cent of low-skilled workers are women and 94.2 per cent are men. This means that most women who work are concentrated in higher skilled occupations.³²

2.6 Conclusion

Our study of group-based inequalities in Iran presents encouraging results: poverty and inequality are generally decreasing, and access to public goods (piped water, electricity, and piped gas) are increasing. Our results suggest that Iran is an example of sustainable progress in decreasing poverty and inequality. Iran's experience is particularly important, as sustainable progress continued despite the war, several rounds of sanctions, and a low price of oil. The substantial reduction in between-group inequalities in Iran has lessons for other developing countries. Expansion of educational and health infrastructure in Iran, particularly to rural areas and to the marginalized population, has reduced between-group inequalities. The social policies have improved wellbeing and living standards for the poor and the rural population, and reduced inequality. Hence, rural development should be recognized as a powerful multi-dimensional factor in development policy.

³² In our 2% census sample, there are 23,309 women in high skilled jobs. These the high skilled women are most frequently reported as managers (514 women), scientists and engineers (782 women), doctors and surgeons (499 women), pharmacists (52 women), professors (651 women), accountants and financial experts (1,182 women), school principals (1,062 women), college educated teachers and educators (9,456 women), college educated nurses (1,507 women), lawyers (152 women), paralegals (180 women), other college graduated professionals (1,500 women), technicians (2,444 women), and Clerks (2,239 women).

There are significant reductions in inequality of education as well as assets among various groups. At the same time, some reduction in between-group inequalities in per capita expenditure and income are observed in the 1990 to 2012 period. Income and expenditure inequalities between some groups seem to have an opposite relationship with the trend in oil prices and revenues. But it is hard to infer any clear causal path without further research and analysis. There are several suggestions for future research. First, further research is required to more carefully investigate the relationship between the ups and down of the oil price and individual wellbeing. Second, this analysis can be extended to similar countries, other oil producing countries or other MENA countries, leading to between-country comparison. Third, while the gender gap in education declined significantly, female participation in the labor market remains low. Middle East scholars have made a series of policy recommendations to increase the FLFP. One is to improve the social acceptance of women working outside home (instead of the stay-at-home wife norm) through changes in social and economic infrastructure (Karshenas 2001, Hayo and Cargyis 2013, Karshenas and Moghadam 2016). Other recommendations include enforcing a gender-neutral policy in the work place (Karshenas 2001, Hayo and Caris 2013, Karshenas and Moghadam 2016), giving tax incentives to firms that employ considerable numbers of women workers (Karshenas 2001), provision of child care and maternity leave (Karshenas 2001), and change in the family laws to support this social change (Majbouri 2017). Women with tertiary education are more active in the private sector and as entrepreneurs. Reforming the financial system to enhance the availability of credit to women, especially to self-employed women and entrepreneurs, not only improves the FLFP but also creates more jobs in the economy (Esfahani and Shajari 2012, Karshenas and Moghadam 2016). These policies reduce gender inequality in the economy and enhance the living standards of future generations.

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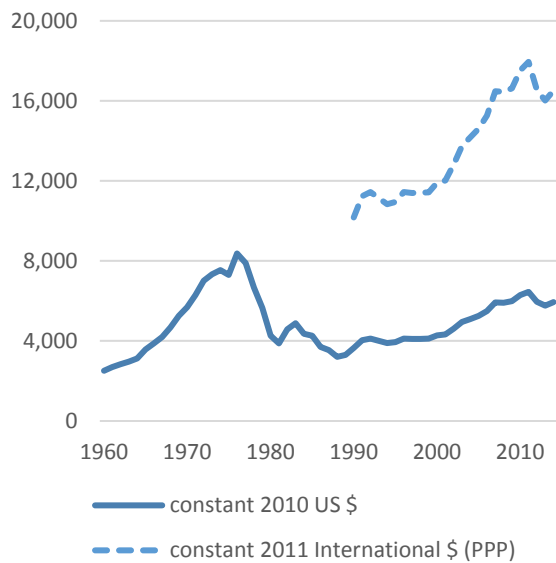
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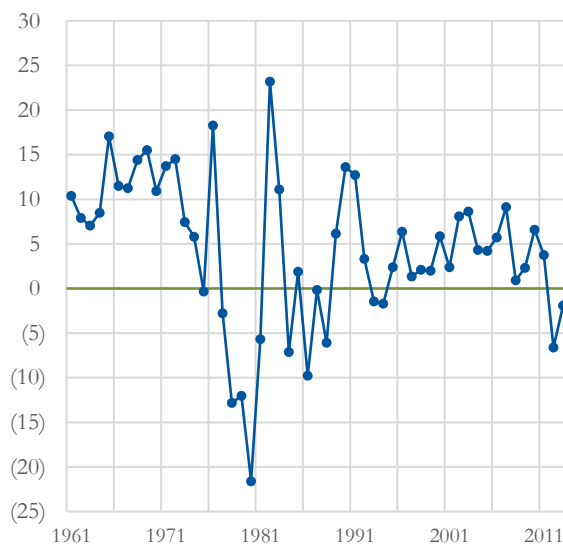
Weidmann, N.B., J. Ketil Rød, and L.-E. Cederman (2010). Representing ethnic groups in space: A new dataset. *Journal of Peace Research*, 47(4): 491–99.

Figures

Figure 2.1. GDP per capita and annual growth rate of GDP



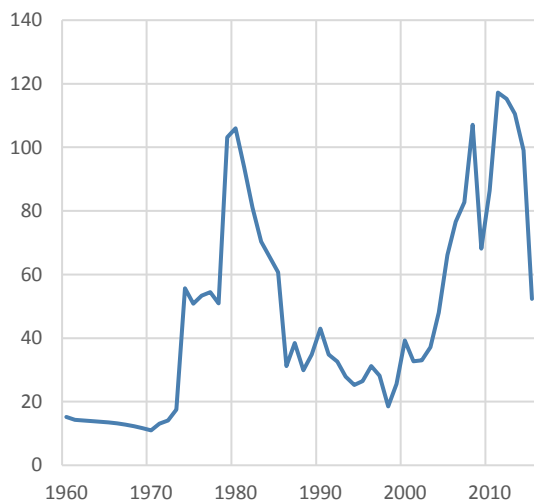
(a) GDP per capita (in US\$ and PPP)



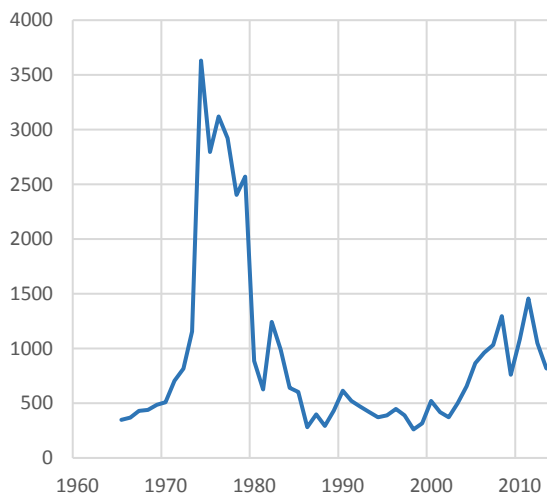
(b) Annual growth rate of GDP (per cent)

Data source: World Bank National Account Data.

Figure 2.2. Oil prices and annual oil revenue per capita, both in 2015 US\$



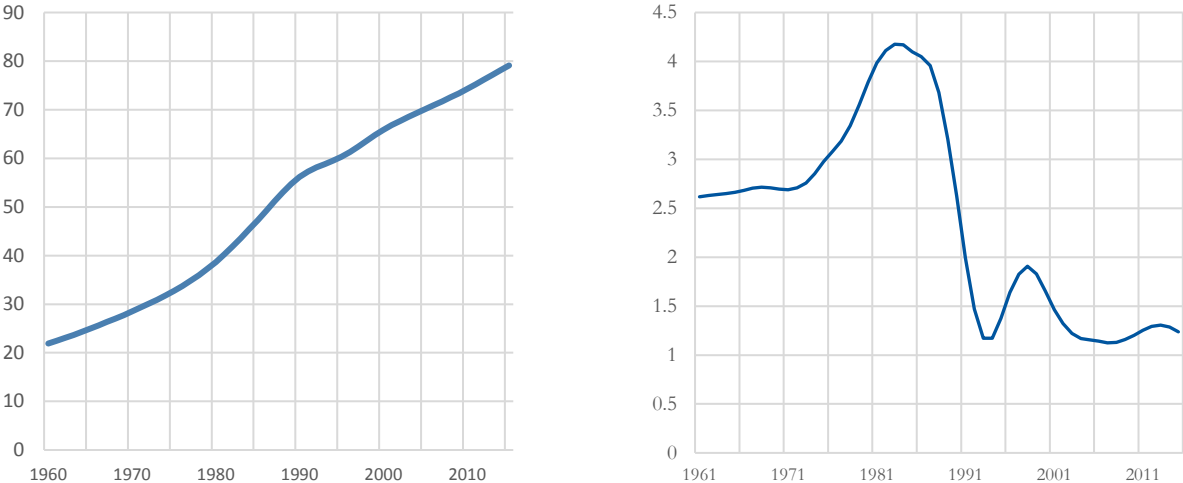
(a) Oil prices, West Texas Intermediate



(b) Annual oil revenues per capita

Data source: BP Statistical Review of World Energy (<http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy/downloads.html>) (accessed on 30 July 2016). Annual oil revenues per capita were calculated by subtracting the annual domestic oil consumption from oil production and multiplying the result by the price of oil (West Texas Intermediate) and dividing it by the size of population in that year.

Figure 2.3. Population (in millions) and population annual growth (%)



Data source: United Nations Population Division.

Figure 2.4. Inflation (%). Data source: International Monetary Fund.

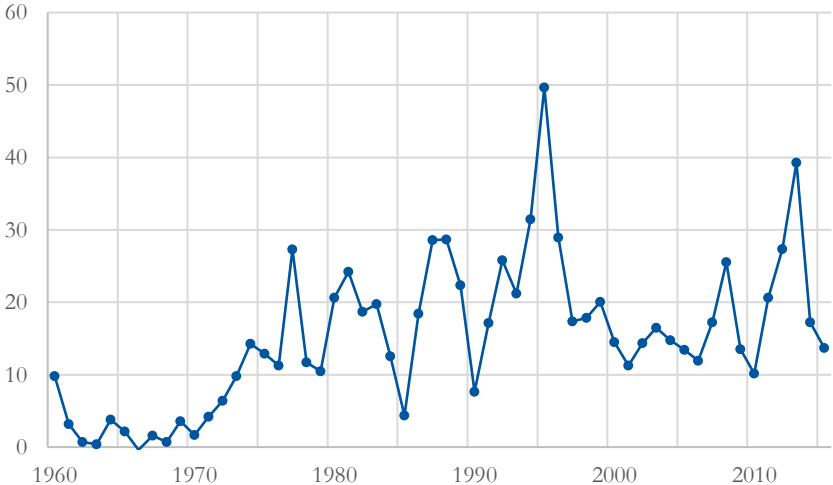


Figure 2.5. Years of education attained across birth cohorts

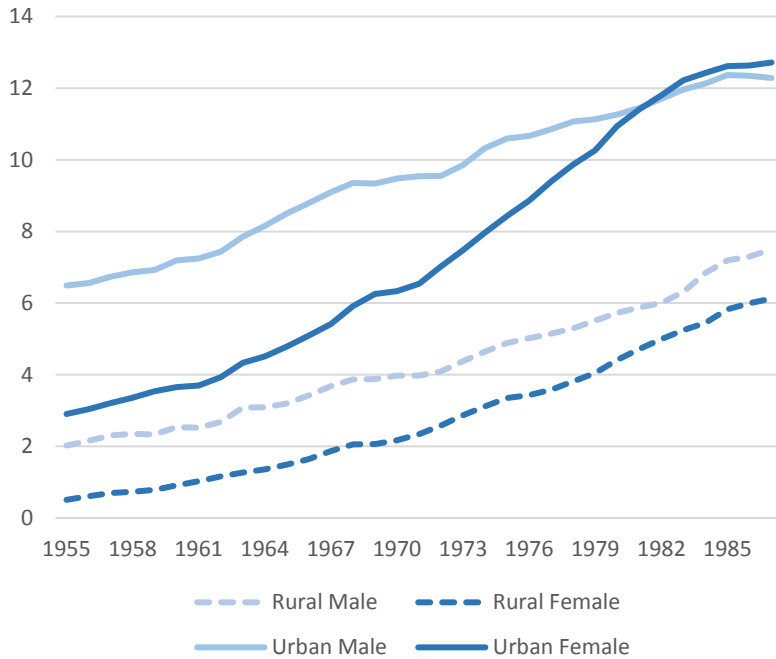
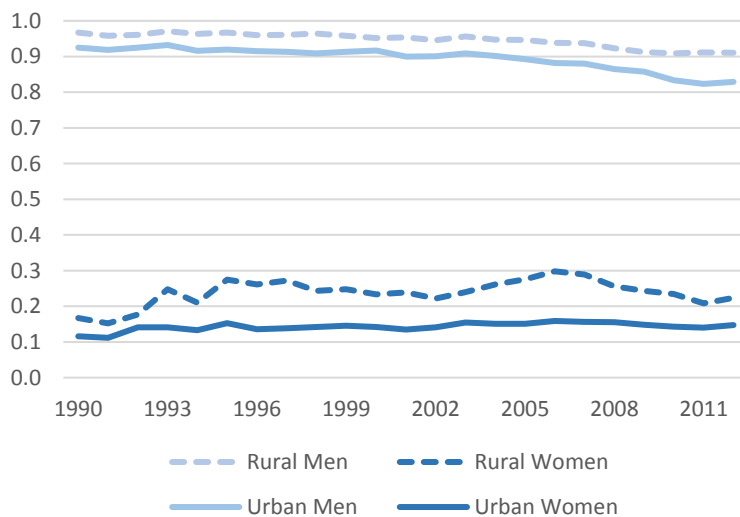
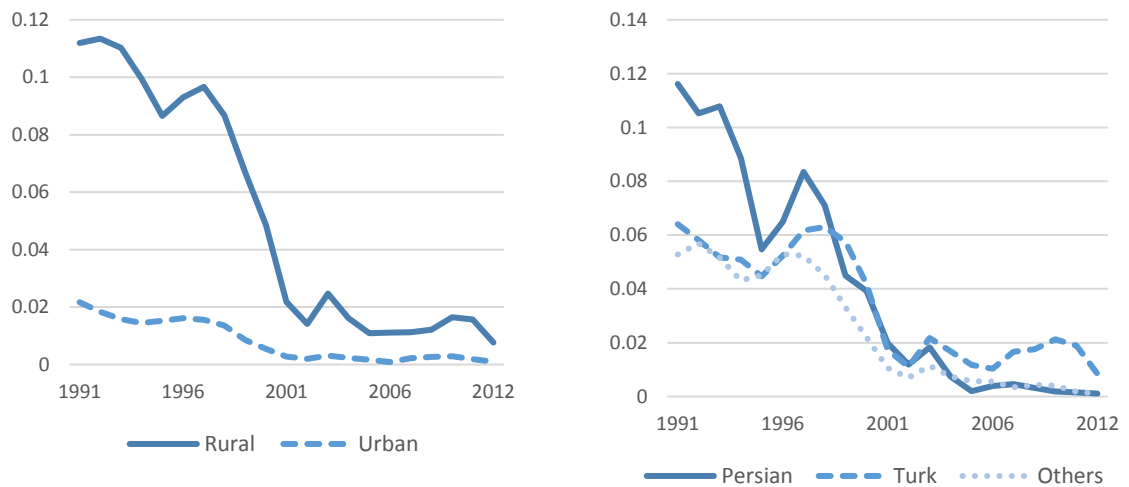


Figure 2.6. Share of population participating in the labor force



Source: Authors' calculations based on Household Expenditure Surveys of 1990 through 2012. Women who work or are looking for work are considered participating in the labor force.

Figure 2.7. Absolute poverty rates (share of population)

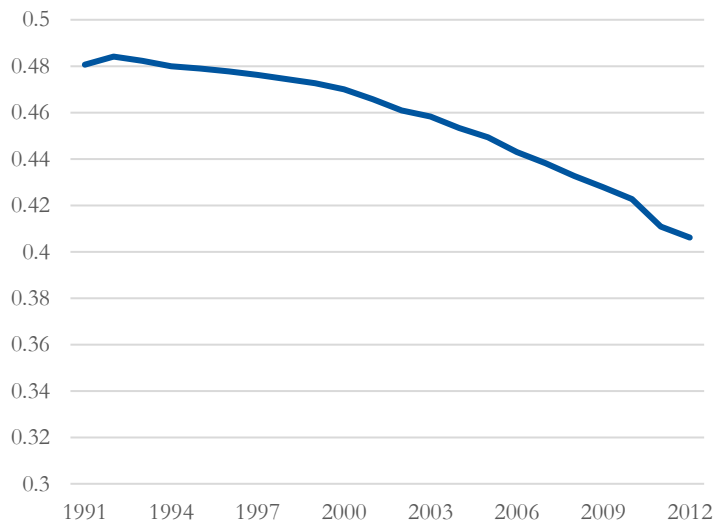


(a) Across Urban–Rural

(b) Across Ethnicities

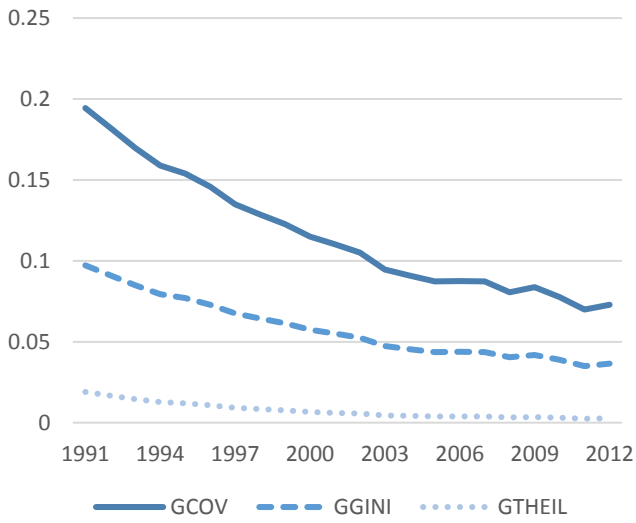
Source: Authors' calculations based on Household Expenditure Surveys of 1990 through 2012. The poverty line is \$1.90 in 2011 international dollars adopted by the World Bank.

Figure 2.8. Gini coefficient for annual income

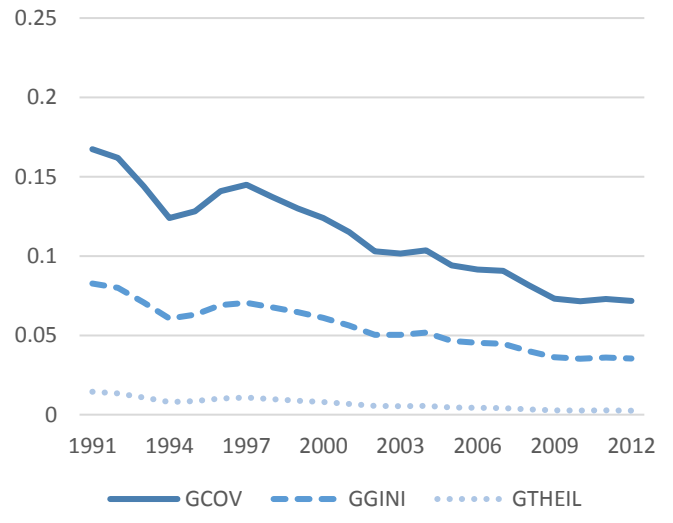


Source: Authors' calculations based on Household Expenditure Surveys of 1990 through 2012. The graph is the 2-year moving average of Gini coefficient for every year.

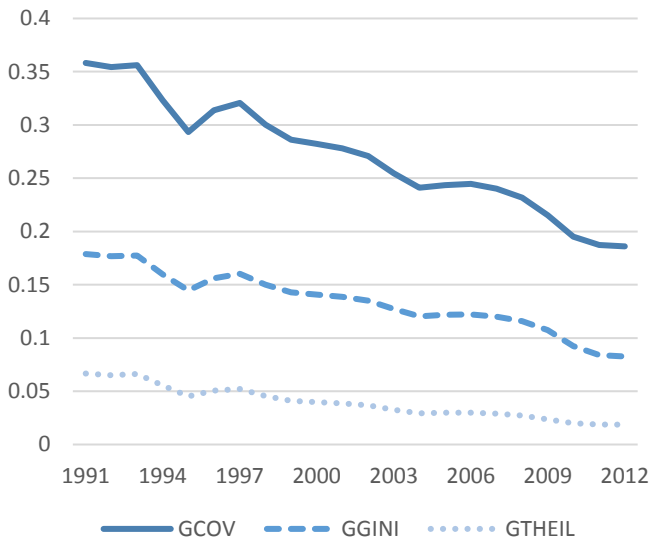
Figure 2.9. Between-group inequality in educational attainment—years of education



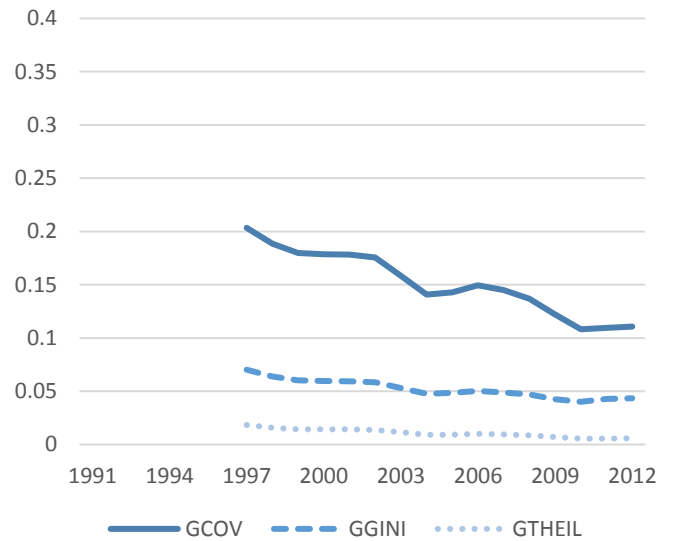
(a) Gender



(b) Ethnicity



(c) Urban/Rural

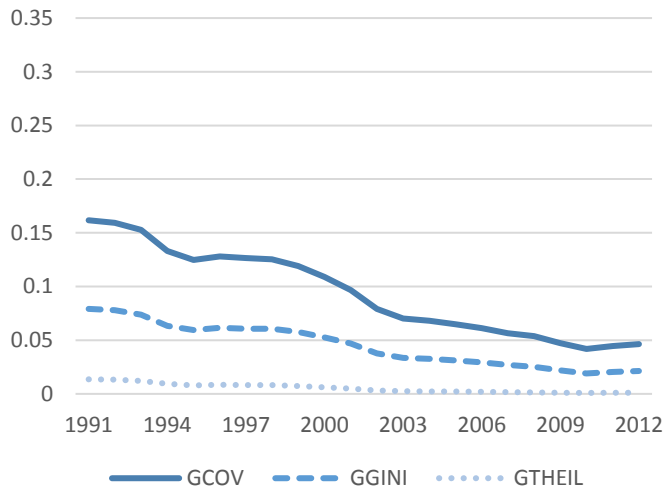


(d) Capital/Other

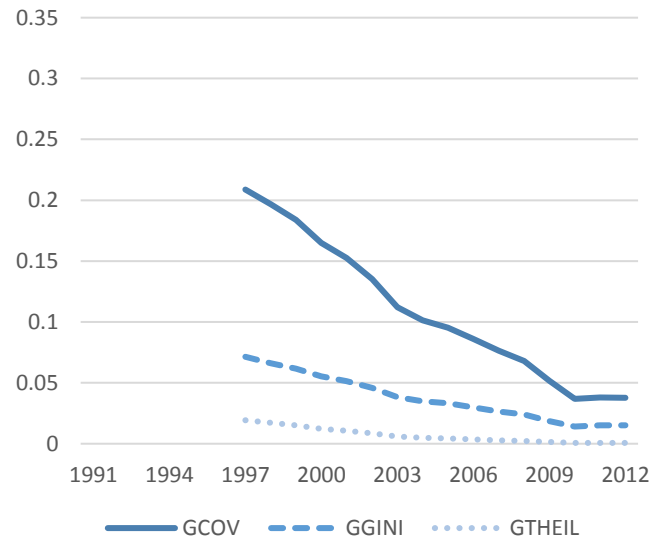
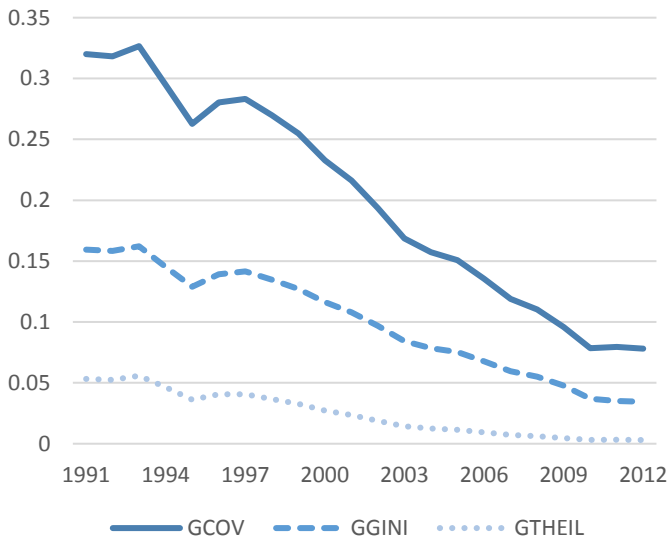
Note: Each figure depicts the two year moving average of Group-Based Coefficient of Variation (GCOV), Group-Based Gini (GGINI), and Group-Based Theil (GTHEIL) for years of education attained across various groups: male/female, ethnicity (Persian, Turk, Others), urban/rural, and capital city/others. The sample contains all individuals aged 15 and above.

Data source: Household Expenditure and Income Surveys (HEIS).

Figure 2.10. Inequality in assets—asset index



(a) Ethnicity



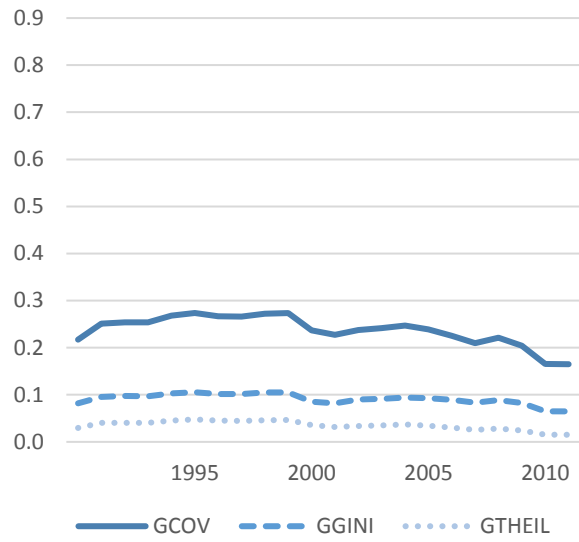
(b) Urban/Rural

(c) Capital/Other

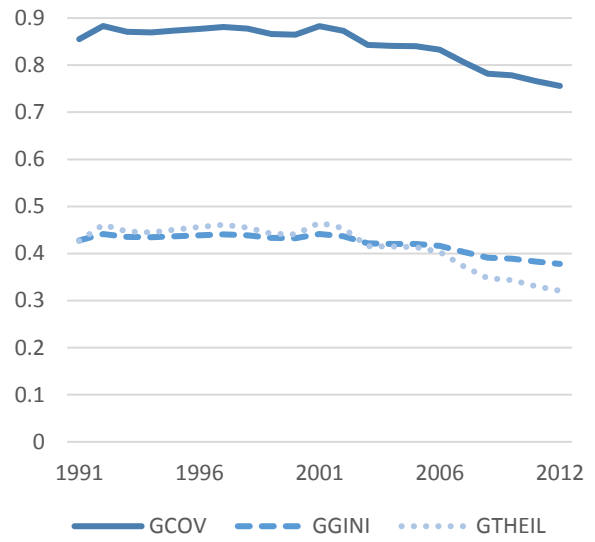
Note: Each figure depicts the two year moving average of Group-Based Coefficient of Variation (GCOV), Group-Based Gini (GGINI), and Group-Based Theil (GTHEIL) for years of asset across various groups: ethnicity (Persian, Turk, Others), urban/rural, and capital city/others. The sample contains all individuals aged 15 and above.

Data source: Household Expenditure and Income Surveys (HEIS).

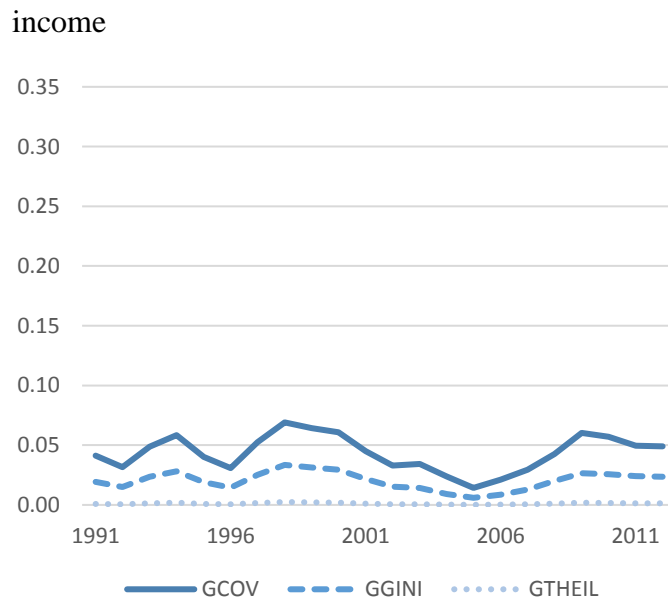
Figure 2.11. Inequality in income for people aged 18+



(a) Gender—Women and men who earned income



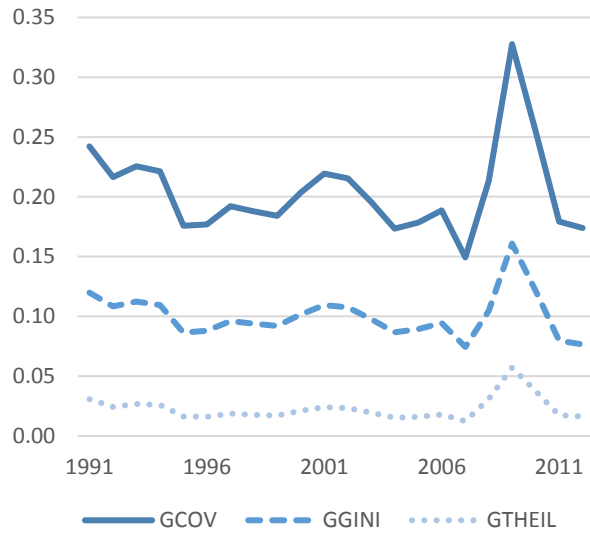
(b) Gender—All women and men



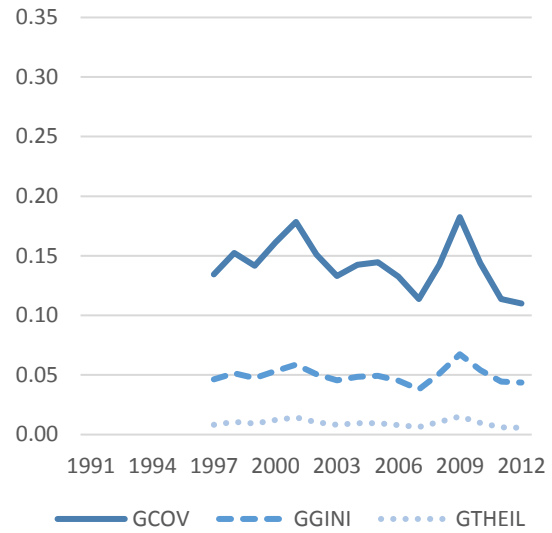
(c) Ethnicity

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Figure 2.11—Continues



(d) Urban/Rural

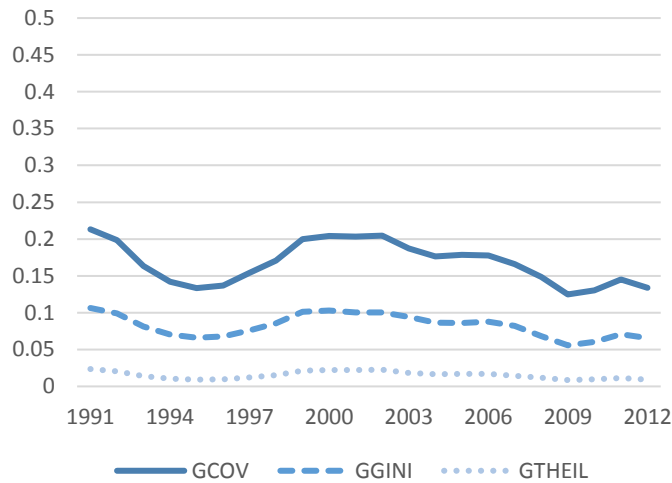


(e) Capital/Other

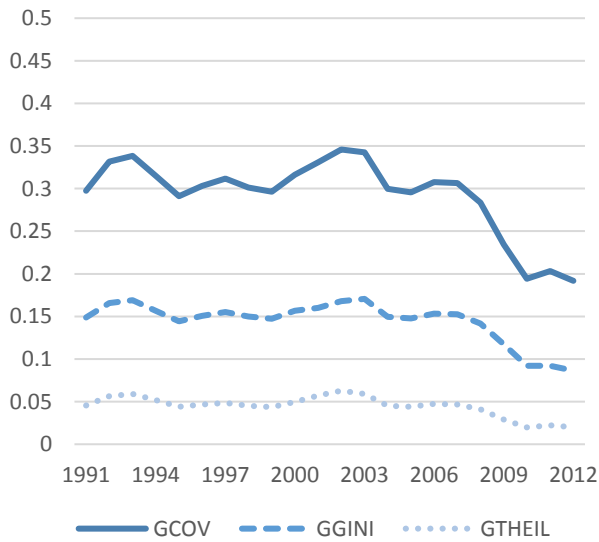
Note: Each figure depicts the two year moving average of Group-Based Coefficient of Variation (GCOV), Group-Based Gini (GGINI), and Group-Based Theil (GTHEIL) for individual level income across various groups: male/female, ethnicity (Persian, Turk, Others), urban/rural, and capital city/others. The sample contains all individuals aged 18 and above who earned income (except for (b)).

Data source: Household Expenditure and Income Surveys (HEIS).

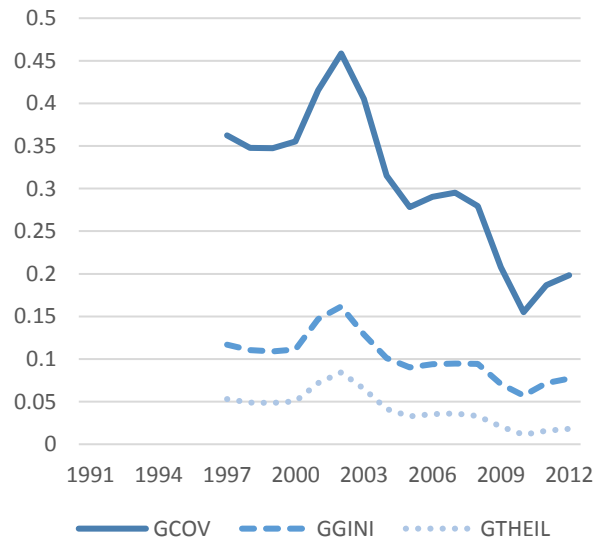
Figure 2.12. Inequality in per capita expenditure



(a) Ethnicity



(b) Urban/Rural



(c) Capital/Other

Note: Each figure depicts the two year moving average of Group-Based Coefficient of Variation (GCOV), Group-Based Gini (GGINI), and Group-Based Theil (GTHEIL) for per capita expenditure across various groups: ethnicity (Persian, Turk, Others), urban/rural, and capital city/others. The sample contains all individuals aged 15 and above.

Data source: Household Expenditure and Income Surveys (HEIS).

Tables

Table 2.1. Percentage of households with access to infrastructure and ownership of facilities/equipment in rural and urban areas

	Rural			Urban		
	1990	2000	2012	1990	2000	2012
Electricity	73	96	100	99	100	100
Piped Water	63	84	95	96	99	100
Piped Gas	1	4	48	20	64	92
Landline Phone	1	23	65	28	64	85
Cellphone	-	0	81	-	4	92
Kitchen	39	64	85	81	90	97
Bath	22	45	85	66	88	98
Stove	59	83	96	88	96	99
Refrigerator	54	86	98	92	97	100
Washer	7	18	45	39	54	80
Vacuum Cleaner	3	16	59	26	58	88
TV	46	81	96	87	95	99
Computer	-	0	12	-	4	39
Car	4	5	22	17	18	42

Source: Authors' calculations from Household Expenditure and Income Surveys of 1990, 2000, and 2012.

Table 2.2. Comparison of Group-weighted Inequality Measures between SECH and HEIS over time

	SECH 1992 & HEIS 1992			SECH 2001 & HEIS 2001		
	GCOV	GGini	GTheil	GCOV	GGini	GTheil
Education, People Aged 15+						
SECH	0.187	0.098	0.018	0.137	0.071	0.009
HEIS	0.162	0.080	0.013	0.110	0.054	0.006
Education, People Aged 25+						
SECH	0.243	0.127	0.030	0.188	0.098	0.018
HEIS	0.216	0.106	0.024	0.161	0.078	0.013
Asset Index						
SECH	0.110	0.058	0.006	0.085	0.042	0.004
HEIS	0.160	0.078	0.013	0.088	0.042	0.004
Income, Population Aged 18+						
SECH	0.141	0.071	0.010	0.195	0.099	0.020
HEIS	0.180	0.090	0.017	0.216	0.109	0.025
Household per Capita Expenditure						
SECH	0.121	0.055	0.008	0.119	0.063	0.007
HEIS	0.072	0.036	0.003	0.096	0.038	0.004

Note: Ethnic groups are found based on the second language that the individual speaks (in addition to Persian) in the SECH data set. Ethnic groups are identified using province of residence in HEIS. Three ethnic groups were defined in each of these data sets: 1) Persian (including Shomalies), 2) Azeri, and 3) the Others.

Source: Authors' calculations.

Table 2.3. Number of observations across religion in the 2006 Census

Muslim	1,294,721
Christian: Assyrian or Chaldean	879
Christian: Armenian	190
Other Christians	37
Jewish	61
Zoroastrian	214
Other	614

Source: Authors' calculations.

Table 2.4. Number of observations across country of citizenship in the 2006 Census

Iran	1,265,685
Afghanistan	19,218
Other	11,813

Source: Authors' calculations.

Table 2.5. Polarization and fractionalization

	Polarization	Fractionalization
Citizenship	0.115	0.057
Religion	0.017	0.008

Source: Authors' calculations.

Table 2.6. Between-group inequality measures for average years of education attained

	15+ Sample		25+ Sample	
	Citizenship	Religion	Citizenship	Religion
GCOV	0.055	0.004	0.052	0.008
GINI	0.009	0.0003	0.008	0.001
GTHEIL	0.002	0.00001	0.002	0.00003

Source: Authors' calculations.

Table 2.7. Between-group inequality measures for asset index

	Citizenship	Religion
GCOV	0.008	0.001
GINI	0.001	0.00005
GTHEIL	0.00003	0.000001

Source: Authors' calculations.

Table 2.8. Cross-cuttingness and cross-fractionalization between the occupational skill levels and religion, citizenship, as well as gender—the 2006 Census

	Religion	Citizenship	Gender
Cross-cuttingness	0.990	0.927	0.767
Cross-fractionalization	0.580	0.572	0.461

Source: Authors' calculations.

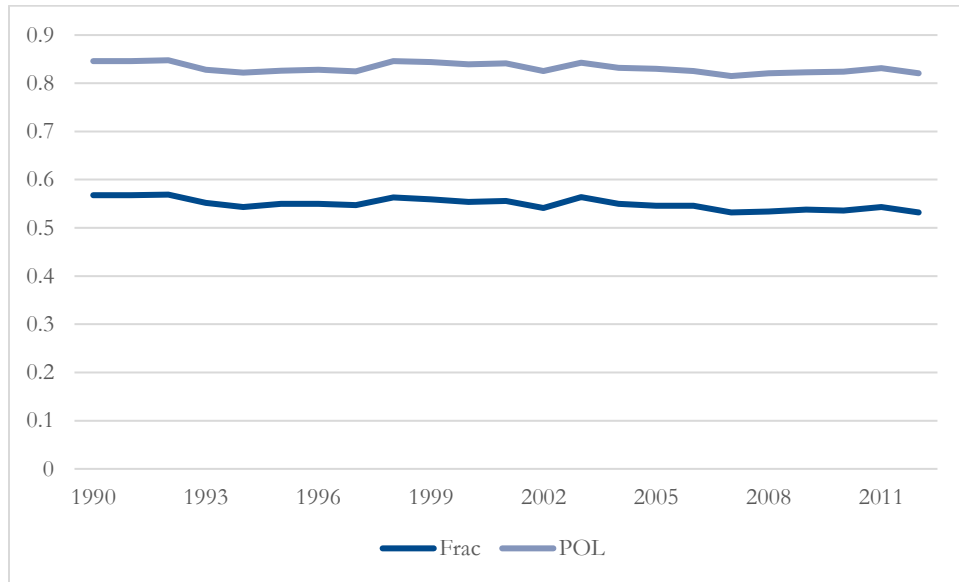
Table 2.9. Percentage of women and men in various occupational skill levels, the 2006 Census

	High skilled	Medium skilled	Low skilled	Total
Men	69.6	89.7	94.2	87.1
Women	30.4	10.3	5.8	12.9
Total	100	100	100	100

Source: Authors' calculations.

Appendix

Figure 2.13. Fractionalization and polarization



Data source: Household Expenditure and Income Surveys (HEIS).

Measuring the Economic Cost of the Trade and Financial Sanctions on Iran

Abstract

This paper measures the economic cost to Iran's economy of the U.N. trade and financial sanctions. While there is a substantial literature studying how sanctions impact the economies of target states, the aggregate economic cost of sanctions remains underexplored. This study provides a new measure of the cost of sanctions at the aggregate level, defined as the gap between Iran's actual GDP and what it would have been without sanctions. Using the synthetic control method of analysis, I replicate Iran's GDP without sanctions. I demonstrate that, while previous sanctions had a negligible impact, Iran's GDP fell markedly following the financial sanctions of 2010.

3.1 Introduction

Economic sanctions are used as a foreign policy tool to harm the economy of a target country and thereby achieve a policy change. In 1919 U.S. President Woodrow Wilson described the power of sanctions: "A nation that is boycotted is a nation that is in sight of surrender. Apply this economic, peaceful, silent, deadly remedy and there will be no need for force. It is a terrible remedy. It does not cost a life outside the nation boycotted, but it brings a pressure upon the nation which, in my judgment, no modern nation could resist."³³

Iran has experienced one of the longest periods of sanctions, beginning with U.S. sanctions during the Iranian hostage crises in 1979. Yet it was recent multi-lateral sanctions which resulted in a policy change by Iran's government.

The theory of sanction says that if the cost of sanctions is high enough, the target country will change its policy. Therefore, estimating the cost of sanction is an important step in the study of sanctions and their success.

There is a substantial literature studying how sanctions impact the economy of target states; however, most research explores the impact of sanctions on subsections of the economy, like military expenditure, trades, or welfare. Studies focused on the effectiveness of sanctions have used the cost of the sanctions as an explanatory variable, calculated roughly by the difference in GDP of the target states before and after imposition of the sanctions. It results in an underestimated measure of the cost, as it does not take into account the economic growth that would have happened in the absence of the sanctions. This study fills that gap by proposing and implementing a systematic procedure for measuring the cost of the sanctions at the aggregate level. By using the synthetic control method, I estimate the per capita GDP of Iran in the absence of the sanctions. The gap between the actual and estimated per capita GDP provides a more accurate measure of the cost of the sanctions at the aggregate level.

³³ (Economic Sanctions Reconsidered, 3rd edition, 2007, vol.1, p.9).

This paper is organized as follows. The next section provides a review of the history of sanctions imposed in Iran and the related literature. After that, there is a brief overview of the synthetic control estimator and data. Then the aggregate cost of sanctions on Iran is estimated by applying the synthetic control method. The results of the analysis are then discussed, followed by a conclusion. Data sources for the empirical example are provided in an appendix.

3.2. Literature Review

3.2.1. History of Sanctions on Iran

Schott (2012) reviews the three-decade history of economic sanctions on Iran. He describes the slowdown in the growth of the Iranian oil industry as a consequence of the combination the sanctions and mismanagement. Since 1984, sanctions mainly hindered foreign investment in Iran's energy industries and prevented the development of the Iranian oil industry, the main source of Iran's export earnings. This has been especially true since 1996 when, through the Iran and Libya Sanctions Act of 1996 (ILSA), companies that invested above a specified level in Iran's oil and gas sector were penalized. The specified level of yearly investment was set at \$40 million for the first year and reduced to \$20 million per year after that. ILSA initially had a five-year life, but it was renewed twice. In 2006, ISLA was renamed the "Iran Sanctions Act (ISA)," and redefined to target only Iran. ISA sanctions have only been enforced against U.S. companies since March 2008. The President can waive sanctions for individuals or companies, but waivers must be renewed every six months. In June 2010 more restrictions were added to previous sanctions. The Comprehensive Iran Sanctions Accountability and Divestment Act (CISADA) places new sanctions against banks and foreign financial institutions engaging in transactions with Iran. It also punishes those who aid Iran's oil sector.

In December 2011, U.S. sanctions were tightened on Iran's oil customers when the National Defense Authorization Act (NDAA) enacted new punishments for non-U.S. financial institutions making transactions with the Central Bank of Iran and other Iranian banks (with a few exceptions).

The European Union joined the sanctions against Iran in January 2012, outlawing all new contracts on Iranian crude oil, petroleum products, and petro-chemical products. It also required all previous contracts on oil and petroleum products to be resolved or terminated quickly. In addition, EU sanctions limit most financial operations: insurance and reinsurance, private insurance for tankers shipping Iranian crude oil, and Society for Worldwide Interbank Financial Telecommunication (SWIFT) services for making or receiving payments.

Even though the main customers of Iranian crude oil are Asian countries like China, Japan, India, and South Korea, which were not directly involved in sanctions, these countries reduced their purchases substantially. Financial sanctions also led Iran's trade partners to change their method of payment for oil to other currencies like Indian rupees or to exchanges of goods.

After president Rouhani was elected in 2013, a new set of negotiations with the five permanent members of the United Nations Security Council plus Germany and the European Union (P5+1) were started under the Joint Plan of Action. Twenty months of negotiations resulted in the Joint Comprehensive Plan of Action (JCPOA) in July 2015 and the removal of U.N. sanctions.

This study focuses on cost to Iran of these recent sanctions by the United States and the United Nations.

3.2.2. Effects of Sanctions in Iran

Amuzgar (1997) did one of the first studies of how Iran's economy is affected by U.S. sanctions. He describes the opportunities lost to Iran's economy as a result of sanctions between 1984 and 1996, but he provides no dollar measure of the cost. The first four years were contemporaneous with the last years of Iran-Iraq war. It is difficult to distinguish the effects of U.S. sanctions from those of wartime conditions and an oil price collapse. For the post-war era, he mentions two major problems: one is the lack of investment in the oil industry and the second is limited access to credit and lending programs. He points to a sudden drop in the value of the Iranian currency after ILSA was extended in 1996. The ILSA extension caused U.S. oil customers to be replaced by non-U.S. customers and also caused terms to be less favorable to Iran. He concludes that "U.S. sanctions have also changed the international climate for Iranian business by adversely affecting the country's terms of trade, and raising the cost of foreign capital for development financing." He states that Iran's economy has problems such as inflation, a public sector deficit, difficulty providing a social safety net for the poor, national savings insufficient to cover depreciation of physical assets, and rising unemployment among the young. Amuzgar emphasizes that these problems are byproducts of a combination of ineffective domestic policy and U.S. sanctions. His work is descriptive, and no measure of the cost of sanctions is provided.

Torbat (2005) reviews U.S. sanctions against Iran until 2002. He investigates how trade and financial sanctions impact different sectors of Iran's economy. To estimate the cost of trade sanctions, he uses data on U.S.-Iran trade and applies the welfare loss method. He studies three categories of trade: U.S. exports of machinery and food, U.S. imports of oil, and U.S. imports of non-oil products. He reconfirms that trade sanctions have primarily a short-term impact, since, after a while, other trade partners appear. He also asserts that financial sanctions have more impact. The costs of financial sanctions are listed as: paying higher rates of return on pay-back of oil and gas contracts, extra interest charges on foreign debt as a result of U.S. pressure on international organizations, higher interest rates on international bonds, and missing out on the flow of income from swap-and-transit pipelines from Turkmenistan, Kazakhstan, and Azerbaijan. He also mentions brain-drain effects and the cost from Iranians living abroad not investing in Iran, due to Iran's unstable economy.

Farzanegan (2011) considers sanctions imposed on Iran as efforts to limit Iranian government spending by limiting oil exports. Using an unrestricted VAR model and applying the impulse response function to annual data from 1959 to 2007, he provides variance decomposition analysis

results showing how different categories of Iranian government spending, like social, health, and education, are affected by oil revenue shocks resulting from sanctions. According to his results, military expenditure is responsive to changes in oil export income and therefore can be limited by sanctions. Effects of sanctions on other government spending categories like health and education are minimal.

Dizaji and van Bergeijk (2013) studied the impact of the Iranian oil boycott on Iran's macroeconomic variables, government expenditure and imports, and two indices of democracy. Their result shows that both the macroeconomic and the democratic impacts of the boycott are limited to the first two years of imposition of the sanctions. After two years, the effect of sanctions is insignificant for macroeconomic variables and negative for democratic impact. Sanctions may work in the short term, but "their impact in the long run is limited at best."

Haidar (2016) studied the decrease in non-oil exports after the U.N. imposed sanctions against Iranian non-oil exporters in March 2008. His results show that "two-thirds of the value of Iranian exports thought to be destroyed by export sanctions have actually been deflected to non-sanctioning countries" and therefore "export sanctions are less effective" as exporters are able to find new markets in non-sanctioning countries. His results confirm Torbat (2005) that, for trade sanctions, new trade partners show up, substituting for old trade partners.

3.2.3. Effects of Sanctions in Other Countries

In addition to studies of Iran's sanctions, there are many scholarly studies of sanctions, their success, and short- and long-term impacts in cross-country settings. Hufbauer et al. (2007) collected a large data set based on studies of economic sanctions up to 2006, to try to identify the conditions under which sanctions are successful. The success of sanctions is measured by whether the goal of the sanctioning country is achieved and by the contribution of sanctions toward achieving the goal. If the cost of the imposed (or threatened) sanctions outweighs the "perceived cost of complying with the sender's demand," the sanctions achieved their goal. The actual (or threatened) cost of sanctions is measured as the welfare loss imposed by "deprivation of markets, supplies or finance, as a percentage of GNP." According to this study, "sanctions often impose meaningful costs on target countries and frequently achieve their policy objectives."

The data set provided by Hufbauer et al. paved the way for further research. Eyler (2007) defines trade sanctions as "nontariff barriers to trade at their core" and explores how sanctions affect exchange rates, as a measure of economic cost. Applying an auto regression method to an open economy model, he concludes that in most cases there is no effect of sanctions on the exchange rate. Therefore, in most cases there is no cost of sanctions, and no success in achieving the sanctions' goals. Conclusion about the effectiveness and cost of the sanctions depends highly on the way the cost on the economy is defined and measured.

While older studies focus on the direct and immediate impact of sanctions on specific sections of the sanctioned economy, recent studies go beyond the direct cost and explore other impacts of

sanctions. Peksen and Son (2015) study whether sanctions result in currency crises in the target economies. They show that beyond the immediate disruption of trade and investment, sanctions increase the chance of financial instability and a currency crisis. They explore currency devaluation as a consequence of multilateral sanctions and its impact on economic growth and prosperity. They “demonstrate that the suggested impact of economic coercion on the target economy goes well beyond the immediate disruption of foreign trade and investment flows.”

Neuenkirch and Neumeier (2015) study “how economic sanctions imposed by the United Nations and the United States affect the target states' GDP growth.” They find that on average, the imposition of sanctions has adverse effects on GDP and GDP growth. Multilateral sanctions imposed by the U.N. have a greater impact than unilateral sanctions and disrupt economic growth for longer periods of time.

Wood (2008) studies the negative impact of sanctions on the suppression of human rights of civilian populations. To do so, he categorizes sanctions into four levels by severity: zero indicates normal economic relations and three indicates severe sanctions. According to his analysis, “Comprehensive economic sanctions such as embargoes on all or most economic activities,” like the experience of Iran after 2012, were categorized as severe. He demonstrated that more severe multi-national sanctions contribute to even more increases in state-sponsored repression.

Afesorgbor and Mahadevan (2016) examine the impact of economic sanctions on income inequality. They find that lower income groups bear the greatest cost of the sanctions. Income inequality is intensified by sanctions, and the longer the duration of the sanction, the larger the effect. Therefore, civilian populations and ordinary people are harmed more than the leaders of the sanctioned country.

Neuenkirch and Neumeier (2015) study the impact of U.S. sanctions on the poverty gap in target states. Using the nearest neighbor matching approach, they show that poverty increases with sanctions, and that severe sanctions increase poverty more than mild or moderate sanctions, using the sanction categories described in Wood (2008). Since elites dictate the policies resulting in sanctions, and elites are not impacted by sanctions, the authors claim sanctions are “affecting the wrong people.”

Allen and Lektzian (2012) emphasize the impact of sanctions on public health. “The public health risks associated with sanctions occur more indirectly as access to resources “may decrease because of” sanctions. They show that compared to military conflicts, sanctions result in fewer deaths, but their harmful impacts on “the ability of individuals to lead healthy lives” is comparable in cases of military conflicts and sanctions.

3.3. Methodology

In this section I describe the synthetic control method, which I employed to estimate the cost of economic and financial sanctions on Iran's economy. The synthetic control method is introduced

by Abadie and Gardeazable (2003) and Abadie, Diamond and Hainmueller (2010, 2013). This method provides a way to estimate the effect of an event or a policy intervention on a unit of interest where the treated unit is at the aggregate level, like a state.

The synthetic control method is based on the tradition of political scientists of performing comparative studies. The comparative studies approach is to select similar units and explore the differences among them. One area of comparative studies is to take as the unit of study an event or policy intervention. If the treated unit and the control group were similar to each other before the event, then any difference in outcomes would be attributed to the event. The main shortcoming of the comparative studies approach is that it only provides qualitative results about an event's impact. Also, the result is sensitive to the choice of sufficiently similar control unit(s), which is subject to researcher judgement. Therefore, the questions of how to measure the similarity, and how much similarity is sufficient, remain unanswered.

Economists use quantitative methods to measure the change caused by an event or policy intervention and to discuss the accuracy of the results. Difference in differences is the favored statistical method to estimate event or policy impact. There are two main assumptions: first, the existence of a sufficiently close control unit; and second, the output variables in the treated and control units follow a parallel path in the absence of the event or policy intervention. The reliability of difference in differences analysis depends on the existence of such a control unit. Whether the control unit is sufficiently similar is subjective to the researcher's judgment. In the absence of control units, difference in differences analyses are not reliable.

The need to extend the comparative studies approach and combine it with statistical analyses and quantitative results led to the development of the synthetic control method. Following the synthetic control method, researchers choose several potential control units, called the donor pool. The donor pool is then used to fabricate a synthetic control unit which matches the unit of study during the pre-event period. The synthetic control unit is built as a weighted average of the donor pool. Numerical optimization methods are used to estimate the synthetic control unit that matches the unit under study as closely as possible during the pre-event period. In the post-event period, any differences between the unit under study and the synthetic control unit are attributed to the event or policy intervention.

Estimation using the synthetic control method has several advantages over other methods. First, it provides a systematic way to build a counterfactual comparison unit when there is no real-world close counterpart. Second, the "goodness of the fit" for a synthetic control is not subjective; it is a numeric measure of how closely the synthetic unit follows the actual unit. Third, it uses macro-level data which have less noise compared to the micro-level data used by difference-in-differences models. Fourth, it relaxes the assumption of a similar difference (parallel path) between the treated unit and the control in the absence of treatment. Fifth, compared to the comparative study

approach, whose results are descriptive and qualitative, the synthetic control method produces quantitative results, which are more reliable and meaningful.

3.3.1. The Synthetic Control Method

Here is an overview of the synthetic control method: suppose there are J potential comparison units in the donor pool. The donor pool includes countries with similar economic structures to the country under study. The synthetic control method requires a panel data setting consisting of several observations of the treated unit and potential comparison units before and after the event of interest. Suppose there are T_0 periods of observation before the event, and T_1 periods of data after the event, where both T_0 and T_1 are positive numbers. Let $T = T_0 + T_1$.

Our data includes the outcome variable we are interested in, GDP per capita, and several other related variables—let's call them GDP predictors or covariates. Assume that X_1 is a $(K \times 1)$ vector including the values for K pre-event characteristics of Iran. Assume X_0 is the $(K \times J)$ matrix including the values of the same predictors for the units in the donor pool. The pre-event characteristics of the unit of interest, Iran, can be more closely replicated by a combination of the control units (donor pool) than by any one single control unit. Using GDP per capita and GDP predictive covariates, the synthetic control method builds a fitting counterfactual for our unit of interest, Iran. The synthesized counterfactual unit is defined as a weighted average of untreated similar units (the donor pool) and is called the synthetic control unit. Weights can be constructed as the $(J \times 1)$ vector $W = (w_2, \dots, w_{j+1})$ where w_j represents the weight assigned to unit j . Each choice of W results in a different synthetic control Iran. The synthetic control method limits the weights to $0 \leq w_j \leq 1$ and $\sum w_j = 1$ for $j = 2, \dots, J + 1$. These restrictions guarantee that the synthetic Iran will be a convex combination of the countries in the donor pool. Therefore, no extrapolation will occur. Following Mill's Method of Difference, the synthetic control method chooses W such that the characteristics of synthetic control Iran fit the actual experience of Iran before the event: $X_1 \approx X_0 W^*$. In reality it is not possible to find W^* such that $X_0 W^*$ fits X_1 precisely. The gap between the characteristics of the unit of interest and the synthetic one is measured by $X_1 - X_0 W$. The synthetic control method includes an optimization procedure to find W^* , where $X_1 - X_0 W^*$ is minimized.

Since GDP predictors vary in their predictive power, another set of weights is required. Assume V is a $(K \times K)$ symmetric and positive semi-definite matrix. For simplicity, let V be diagonal. For each diagonal value of V , v_k is a weight assigned to the corresponding predictor. The covariates with greater predictive power are assigned higher weights. If V is diagonal with a main diagonal equal to (v_1, \dots, v_k) , then W^* is equal to the value of W that minimizes equation $(X_1 - X_0 W)' V (X_1 - X_0 W)$ (1) subject to $0 \leq w_j \leq 1$ and $\sum w_j = 1$ for $j = 2, \dots, J$. Matrix V can be chosen by the researcher subjective to her prior knowledge of the relative importance of the predictors. The choice of V influences the optimum value of W^* , alternately expressed as $W^*(V)$. Another option is to choose $V = I$, changing equation (1) to minimize the norm of $X_1 - X_0 W$. However, this option results in less appropriate predictors of the GDP path.

Assume Y_{jt} is the outcome variable for unit j at time t , where $j = 1$ refers to Iran. $Y_1(T \times 1)$ includes the value of Iran's GDP per capita. Matrix $Y_0(T \times J)$ includes the values of GDP per capita of the donor pool during the same period. By fitting the output variables for the synthetic and actual GDP of Iran, we control both the unobserved factors and the heterogeneity of the effect of the observed and unobserved factors on the outcome of interest, real GDP per capita. The choice of V is data driven: The synthetic method includes a built-in numerical routine to choose optimum values for V , such that the real GDP per capita of the synthetic output is fitted to the real GDP per capita of actual Iran before imposition of the sanctions, $Y_1 = Y_0 W^*(V)$, where $t \leq T_0$. V is chosen so that, for the pre-treatment period, the outcome variable's mean square error is minimized. This approach takes into account the information available in our data about the known determinants of GDP. Scale changes in (v_1, \dots, v_k) do not affect W , so these weights can always be normalized so that they sum to one.

Remember that Y_{jt} is the outcome variable, GDP per capita, for unit j at time t , where $j = 1$ refers to the unit of study, Iran. The goal of the synthetic control method is to estimate the trend of output of interest, Iran's GDP per capita, in the absence of the sanctions imposed in 2010. This counterfactual Iran is called the synthetic Iran and is calculated as $Y_1^* = Y_0 W^*$. The GDP gap between Iran's actual GDP, Y_1 , and the GDP of synthetic Iran, Y_1^* , is a measure of the cost of sanctions at the aggregate level: $Y_1^* - Y_1$.

Abadie, Diamond and Hainmueller (2015) compare the synthetic control method with regression analysis and show that both approaches utilize the linear combination of control units with weights that sum to one. In regression analysis, there is no restriction on the coefficients. On the other hand, weights assigned by the synthetic method are limited to be between zero and one. Therefore, regression allows for extrapolation beyond what the data support. The choice of weights in the synthetic method guarantees that the constructed control unit remains inside the set of convex combinations of the donor pool.

Inferential methods cannot be used here because of the small and non-random nature of the data. Abadie, Diamond and Hainmueller (2015) propose other methods of “informative” inference or “falsification”. These methods are discussed in the results section.

3.4. Data

Data for this work are taken from the World Development Indicators of the World Bank. The data set includes annual country level panel data for the period 1998-2014. The new wave of sanctions started in 2008, was amplified in 2010, and again in 2011. The data begins in 1998, providing ten years of pre-event data. Including data from before 1998 does not improve the fit of the model. The model ends in 2014, because data for 2015 are not completely available.

The economic indicator used to measure the impact of the sanctions is real GDP per capita, Purchasing Power Parity (PPP)-adjusted and measured in constant 2011 international dollars). The

explanatory variables are chosen from the standard set of economic growth indicators used in the literature, plus the rent from natural resources. Following Abadie, Diamond and Hainmueller (2015), all the explanatory variables are measured as their share of GDP: gross capital formation (%GDP), agriculture value added (%GDP), services value added (%GDP), manufacturing value added (%GDP), and total natural rents (%GDP). In addition to the standard predictors of economic growth discussed above, I use data from Human Development Index (HDI), such as life expectancy at birth, total (years), as measures of human capital related to the health of the population.

Estimation of the synthetic Iran requires a set of potential control units or donor pool. This donor pool is used to construct a synthetic control Iran that best reproduces relevant economic characteristics of Iran in the absence of the new waves of the sanctions that started in 2008. The comparison units are chosen from the resource-rich countries that experienced smooth economic growth during the decade of 1998-2008, like Iran's economic trend and Iran's GDP per capita. The donor pool used here is Algeria, Australia, Brazil, Chile, China, Colombia, Ecuador, Indonesia, Kazakhstan, Malaysia, Russia and Uzbekistan. Kuwait, Iraq, Egypt, Tunisia, and Libya were dropped from the donor pool because they experienced war or social unrest during the period between 1997 and 2014. Venezuela was dropped because it experienced economic crises through the period of interest. Saudi Arabia, Bahrain, and Qatar experienced ups and down in their GDP per capita. Therefore, they do not provide a match for Iran's economic trend.

3.5. Results

A synthetic Iran built as a convex combination of donor countries that reproduces the economic evolution of Iran in the absence of the sanctions started in 2008 is presented here. Table 1 contains the pre-sanctions values of the variables associated with GDP predictors, for the actual Iran, the synthetic Iran and the average of potential control countries, for the years prior to 2008. Table 1 suggest that the synthetic Iran provides a much better comparison for Iran than the average of the "donor pool" countries. The synthetic Iran is similar to the actual Iran in terms of pre-2008 per capita GDP. The synthetic Iran provides the closer fit for Iran, although the characteristics cannot be perfectly matched.

Table 3.1. Economic Growth Predictors Means before Imposition of the Sanctions in 2008

	Iran	Synthetic Iran	Average of the Donor Pool
Total Natural Rent (% of GDP)	24.59	9.59	10.31
Industry (% of GDP)	42.63	42.08	37.20
Agriculture (% of GDP)	8.29	9.03	10.85
Service (% of GDP)	49.08	49.09	51.95
Life Expectancy of Female	72.31	75.64	74.70
Gross Capital Formation	37.12	29.78	23.99
GDP per Capita Growth	3.80	5.59	3.75
GDP per Capita in 1999	11383.33	11452.00	11107.03
GDP per Capita in 2006	15207.27	15425.09	14619.69

Source: World Development Indicators, World Bank.

As mentioned before, the synthetic control method equips qualitative researchers with a quantitative tool to select the best fitted comparison units. Here, China, Algeria, Kazakhstan, Australia, Chile and Brazil emerge, in this order, as potential comparison units for Iran. Table 2 displays the weight of each control country in synthetic Iran. China and Algeria are the most similar control countries together they account for more than fifty percent of synthetic Iran. All donor states not mentioned in Table 2 are assigned zero weight.

Table 3.2. Country Weights for the Synthetic Control Iran

Country Name	Weight
China	.322
Algeria	.213
Kazakhstan	.149
Australia	.131
Chile	.107
Brazil	.079

Figure 3.1 plots GDP per capita for actual and synthetic control Iran for the period 1997–2014. Actual Iran and its synthetic control behave similarly before the imposition of the first round of the sanctions in 2008 and follow similar paths until 2011, providing evidence that Iran’s economy did not suffer much from the sanctions in the first three years.

Figure 3.1. Trends in per capita GDP, Iran versus Synthetic Iran.

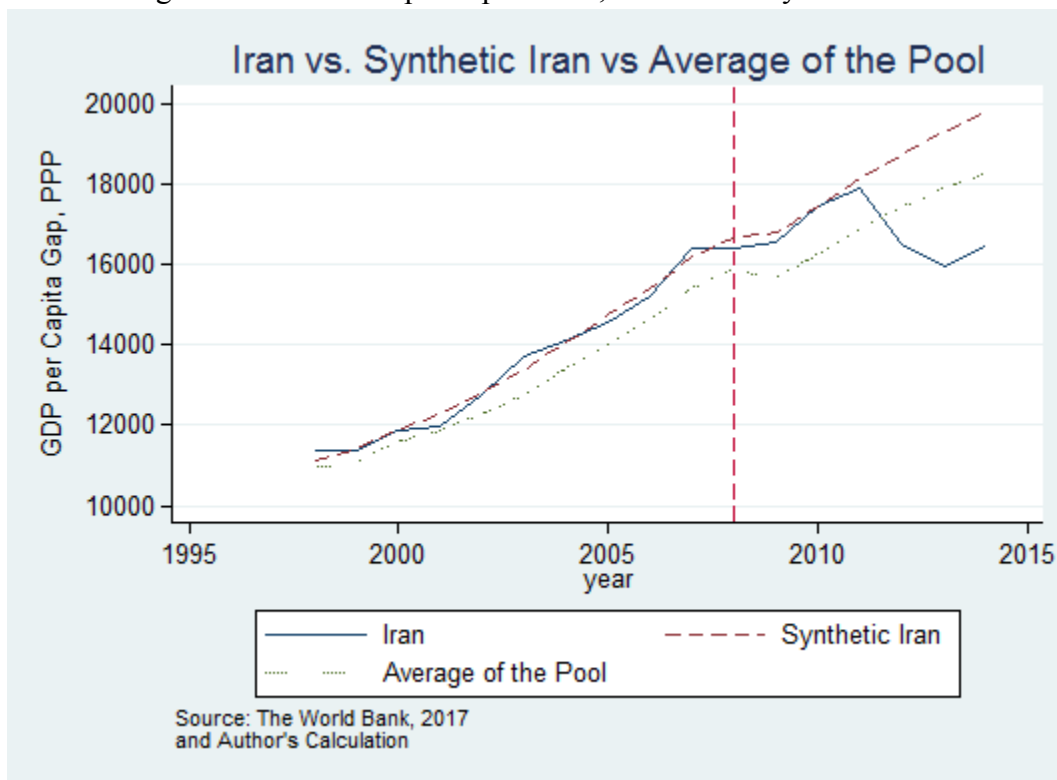
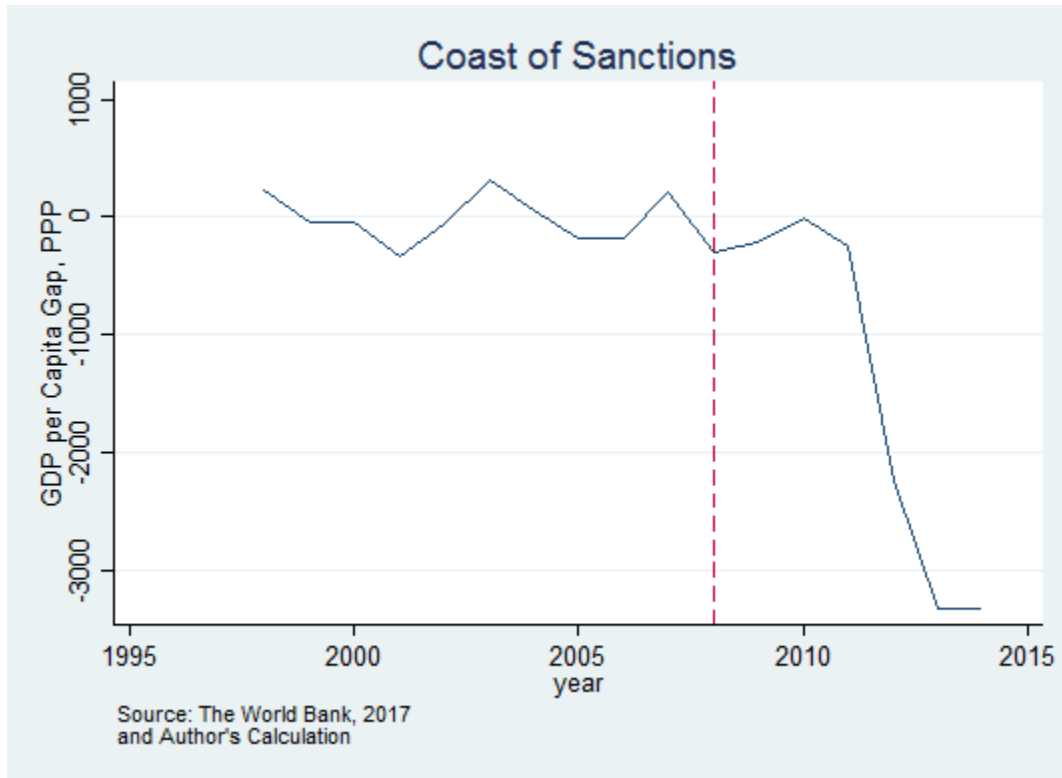


Table 3.1 verifies that the estimated counterpart of Iran closely matches the growth predictor of Iran and Iran per capita GDP before the sanctions. Figure 1 shows the trend of per capita GDP for Iran and its estimated synthetic counterpart. The black line represents the Actual Iran and the dash line represents estimated per pita GDP for synthetic Iran. The dotted line represents the average of the donor pool. It is notable that both actual Iran and synthetic Iran suffer very little from the global financial crisis that began in 2008.

From 2008 until 2011, the sanctions have no significant impact on Iran per capita GDP. The main customers of Iran's oil, China and India, did not participate in the sanctions. From 2011, when sanctions became a large-scale phenomenon as the financial restrictions took effect, Iran's per capita GDP and its counterpart follow different paths. After 2011, the synthetic Iran continues to grow at a pace like the period before the sanctions while actual Iran per capita GDP rapidly declines until 2013. The small increase in 2014 is not enough to decrease the size of the resulting gap. Per capita GDP of Iran falls \$2235.56 to \$3319.17 (PPP international dollars) below synthetic Iran in 2012-2014. Overall, Figure 3.1 suggests that the maximum loss in per capita GDP happened in 2013. In 2014, as the result of presidential election and change in Iran's foreign policy, new waves of negotiation are started. The small improvement that is observed in per capita GDP in 2014 can be counted as the result of the optimism about the negotiations.

Figure 3.2 shows the estimates of the per capita GDP gap given by the difference between actual Iran and its synthetic counterpart. The estimated gap is negligible for the first three years immediately following the imposition of the sanctions. The gap in per capita GDP is between 13 to 20 percent of actual per capita GDP in 2012–2014.

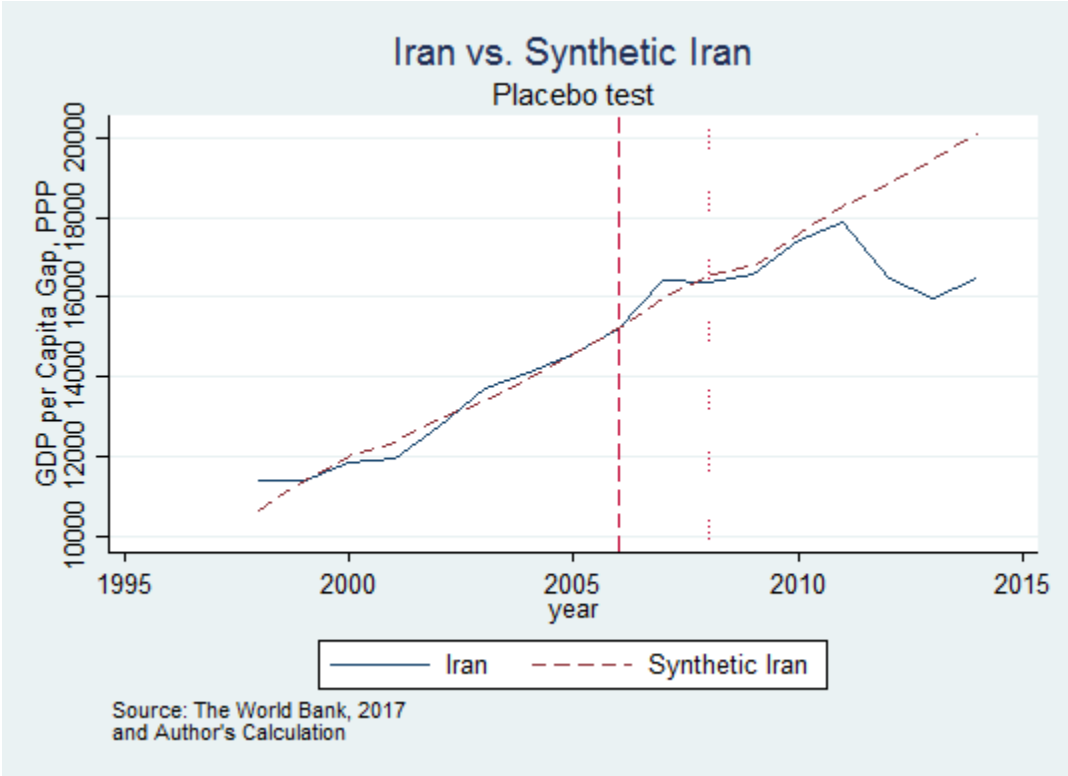
Figure 3.2. Estimated change of the per capita GDP



To assess how reliable our results are, Abadie, Diamond and Hainmueller (2015) suggest implementing “falsification exercises”: two series of placebo tests. The first placebo test is called an in-time placebo which means applying the synthetic method to a time other than imposition of the sanctions. We expect the synthetic and actual Iran GDP per capita continue the similar trends before actual imposition of sanctions in 2008 happens. If a substantial gap resulted earlier than the imposition of sanctions in 2008, the estimated cost of the 2008 sanctions shown in Figure 1 will merit less confidence. Feasibility of the “in-time placebo” test depends on availability of data for a sufficiently large number of time periods before the event of interest and the absence of structural shocks to the economy of interest and the donor pool. To conduct the in-time placebo study, I rebuilt the model for the case when it is assumed that sanctions were imposed during the pretreatment period in the year 2006, 2 years earlier than sanctions actually occurred. All other variables are adjusted for the period 1998-2004. Figure 3.3 shows the results of this “in-time placebo” study. The synthetic Iran follows the evolution of per capita GDP in the actual Iran for the 1998–2006 period, and the 2005 placebo imposition of the sanctions makes no noticeable difference to outputs of interest. Most importantly, per capita GDP of Iran and its synthetic

counterpart continue the same similar trend during the 2006–2008 period. The projection of GDP per capita after 2008 closely matches the one presented in Figure 3.1. The in-time placebo verifies that the estimated gap in Figure 3.2 reflects the impact of the sanctions and did not result from a lack of predictive power of the synthetic control. Similar in-time placebo studies assuming 2005 and 2007 as the time of the imposition of the sanctions lead to similar results.

Figure 3.3. Trends in per capita GDP, Iran versus Synthetic Iran, in-time placebo test.



There is another way of performing placebo test, which is called “in-space placebos.” This test applies the synthetic control method iteratively to every unit in the donor pool and measures the treatment effect. As other countries are not impacted by the similar sanctions, we expect to observe similar paths of output for the actual and synthetic counterparts of the control units, assuming the existing donor pool provides good estimates for all countries in the pool. Figure 3.4 shows the estimated per capita GDP gap for Iran and the placebo gaps, or the treatment effect, for all the control units. The black line represents the estimated per capita GDP gap between Iran and its synthetic counterpart. The estimated per capita GDP gap between each control state and its synthetic counterpart is shown by the grey lines.

Figure 3.4. In-Place Placebo test: Estimated per capita GDP Gap.

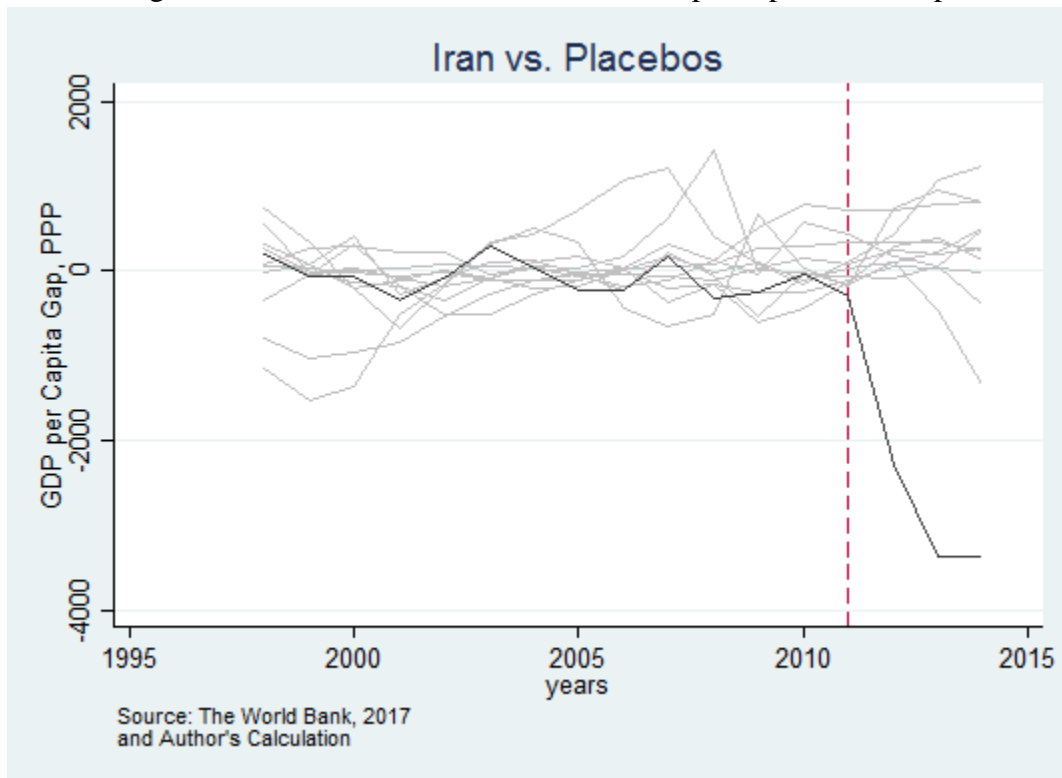
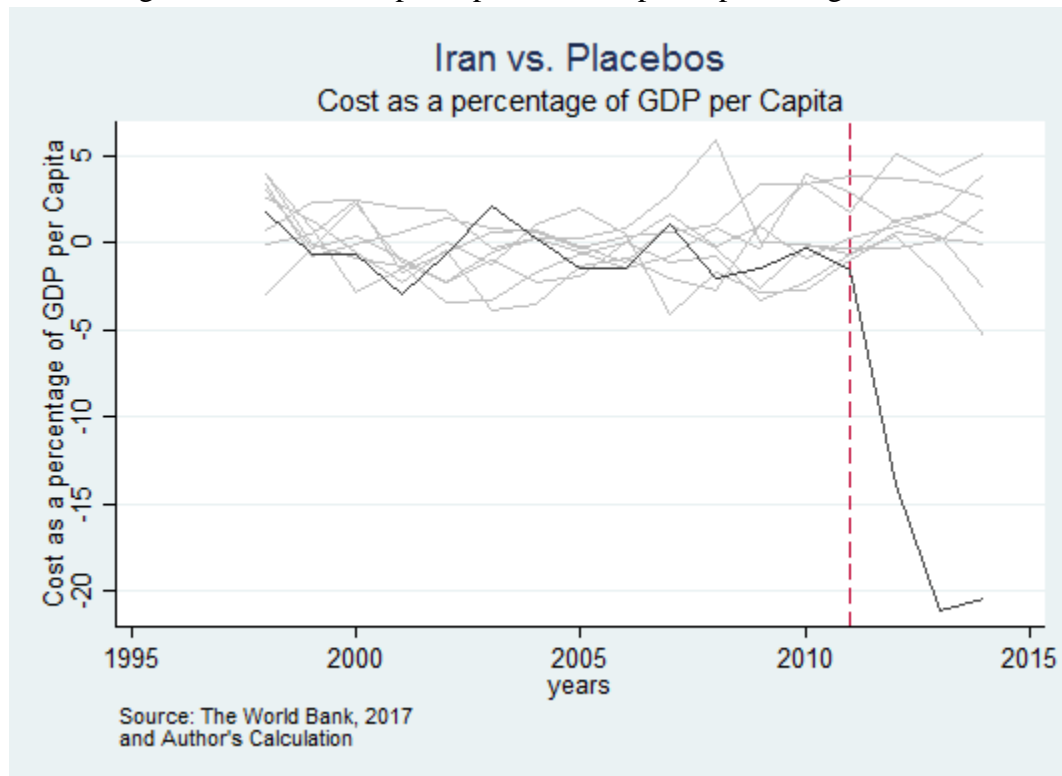


Figure 3.4. illustrates that, with a few exceptions, the synthetic control method provides a good fit for Iran and many of the control states prior to the sanction period at 2008. The goodness of the fit in 1996-2008 period is measured by the pre-treatment root mean squared prediction error (RMSPE), which equals 193.67 for Iran. The average of the pre-treatment RMSPEs for control states in the placebo is 297.50, which represents reasonably acceptable pre-treatment fits. The pre-treatment RMSPEs for two countries are pretty high, indicating that their synthetic counterparts provide weak replication and not close fits. The highest RMSPEs belong to Kazakhstan, 961.15, China, 619.85, and Australia, 477.36. While most of countries in the world were impacted negatively by the 2008 financial crisis, these countries continue to grow. China and Kazakhstan are countries with exceptionally high growth rates after 2008. Australia's growth is low, but compared to the rest of the OECD countries, its trend is exceptional. Since the in-place placebo is not able to replicate the per capita GDP for countries like China and Kazakhstan before 2008, the estimated gap after 2008 is not also reliable. As Abadie, Diamond and Hainmueller (2015) note, "placebo runs with poor pre-treatment fit do not provide information to measure the relative rarity of estimating a large post treatment gap for a state that was well fitted prior to treatment." Thus, I drop placebo runs for these three countries with pre-sanction RMSPEs more than two times the pre-sanction RMSPE for Iran. Fig 5 shows the estimated gap from dropping the controls with poor

pre-treatment fit. The gap is shown as a percentage of the actual per capita GDP. It is clear from Figure 3.5 that the estimated per capita GDP gap for Iran is larger (negatively) than the estimated per capita GDP gaps for any of the control states.

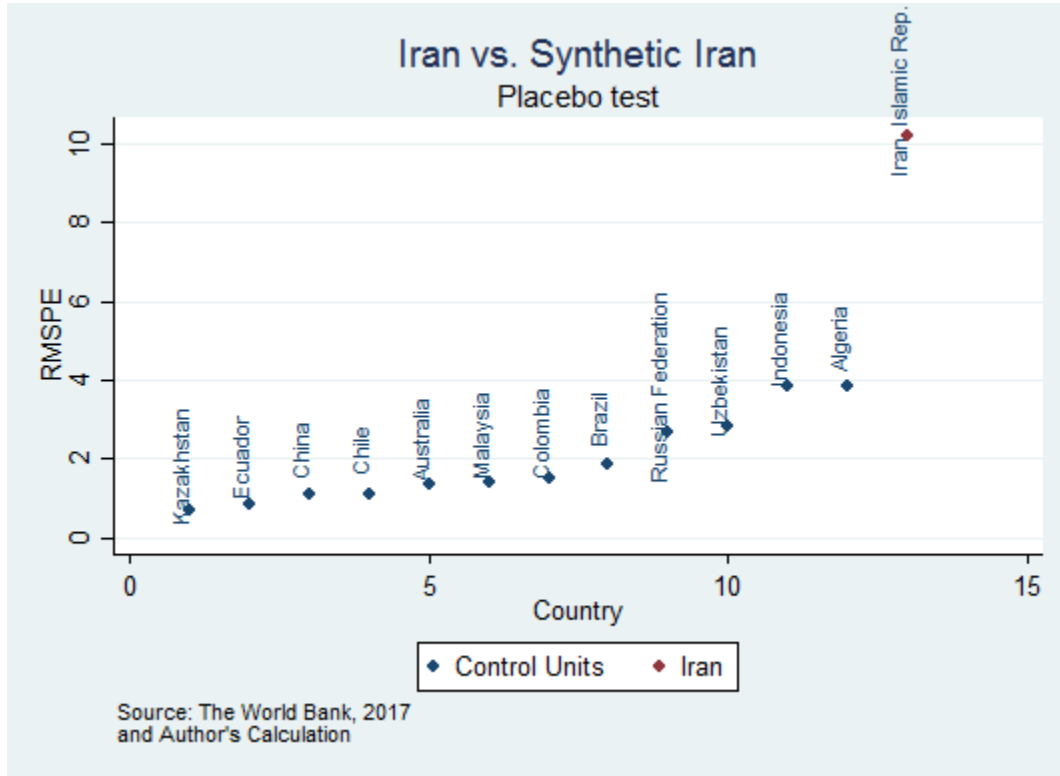
If in-place placebo tests resulted in estimated GDP per capita gaps for other control units comparable to the size of the impact on Iran, there would be no evidence that reduction in per capita GDP was the cost of the sanctions, and our result in Figure 2 would merit no confidence.

Figure 3.5. Estimated per capita GDP Gap as a percentage of GDP.



Another way of checking the significance of the estimated impact of the sanctions on Iran is to examine the ratios of the post-sanctions RMSPE to the pre-sanctions RMSPE. A poor pre-event fit leads to small ratios. Therefore, the post-event RMSPE to pre-event RMSPE ratio provides another measure of the goodness of the fit. Figure 6 reports the ratios of the post-2008 RMSPE to the pre-2008 RMSPE for Iran and for all the countries in the donor pool: the ratio for Iran is clearly higher than all the control units.

Figure 3.6. Ratio of the post-2008 RMSPE to pre-2008 RMSPE.



While the usual statistical inference is not possible due to the small and non-randomly selected dataset, Abadie, Diamond and Hainmueller (2015) suggests using the result of the in-place placebo test to fabricate a p-value. Remember that the output gap between the paths of the actual and synthetic unit counts as the treatment effect. The in-place placebo test provides a distribution of treatment effect in the absence of the treatment. It can be used to compare the estimated impact of the sanctions imposed on Iran to the distribution of placebo effects obtained for other countries. This distribution is used to construct a p-value as the fraction of such effects greater than or equal to the effect estimated for the treated unit. This p-value serves as the probability of getting a treatment effect at least as large as the estimated cost of the sanctions in Iran when the intervention is reassigned at random in the data set (the in-place placebo test). We will become less confident in validity of the estimated effect of the sanctions imposed on Iran economy if the calculated p-value is large. When using all the countries in donor pool, the probability of estimating effects greater than or equal to the effect estimated for Iran is 1 out of 13. This is not the traditional p-value calculated using the distribution.

Here I suggest another approach to construct a synthetic p-value based on the distribution of the gaps resulted from the in-place placebo test. Using the estimated gaps in each year after 2008, I

calculate the sample mean and standard error, which used to calculate the t-test and p-value listed in Table 3.3.

Table 3.3. P-value of the Estimated per Capita GDP Gap

	2008	2009	2010	2011	2012	2013	2014
p-value	0.0132	0.0410	0.3339	0.0009	0.0000	0.0000	0.0000

3.6. Conclusion

In this paper, I explore the effect of economic and financial sanction on per capita GDP in Iran. The rationale of sanction policies claims that a sufficiently high cost of sanctions results in requested change of policy in the target country. The Iran economy had been the target of more than thirty years of various sanctions, yet the sanctions of 2008 are the first time that sanctions led to a serious policy change by Iran government. The basic question is how high was the economic cost of sanctions? Simply comparing the Iran's economic performance after and before the sanctions neglects the economic growth that would happens in the absence of the sanctions. Also, comparison with other countries in post-sanctions era does not provide good evidence for the impact of the sanctions on the economy, since there are other pre-sanction differences which affected the economy as well. In the absence of a perfect comparison unit, I address this problem by comparing the economic evolution of Iran during the post-sanctions era with its synthetic counterpart.

Using GDP per capita and GDP predictive covariates, the synthetic control method builds a fitting counterfactual for our unit of interest, Iran, as a convex combination of comparison units that are similar to Iran's economy in terms of covariates traditionally used in the literature and pre-treatment realizations of the outcome variable. The estimated counterfactual is called "synthetic" Iran, representing Iran's experience without the experience of sanctions. The GDP gap between actual and synthetic Iran provides the measure of the cost on an aggregate level. The cost of the sanctions estimated by using two sets of donor pool countries and is verified by a series of falsification exercises.

I find that sanctions have insignificant costs in early stages, but as sanctions intensified in 2010 the per capita GDP fell substantially. The per capita GDP decreased by \$2,282 (PPP international dollars) in 2012 and by \$3,370 in 2013 and 2014. In other words, Iran's per capita GDP decreased by 13 to 21 percent during 2012-2014 period.

I built a synthetic p-value, using the distribution of the gaps that resulted from the placebo test. Using the synthetic p-value enables us to understand the significance of the estimated gap in terms similar to those of other estimation methods used in the literature.

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3.8. Appendix.

Table 3.4. RMSPE's Before and After the 2008, and the Ratio.

Country Name	RMSPE_Before	RMSPE_After	After to Before Ratio
Iran	196.5112	2007.342	10.2149
Malaysia	196.2529	277.188	1.412402
Australia	477.3609	636.2556	1.332861
Russian Federation	284.5152	760.5114	2.673008
Brazil	173.8138	320.6641	1.844871
Chile	317.4858	350.8154	1.10498
China	619.8557	678.7656	1.095038
Colombia	147.2552	217.8359	1.479309
Ecuador	183.546	158.6694	0.8644665
Uzbekistan	61.80729	173.4568	2.806413
Indonesia	73.45061	284.0826	3.867669
Algeria	73.45061	284.0826	3.867669
Kazakhstan	961.1506	662.0729	0.6888337