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The Effect of International Sanctions on the Size of the Middle Class in Iran*

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Abstract

This study examines the impact of international economic sanctions, imposed on Iran due to its nuclear program, on the development of the middle class. Specifically, it investigates how the middle class in Iran would have developed in the absence of these sanctions post-2012. To address this question, we employ a synthetic control model to create a counterfactual scenario for Iran, using a weighted average of other comparable countries that mirror pre-sanction Iran, but did not experience significant international sanctions. By comparing the middle-class size of this counterfactual Iran with the actual Iran that faced major economic sanctions, our results indicate that the annual middle-class size would have been approximately 11 percentage points larger, on average, without the post-2012 sanctions. Our findings are robust across various tests, including placebo tests and synthetic difference-in-difference analyses. The latter analysis shows that the estimated average effect of sanctions on the middle-class size of Iran from 2012 to 2019 is highly statistically significant. Finally, we provide evidence on the relevance of real GDP per capita and merchandise imports as key selected channels through which sanctions negatively affect the size of the middle class.

Keywords: Sanctions; Iran; Middle Class; Poverty; Inequality; Synthetic Control Method; Counterfactual

JEL classification: F51; I31; P36

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1. Introduction

The middle class has acquired a sacred position in Western nations and the emerging market economies alike. It is valued for many positive economic and social attributes that are essential for sustained economic progress and socio-economic stability. As a result, it enjoys a strong political status in democratic societies and politicians often present themselves as the guardians and servants of the middle class. If a country is successful in the development process, it will experience a strong transition of its poor and low income population into the middle class category (Kharas and Gertz 2010). The emergence of the middle class, in turn, contributes to sustainable development and technological progress in several ways such as increasing entrepreneurship and innovation, pro-development values with respect to education and market diversification (Banerjee and Duflo 2008; Chun et al. 2017; Pleninger, de Haan, and Sturm 2022). Beyond the positive association between development and middle class expansion, a sizable middle class is crucial for balancing the demands of the wealthy and the poor within a society. Without this middle ground, the lack of compromise between extremes can lead to political and social conflict (Feng 2003, p.59).

Our focus in this study is on the development of the middle class in Iran under international economic sanctions. How have economic sanctions imposed on Iran by the US, European Union, and their allies, after 2012, shaped the size of middle class in Iran? Addressing this question needs a counterfactual Iran which has been similar to Iran in terms of the size of its middle class before the 2012 sanctions as well as some other socio-economic and institutional characteristics. Using this counterfactual scenario, we are able to trace and measure the effect of sanctions on the consumer class of Iran. To draw this causal conclusion, we employ a synthetic control methodology for the period of 1996-2019.[1] This timeframe provides ample data before the 2012 international sanctions, allowing for the construction of a counterfactual Iran.

Figure 1 illustrates the development of the middle class share of the total population in Iran from 1996 to 2019. We observe a continuous increase in the size of the middle class in Iran since the early 1990s, following the end of the war with Iraq. However, this growing trend

[1] The case study of Iran has attracted more attention in the sanctions literature since it is one of the most sanctioned countries. Quantitative case studies of Iran often rely on methods such as vector autoregressive analysis, which use historical dynamics among included variables to simulate the response of specific variables to shocks in proxies of economic sanctions (e.g., Dizaji and Bergeijk 2013). In these simulation approaches, we lack counterfactual analysis and thus may not be able to address questions such as what could happen in the absence of sanctions.

halted and began to decline during the period of international economic sanctions imposed on Iran due to its nuclear program activities. Besides the economic sanctions, other factors may also have contributed to this change. To what extent were the sanctions responsible for this decline?

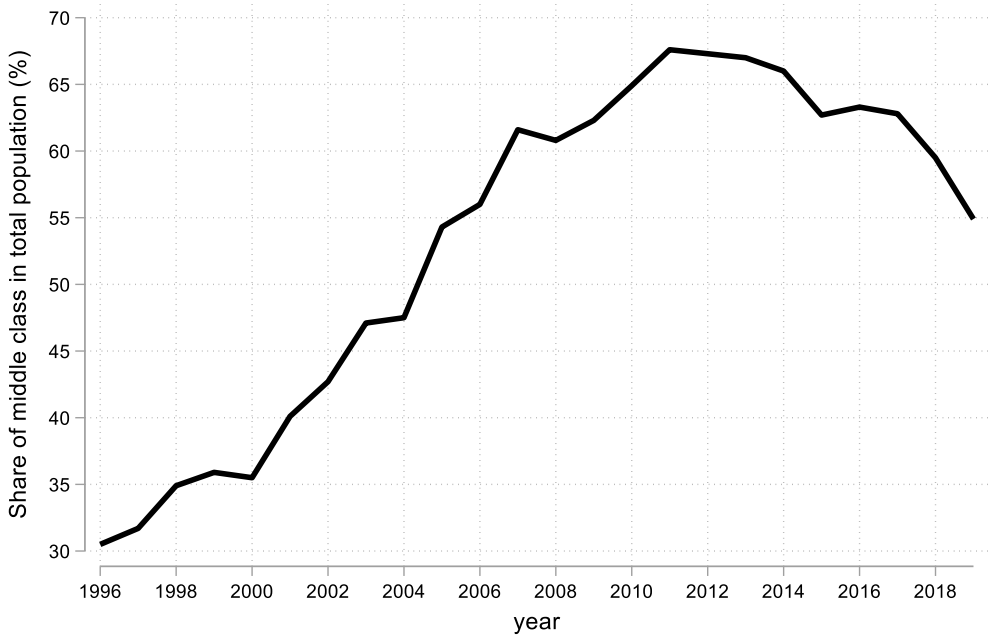

Figure 1. Iran's middle class as a percentage of total population
Note: Middle-class variables estimate the number of people living in households earning or spending between $11 and $110 per person per day (2011 $ purchasing power parity (PPP) prices) and are taken from Kharas (2017).

Our goal is to understand how the Iranian middle class might have developed in the absence of the major economic sanctions that were introduced starting in 2012, and to identify the independent effects of these sanctions on the middle class. This is a challenging task because some socio-economic factors that led to the sanctions (e.g., economic and political conditions) may also have influenced subsequent changes in the development of the middle class in Iran. As noted by Holland (1986), one of the main problems of causality analysis is that the unit of intervention cannot exist without the specific treatment. In other words, it is impossible to observe our unit of interest both with and without the treatment simultaneously. Therefore, the challenge in causal analysis is to estimate a synthetic unit that best replicates the factual unit of interest under treatment.

Our approach, based on the synthetic control method (SCM) introduced by Abadie and Gardeazabal (2003), helps to construct a counterfactual Iran that is similar to the real Iran but does not experience major sanctions. Using the SCM approach, we quantify the magnitude of the middle-class size lost due to the sanctions. We also explore the possible reasons behind the

estimated effect, thereby contributing to our understanding of the impact of sanctions on the middle class.

The study is structured as follows: Section 2 provides a brief overview of the major international economic sanctions imposed on Iran and their impact on the middle class. In Section 3, we describe the data and methodology used in the study. Section 4 presents the main results. Section 5 discusses these results and examines selected channels (real GDP per capita and merchandise imports) through which sanctions may impact the size of the middle class. Finally, we conclude the paper in Section 6.

2. Sanctions on Iran and their Implications for Development of the Middle Class

2.1. A brief overview of the major economic sanctions: The international economic sanctions against Iran gradually became more potent after 2012 due to several important developments (Laub 2015). First the U.S. adopted more comprehensive sanctions that targeted Iran's entire financial system and oil exports. This was achieved by the introduction of extraterritorial and secondary sanctions against non-U.S. firms that did business with Iran. Second, the Obama administration reinforced this initiative by imposing extraterritorial sanctions on purchase of Iranian oil and investment in Iran's energy sector (Schmidt 2022). Third, the European Union adopted similar measures, which included a ban on transactions with the Iran Central Bank and all commercial banks. During 2012, both the United States and European Union strengthened the financial and energy sanctions against Iran, without any significant challenge by China (Morris 2012) or Russia (Katz 2012).

The key economic indicators show that the Iranian economy suffered strong adverse macroeconomic shocks after 2012 as these sanctions reduced the oil export revenues sharply and disrupted trade and investment in all sectors of the economy (Azarbayejani, Tayebi, and Safa Dargiri 2015; Dizaji and Farzanegan 2024; Ghomi 2022). The oil exports were not only reduced under these sanctions, but the government was not even able to repatriate the export revenues because of the financial sanctions. Furthermore, the severe sanction regime that reached its peak in 2012 continued with minor oscillations in the years that followed. Even after some of the sanctions were diminished in 2016 following the nuclear agreement, Iran was not able to fully benefit from these changes because many private firms in Asia and Europe were reluctant to conduct business with Iran, for fear of being punished financially by the U.S. government (Heydarian, Pahlavani, and Mirjalili 2022). The limited sanctions relief that was achieved after the nuclear agreement, was eliminated when Donald Trump left the agreement

and launched a new round of maximum pressure sanctions in late 2017 (Aslan, Aslan, and Rashid 2020). Many U.S and international sanctions remain in effect as of 2024. After comparing the severity and scope of the economic sanctions in various periods we concluded that 2012 was the effective year for the new era of severe sanctions that have affected the economy of Iran ever since.

2.2. Impact of sanctions on the middle class: The impacts of economic sanctions on economic growth and macroeconomic stability in Iran and other countries have been addressed in many academic studies in recent years but their impact on economic inequality and the economic conditions of various income groups has received less coverage (for a survey on studies related to Iran see Farzanegan and Batmanghelidj 2023 and for cross country studies see, for example, Neuenkirch and Neumeier 2015; Gutmann, Neuenkirch, and Neumeier 2021; 2023; Liou, Murdie, and Peksen 2021; Peksen 2009). Furthermore, the limited studies that are available focus primarily on the impact of the economic sanctions on the relative income of various income classes (Afesorgbor and Mahadevan 2016).

In this section we offer a conceptual framework for how the comprehensive sanctions can affect the size of the middle class in a middle-income oil exporting economy such as Iran. We believe that, during 2012, the sanction regime against Iran changed from targeted economic sanctions against specific sectors to comprehensive sanctions that were intended to affect the entire economy in order to intensify the economic and political pressure on the state. As a result, the impact of sanctions was felt in many economic sectors and affected a broad range of people.

Comprehensive and intense economic sanctions can impact the size of the middle class through several channels. First, effective macro-level sanctions that reduce the GDP and per capita income will ultimately lead to downward mobility of some middle-class households. This is particularly the case for our analysis because we use a fixed income bracket ($11 to $111 per day (PPP)) to measure the size of the middle class. While a small number of upper-class households might enter the middle class as their per capita income falls below $111, because of the sanctions, their number will be much smaller than the middle-class households that will be shifted into the lower class (Cantó and Ruiz 2015) as their incomes fall below the lower threshold of $11 per day.

The second channel is through the impact of sanctions on the labor market. These comprehensive sanctions have affected the labor market for Iran’s middle class wage earners in two ways. First, the sanctions have resulted in the reduction of employment in manufacturing

and other industries that rely heavily on imports (Moghaddasi Kelishomi and Nisticò 2022). Second, they have reduced the real wages for a large segment of workers and retirees. This is especially the case for fixed salaried employees in both private and public sectors (Salehi-Isfahani 2023). By causing a sharp reduction in the government's oil export revenues the sanctions have resulted in large budget deficits that, in turn, have resulted in record high inflation rates and declining real wages. While traditionally the public sector wages have kept pace with the inflation rate, they began to fall behind in 2012 and have continued since. The pensions of many retirees have also declined in real value after adjustment for inflation and as a result a growing segment of the retirees have dropped down from the middle class to the lower class (Barardehi, Milani, and Soltani 2024).

The third channel is the impact on the international trade linkages of the business sector. The sanctions have disrupted the imports of many intermediate goods and natural resources, causing financial stress for many firms (Ebadi 2022). These disruptions have not only affected many large manufacturing enterprises, but also thousands of small and medium sized enterprises that sell their goods and services to the larger firms (through backward linkages.)[2] As a result, some workers, and middle-class entrepreneurs (small business owners) have also suffered a downward mobility into the lower-class category. The business bankruptcies have also contributed to a rise in inequality as some state-owned enterprises and well-connected private businesses have stepped forward to purchase the bankrupt businesses (Rizvi 2012).

The fourth transmission channel is the adverse impact of sanctions on the quality of governance and efficiency of government services that matter for economic activity. In order to avoid or bypass these sanctions, the government of Iran has resorted to the creation of front companies and the recruiting of some middlemen to disguise the Iranian origin of its international transactions (Habibi 2012). These inefficient mechanisms have paved the way for a rise in corruption and a significantly higher cost of trade, which has had an adverse effect on economic activity. There have been several discoveries of large-scale embezzlements and loss of large amounts of public funds in these clandestine dealings (Farzanegan and Zamani 2024; Gordon 2013). The government has also had to give a more prominent role to the Islamic Republic Revolutionary Guards (IRGC) in the management of government ministries and public enterprises, because of the IRGC's active role in counter-sanction activities. These steps have

[2] To learn more about the business strategies adopted by Iranian SMEs under sanctions, see Cheratian et al. (2023).

resulted in an increase in nepotism, corruption, and inefficiency (Salehi-Isfahani et al., 2024, p.77).

3. Data and Methodology

3.1. Data

Outcome variable: middle class

Our focus is on the size of the middle class as comprising those households with per capita incomes between $11 and $110 per person per day (PPPD) in 2011 PPP terms (Kharas 2017). The basis for this definition is the Weberian idea that households need to have a certain minimum level of economic security to be classified as middle class (Wietzke and Sumner 2018). Kharas (2010, pp. 11–13) discusses the advantages of this absolute approach to measuring the size of the middle class, compared to the relative measures used by others. Loayza, Rigolini, and Llorente (2012) also argue that the absolute measure is more promising for developing countries. They, along with Milanovic and Yitzhaki (2002), suggest using a lower bound of $10 per capita per day to distinguish the middle class from those struggling near the poverty line. Birdsall (2010) similarly defines the middle class in the developing world as including individuals living on the equivalent of $10 a day or more in 2005, but at or below the 95th percentile of their country's income distribution. According to Birdsall, this implies an absolute global threshold ($10 a day), below which individuals are too poor to be considered middle class in any society within today’s globally integrated economy, and a relative local threshold (the 95th percentile), above which individuals are considered "rich" within their own society. Birdsall offers several arguments for using these absolute lower and upper bounds to define the middle class in developing countries.

To estimate the size of the middle class globally, Kharas (2017) examines the numbers and spending levels of the middle class in each country. This analysis is based on household surveys, which provide income distribution data, and national accounts, which offer average household expenditure per person. These estimates can illustrate the evolution of the middle class over time. The assumption for each country is that mean household expenditure will grow at the same rate as real GDP per capita. While there are also other definitions and indicators of middle class, the Kharas approach is preferred for synthetic control estimation due to its large coverage over time.

Predictor variables:

The following predictors of middle class are used to produce a counterfactual Iran before major 2012 sanctions. The selection of predictors is based on earlier literature regarding determinants

of middle class development, the availability of data from all countries in the donor group from 1996 to 2011 and their contribution in generating a counterfactual Iran before international sanctions on Iran. The following are used as predictors and correlates of the outcome in SCM.

The first predictor is the log of real GDP per capita. It is an expenditure-side real GDP at chained PPPs and is useful for comparing relative living standards across countries and over time. This data is from Penn World Table version 10.01 (Feenstra, Inklaar, and Timmer 2015). The expansion of the middle class in emerging economies is widely regarded as a direct result of economic growth, which has significantly alleviated poverty (Drabble et al. 2015). In Latin America, for instance, economic growth has been identified as the primary driver behind the increase in the middle-class population, exerting a far greater influence than income redistribution efforts (Cárdenas, Kharas, and Henao 2015). Easterly (2001) also found a strong positive relationship between economic development and the size and share of income held by the middle class. Expansion of middle class in China and India are mainly driven by their economic boom (Ravallion 2010).

We also include three indicators to control for demographic structure and health of the population from WDI (2024) including the share of urban population in total population, age dependency ratio and life expectancy. The rapid expansion of urban areas worldwide marks a significant demographic shift from rural to urban living, reflecting the transition from agrarian economies to those dominated by industry, technology, and services. Theoretically, urban environments provide a more conducive setting for addressing social and environmental issues compared to rural regions. Cities facilitate job creation and income generation, and they offer access to education, healthcare, and various other essential services. Furthermore, urban centers present unique opportunities for social mobility. As discussed by Bloom et al. (2008) strong evidence suggests that urban workers exhibit greater individual productivity and earn higher incomes compared to their rural counterparts. However, Bloom et al. did not find any evidence on the effect of urbanization on economic growth. It is likely that the effect is from economic growth to urbanization, which is then associated with higher share of middle class in population. The age dependency ratio is defined as the ratio of dependents—individuals younger than 15 or older than 64—to the working-age population, those aged 15-64. This metric is expressed as the number of dependents per 100 working-age individuals. Dependency ratios reflect the proportions of children, elderly individuals, and working-age individuals within a population, indicating the dependency burden that the working-age population carries in supporting both children and the elderly. An increase in the age dependency ratio diminishes per capita income

and necessitates the allocation of resources towards providing basic services for children and the elderly. This situation hampers families' ability to save and invest, making it more challenging to elevate the poor into the middle class (Li, Zhang, and Zhang 2007). Life expectancy at birth (years) from WDI (2024) is one of the key health indicator and a component of human development index by the United Nations. Bloom, Canning, and Graham (2003) show theoretically and empirically that increases in life expectancy results in higher savings rate at every age. External events such as war and sanctions are shown to reduce life expectancy significantly (e.g., Gutmann, Neuenkirch, and Neumeier 2021; Farzanegan 2023). Thus, it can be another channel through which such negative shocks may influence development of middle class in a country.

We also account for the secondary school enrollment rate as another factor correlated with the size of the middle class. Secondary education builds upon the foundation of basic education established at the primary level and aims to lay the groundwork for lifelong learning and human development. It achieves this by providing more subject- or skill-specific instruction through the use of specialized teachers (WDI 2024). Education is a key factor for socio-economic mobility and joining the middle class. Another predictor is the share of total natural resources in GDP (%) from the WDI (2024). This metric includes the rents from the production of oil, gas, minerals, coal, and forests. The rents from natural resources can have both positive and negative effects on the development of the middle class. According to the resource curse hypothesis, resource-rich countries tend to exhibit slower economic growth rates over the long term compared to resource-poor economies. This slower growth is primarily due to the distortions that resource dependency introduces, such as a higher risk of conflict (Ross 2004; Ishak and Farzanegan 2022), corruption and the weakening of democratic institutions (Arezki and Gylfason 2013), the strengthening of autocratic systems, dampening entrepreneurial activities (Farzanegan 2014), and the Dutch disease (Corden and Neary 1982), among others. The Dutch disease can have a strong adverse effect on the growth of the middle class through its adverse effect on the industrial and manufacturing output. As a result, fewer manufacturing jobs, which offer a middle-class wage and benefits, will be created. In the short term, however, the flow of resource rents can boost the economies of resource-exporting countries, leading to the expansion of the consuming class, which financially depends on the distribution of rents and public sector jobs provided by the state.

Our next predictor of the development of the middle class in the model is share of household consumption in GDP from Penn World Table version 10.01 (Feenstra, Inklaar, and Timmer

2015). Household consumption is the total money spent on final goods and services by households, here expressed as a share of GDP. This data is adjusted for inflation and differences in the cost of living between countries. The higher share of household consumption in GDP may imply lower rates of saving and investment. Using data from Our World in Data (2024) and applying a country-year fixed effects regression of logarithm of GDP per capita on share of household consumption in GDP shows a negative within country correlation. An increase in ratio by one percentage point is associated with a decline of GDP per capita by about 1.2% (with robust t statistic of -7.2).

Additionally, we include the share of government expenditures in GDP, adjusted for differences in the cost of living between countries, and for inflation. The data is from Penn World Table version 10.01 (Feenstra, Inklaar, and Timmer 2015). A larger share of government spending in GDP may have a crowing out effect on share of private sector investment, restricting the opportunity of private business formation and thus expansion of middle class. Our country-year fixed effects regression of log of GDP per capita on share of government spending in GDP shows a negative (although statistically insignificant) association. However, a larger size of government in the economy may also be associated with expansion of middle class with stronger connections with government administration. For example, Farzanegan et al. (2021) shows a positive response of size of middle class to positive changes in oil revenues. The latter oil rents increases may increase size of middle class through expansion of government spending and public employment.

We also control for the log of merchandise trade (imports and exports) from the WDI (2024). One important channel through which economic growth may affect the size of middle class is by intensifying international trade and globalization.

Finally, we use two indicators for the quality of governance taken from WGI (2024). One is the voice and accountability index, which measures the perceptions of quality of political institutions, and the other is a perception measure of control of corruption. Higher values indicate better quality of governance. These indicators are significant predictors of economic growth and welfare, making them critical factors for the expansion of the middle class. Higher levels of corruption can increase the cost of doing business, reduce foreign direct investment, and raise transaction costs. These effects translate to lower rates of saving and investment in the economy (Dimant and Tosato 2018), all of which negatively impact the middle class. For a discussion on the structural relationship between the middle class and democracy, see Lu (2005) and Leventoğlu (2014).

We control for previous records of size of the middle class in the years 2010, 2008, 2006, 2004, 2002, 2000, 1998 and 1996 to help increase the goodness of fit of the counterfactual Iran with the factual Iran during the pre-international sanctions.

3.2. Methodology

We employ the synthetic control method (SCM) to analyze the trajectory of the middle class in Iran surrounding the imposition of major international sanctions in 2012. This method constructs a synthetic control unit by using a weighted average of control units that match the characteristics of the treated unit (Iran) in terms of predictors for the outcome variable (the size of the middle class) before the sanctions. The SCM aims to minimize the difference between the characteristics of Iran and its synthetic counterpart prior to the sanctions.

Abadie, Diamond, and Hainmueller (2010), Abadie (2021) and Gilchrist et al. (2023) highlight several significant advantages of the synthetic control method (SCM) compared to traditional regression-based approaches. SCM utilizes a transparent weighting framework and accounts for time-varying unobserved characteristics of countries, addressing concerns that arise when simply comparing countries, as seen in more descriptive studies that often lack a clear counterfactual.

Athey and Imbens (2017) describe SCM as "*arguably the most important innovation in the evaluation literature in the last 15 years*," noting that it builds on difference-in-differences estimation but provides more robust causal effect estimates through more attractive comparisons. SCM in our study achieves this by matching the pre-international sanctions outcome of middle-class size and incorporating pre-international sanctions trends and additional predictors (as explained earlier) to construct a counterfactual scenario that reflects what would have happened for development of middle class of Iran in the absence of the international sanctions.

Our analysis covers the period of 1996 to 2019. The treatment year is 2012, when the international sanctions (driven mainly by the US and EU) imposed on Iran in a level which was not seen before.[3] These sanctions include an embargo on the crude oil export of Iran which has been , on average, 80% of total export revenues of Iran from 1980-2011 (OPEC 2024). These

[3] Other studies that also use SCM to examine the effects of sanctions on Iran have used 2012 as the treatment year (e.g. Ghomi 2022; Farzanegan 2022). In a study by Gharehgozli (2017), the selection of the treatment year appears to be 2011, although the pre-treatment period in her study covers 1995–2011. We also conducted an in-time placebo test by changing the treatment year from 2012 to 2007, a year in which no major events occurred. The results (Figure A2 in the Appendix A) support the relevance of 2012 as the effective treatment year for major sanctions.

major sanctions coupled with financial and banking sanctions especially on the Central Bank of Iran were not experienced by Iran before. To search for possible donor sample, our focus has been on the Middle East and North Africa (MENA) region as defined by the World Bank, members of OPEC and few more countries from the Organization of Islamic Cooperation. We exclude countries which have had significant experiences of major sanctions or major events such as war during the pre- and/or post-2012 years. For example, we have excluded Syria, Iraq, Libya and Yemen due to their civil war and other forms of major conflict and instability. West Bank and Djibouti are excluded due to missing data on some of the key variables. Finally, we have also excluded Venezuela due to a similar experience of major sanctions imposed on it.

SCM takes into account that countries in the donor pool share varying degrees of similarity with Iran by assigning a weight ω_d for each country d in donor pool. These weights range between 0 and 1, i.e., $0 \leq \omega_d \leq 1$ and sum to 1, i.e., $\sum_{d=1}^{D} \omega_d = 1$. To construct the most accurate counterfactual for Iran from the available donor countries, SCM utilizes pre-2012 data on the outcome variable (the size of the middle class) Y_t and additional predictor variables Z_t. Formally, the synthetic Iran is generated by selecting weights ω_d such that $Y_t - \sum_{d=1}^{D} \omega_d^* Y_{dt}$ and $Z_t - \sum_{d=1}^{D} \omega_d^* Z_{dt}$ are minimized for the years prior to the 2012 international sanctions, i.e., $t < 2012$.

In essence, the optimal synthetic Iran should closely match the actual Iran in terms of both the size of the middle class and the values of relevant covariates during the period before the international sanctions were imposed. The treatment effect α_t is calculated as $\alpha_t = Y_t - \sum_{d=1}^{D} \omega_d^* Y_{dt}$ for $t \geq 2012$.

The effect of the international sanctions is measured by the difference between the observed size of the middle class and the estimated size of the middle class that would have existed from 2012 to 2019 if the sanctions had not been imposed.

4. Results

The final donor pool consists of 19 countries, excluding those with missing observations and/or affected by major events such as war or sanctions (including Djibouti, Equatorial Guinea, Gabon, Iraq, Libya, Syria, Venezuela, West Bank & Gaza, and Yemen). This donor sample focuses on the MENA region, OPEC, and the Organization of Islamic Cooperation; and includes Algeria, Azerbaijan, Bahrain, Congo, Rep., Egypt, Arab Rep., Indonesia, Israel, Jordan, Kuwait, Lebanon, Malaysia, Malta, Morocco, Nigeria, Oman, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates. The counterfactual Iran, in terms of the size of the

middle class, is generated from the following five countries, listed by their respective weights in synthetic Iran: Qatar (30.7%), Tunisia (24.4%), Nigeria (20%), Azerbaijan (19%), and Malaysia (5.8%).[4]

Table 1 presents the average values of the covariates for Iran, both in its actual state and its synthetic counterpart, prior to the 2012 international sanctions. The synthetic Iran closely resembles the actual Iran in terms of the pre-sanctions size of the middle class.

As shown in column 5 of Table 1, the difference in the size of the middle class between Iran and its synthetic counterpart is negligible. Additionally, there is a strong alignment in the predictors of the size of the middle class between the factual and synthetic Iran in majority of cases. According to Botosaru and Ferman (2019), the synthetic control method does not necessarily require perfect balance on covariates if there is a good match on outcomes prior to the treatment. In our case, there is both a good match in covariates and a significant closeness in the size of the middle class outcome during the selected pre-sanctions years between Iran and its synthetic version. Moreover, the optimization process in the Synthetic Control Method (SCM) assigns weights to variables based on their predictive power. Consequently, covariates that are poor predictors of the outcome are given less importance in the matching process (Bonander 2018).

In addition to comparing factual Iran with its synthetic counterpart, Table 1 also presents the unweighted averages of variables for countries with weights greater than 0 (Qatar, Tunisia, Nigeria, Azerbaijan, and Malaysia), excluding Iran, during the pre-2012 sanctions period. This highlights the significant differences that arise when the correct weights are not constructed, as shown in column 6. Notably, there are non-negligible differences, especially in the predicted outcomes, between the factual Iran and its counterfactual without using the optimal weights (with an exception case for year 2000). This underscores the effectiveness of the SCM approach in generating a reliable counterfactual Iran prior to the onset of international economic sanctions. It demonstrates that the unweighted donor pool provides a weak counterfactual in terms of pre-sanctions outcomes.

[4] In one of our sensitivity tests (Figure A3 in the Appendix A), we conduct a Leave-One-Out exercise following Abadie et al. (2015). We iterate over the model, leaving out one selected country (with non-zero weight) each time to assess whether any single country is driving the results. In our case, we generate five additional synthetic controls by excluding Qatar (30.7%), Tunisia (24.45%), Nigeria (20%), Azerbaijan (19%), and Malaysia (5.8%), respectively. We show that the leave-one-out synthetics closely match the original synthetic Iran, which includes all five donor countries, verifying the robustness of the original finding.

Table 1. The means of predictors during the pre-international sanctions period (1996-2011) for size of middle class

Predictors	Iran (1)	Synthetic Iran (2)	Unweighted average of variables for countries with weight >0 (3)	Difference (1-2)	Difference (1-3)
Middle Class (2010) %	64.90	63.33	61.00	1.57	3.90
Middle Class (2008) %	60.80	61.06	58.98	-0.26	1.82
Middle Class (2006) %	56.00	55.05	52.64	0.95	3.36
Middle Class (2004) %	47.50	47.01	43.74	0.49	3.76
Middle Class (2002) %	42.70	42.88	39.16	-0.18	3.54
Middle Class (2000) %	35.50	38.00	34.68	-2.50	0.82
Middle Class (1998) %	34.90	35.51	31.66	-0.61	3.24
Middle Class (1996) %	30.50	30.81	29.20	-0.31	1.30
Log real GDP per capita	9.38	9.34	9.67	0.04	-0.28
Share of urban population in total population (%)	66.38	66.86	68.13	-0.47	-1.75
Age dependency ratio (% of working-age population)	51.25	51.69	52.49	-0.44	-1.24
Life expectancy at birth, total (years)	70.92	68.13	69.73	2.79	1.19
School enrollment, secondary (% gross)	80.16	74.57	73.79	5.59	6.37
Total natural resource rents in GDP (%)	25.31	22.20	18.24	3.11	7.07
Share of private consumption in GDP	0.47	0.44	0.44	0.03	0.03
Share of government spending in GDP	0.21	0.15	0.15	0.07	0.07
Log of merchandise trade	25.00	23.95	24.82	1.04	0.17
Voice & Accountability Index	-1.31	-0.90	-0.76	-0.41	-0.54
Control of Corruption Index	-0.55	-0.25	-0.07	-0.29	-0.48

To determine whether the comparison unit created using the SCM is an effective counterfactual, it is essential to measure how well it mirrors the treated unit (i.e., Iran) before the 2012 international sanctions. Abadie et al. (2010) use the root mean square prediction error (RMSPE) of the outcome variable to assess the fit between the outcome trends of the treated unit and its synthetic version. An RMSPE of 0 indicates a perfect reproduction of the factual unit's trajectory by the counterfactual unit. Any deviation from 0 makes it difficult to gauge the goodness of fit for the synthetic unit. To further assess the quality of the pretreatment fit, (Adhikari and Alm 2016) developed a "pretreatment fit index," where a value of 0 denotes a perfect fit. In our study, the pretreatment fit index is 0.03, indicating a close match between Iran and its synthetic control regarding the size of the middle class before the 2012 international sanctions.[5]

[5] We employed Bibek Adhikari's recommended method to compute the pretreatment fit index for SCM, as outlined on the following website: https://bibekadhikari.com/research/pre-treatment-fit-index-for-scm/

Figure 2 illustrates the middle-class trajectory of actual Iran and its synthetic counterpart from 1996 to 2019. The synthetic Iran closely replicates the middle-class size of actual Iran throughout the pre-2012 international sanctions period. However, the two lines diverge significantly starting in 2012. While the size of the middle class declines in actual Iran, it continues to grow gradually in its synthetic counterpart.

The average annual decline in the size of the middle class over 8 years from 2012 to 2019 is estimated to be approximately 11 percentage points. Put differently, had it not been for the international economic sanctions imposed on Iran in 2012 (initiated by the US and the EU), the middle class in Iran would have expanded by an annual average of approximately 11 percentage points. The gap between the size of the middle class in Iran and its synthetic counterpart continues to widen until the end of the period (2019). In 2019, the estimated size of loss in middle-class share of population in Iran is more than 20 percentage point. This suggests that the imposed sanctions exacerbated the decline of the middle class in Iran over time by pushing more individuals from the lower middle-class into lower income deciles and increasing the outmigration of the upper middle-class. The in-space placebo test (Figure A1 in the Appendix A) and synthetic difference-in-difference estimations (Table A1 in the Appendix A) also show that the negative effect of sanctions on the size of the middle class in Iran is statistically significant. Figure 3 illustrates the disparity in the size of the middle class between Iran and its synthetic counterpart.

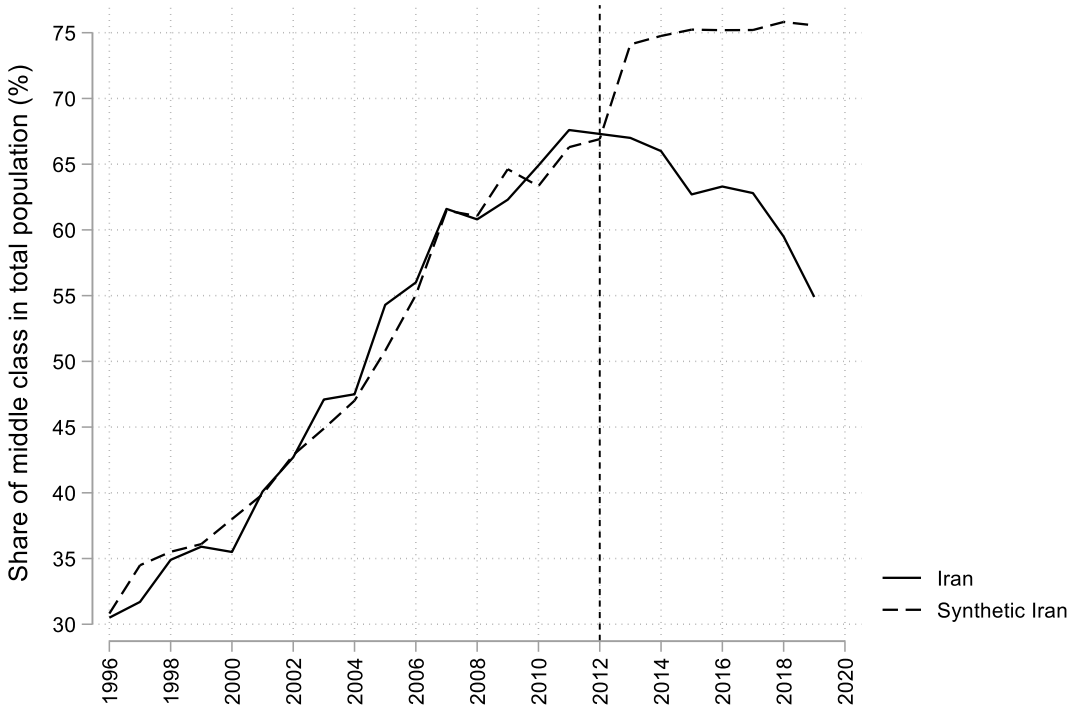

Figure 2. The size of the middle class: Iran versus Synthetic Iran

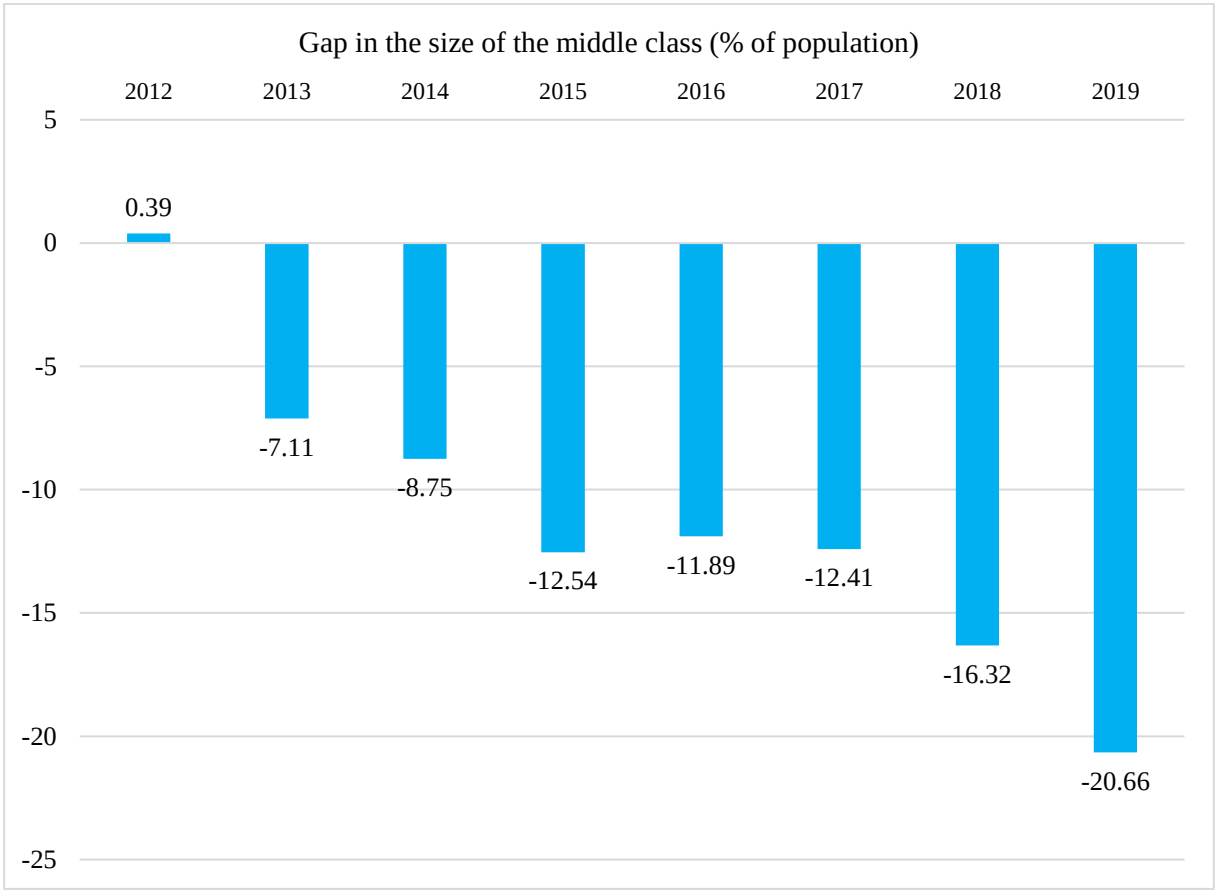

Figure 3. Loss of middle class population share after 2012, as a result of increased sanctions

5. Discussion and Selected Channels

Our analysis shows that the size of the middle class in Iran has not only declined relative to where it stood before the elevation of sanctions in 2012, but it has declined by a larger amount relative to how much it could have increased during 2012-2019 in the absence of these sanctions. The trajectory of the size of middle class that we report in Figure 2 for 2012-2019 is consistent with multiple other studies that use a relative measurement of the middle class based on the distance of household income from the poverty line.

The impact of sanctions on the middle class is also validated by the temporary trend reversal in 2016-2017, in Figure 2. In these two years, the economy of Iran benefited from the October 2015 nuclear agreement (implemented on Jan 2016), which resulted in sanctions relief (Batmanghelidj and Rouhi 2021). The impact of this agreement is also visible in Figure 3, which shows our estimates for the gap between the size of the middle class in actual Iran and synthetic Iran. We observe that this gap diminished from 12.54% in 2015 to 11.89% in 2016, before reversing again to 12.41% in 2017, the year in which Trump was elected president of the US. The lifting of oil sanctions and the reduction of financial sanctions after the nuclear deal, resulted in an 8.8% annual economic growth and increased the size of the middle class in 2016. The worsening situation in 2017, was a result of the decline of the U.S. commitment to (the nuclear agreement's) sanctions relief package by Donald Trump. His renewed economic pressures on Iran eventually culminated in total withdrawal of the U.S. from the JCPOA nuclear agreement and introduction of the unilateral maximum pressure sanctions on May 2018 (Ghet 2022).

The severe adverse impact of Trump's maximum pressure sanctions on Iran's middle class is clearly visible in Figures 2 and 3. Under the pressure of these sanctions annual economic growth declined to 2.8% in 2017, followed by -1.8% and -3.1% in 2018 and 2019 respectively (WDI 2024). Another factor that contributed to the declining size of the middle class in Iran (2012-2019) was the worsening inequality of income. Iran's GINI index of income inequality rose steadily from 34 in 2013 to 37.4 in 2018 and 36.5 in 2019 (WDI 2024). The combination of negative economic growth and rising inequality pushed a large number of middle-class households into poverty and reduced the relative size of the middle class.

For most middle-class households that suffered downward mobility into the lower class the key culprit was the declining real wages and benefits. The high inflation rates and the inability of nominal wages to keep pace with inflation resulted in the decline of per capita earnings below

the $11 per day (PPP) threshold of the middle-class category. The second factor was the loss of middle-class jobs. On one hand the government was unable to grow the public sector jobs due to lower oil export revenues, and on the other hand the severe sanctions resulted in bankruptcy of many private sector firms and loss of many skilled and semi-skilled jobs.

One possible channel through which economic sanctions may reduce the size of the middle class is through decreasing economic development, as captured by falling income per capita (adjusted for inflation and for differences in the cost of living between countries). To test this possible channel, we re-estimate the synthetic control model using the logarithm of real GDP per capita, calculated based on PPP-adjusted international dollars following Feenstra, Inklaar, and Timmer (2015) as the outcome of interest. Predictors include income per capita in selected years before the 2012 sanctions (the same as in our analysis of middle-class development) and other covariates relevant for economic development mentioned earlier. Figure 4 shows a good match between the log of real GDP per capita of Iran and its synthetic version before the 2012 major economic sanctions. These two diverge from each other after the 2012 sanctions. The pretreatment fit index is 0.002, which is close to a perfect match. The countries contributing to synthetic Iran for the outcome of real GDP per capita are Lebanon (29.6%), Tunisia (23.2%), Nigeria (18%), Qatar (11%), UAE (10.1%), Oman (4.5%), and Saudi Arabia (3.5%). The leave-one-out analysis also shows that the estimated effect of sanctions on income per capita of Iran is not sensitive to inclusion of one of the mentioned countries in synthetic version of Iran.

We find a significant negative effect of major economic sanctions on the real income per capita of Iran. Figure 5 shows the estimated gap between the log of real GDP per capita of Iran and its counterfactual between 2012 and 2019.The gap in GDP per capita during 2012-2019 was on average 22% on an annual basis. Applying the synthetic difference-in-differences approach (Arkhangelsky et al. 2021) shows that the average estimated effect of sanctions on Iran has declined real GDP per capita by about 28% over the 8-year period. This effect is also statistically significant at the 95% confidence level, with a t-statistic of 2.33. Converting logarithmic scales to PPP$ shows that, on average, the annual reduction in real income per capita between 2012 and 2019 is about $3,600. In other words, in the absence of major economic sanctions after 2012, the average income per capita could have enjoyed an additional $3,600. The biggest decline is observed in 2019, in which the lost income per capita reached $4,276.

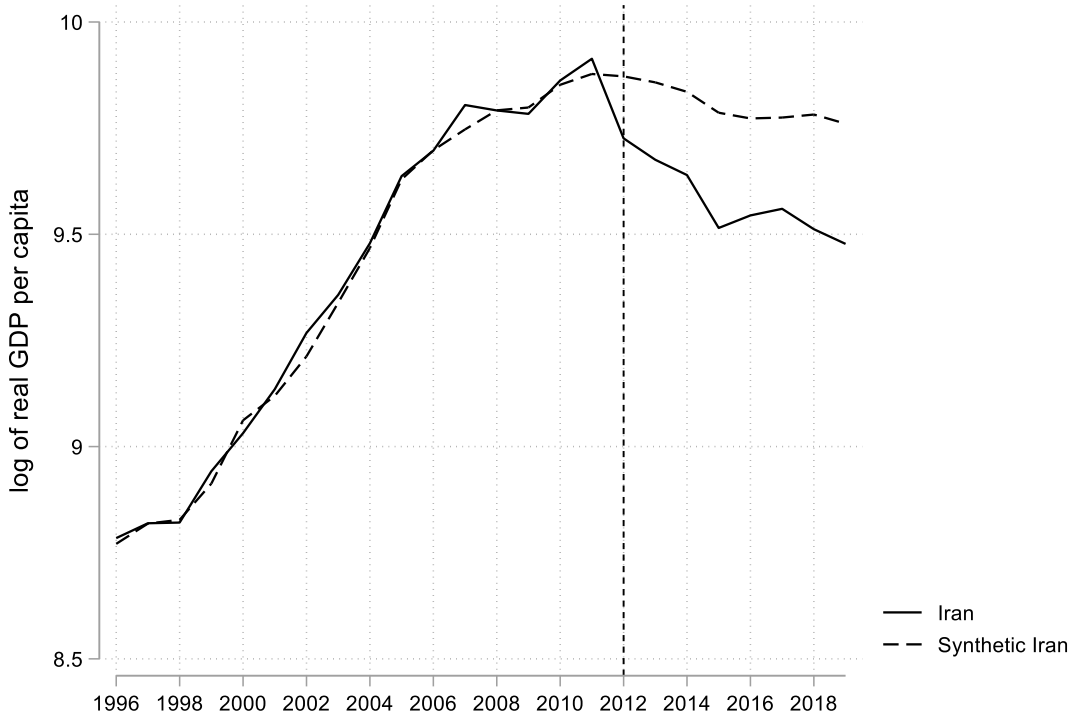

Figure 4. The real GDP per capita: Iran versus synthetic Iran

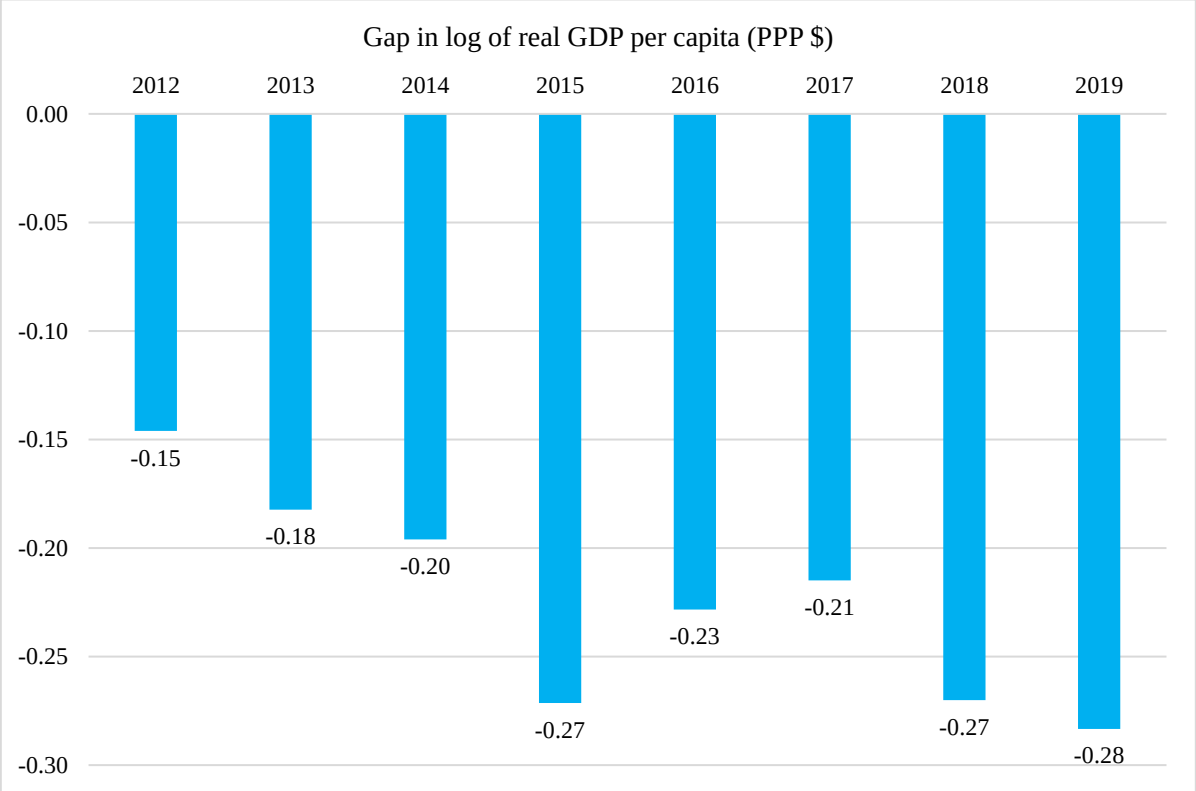

Figure 5. Loss of (log) income per capita after 2012, as a result of increased sanctions

Another channel which can connect the imposed sanctions on declining size of middle class is the merchandise imports. Economic sanctions, and especially the oil embargo and measures against the Central Bank of Iran resulted in drop of oil export revenues and available funding for imports. In addition, devaluation of Iranian rial under sanctions increased black market premiums and costs for imports (Farzanegan 2013). Higher import costs and deficit in petrodollars have had a negative impact on import of goods. Scarcity of imported goods can drive up prices making it more expensive for the middle class to keep their standard of living. Also, the impact on domestic production is important. Many domestic industries depend on imported raw materials and components. A fall in imports can disrupt the production line, leading to job losses and decreasing economic activities which negatively affects the middle class. Higher costs of imported inputs can be passed on to consumers, resulting in higher prices for goods and services. Moreover, a reduction in imports following sanctions can lead to decreased government revenues from taxes and tariffs, amplifying the budget deficit problem of state. This potentially can result in a reduction of public goods and social programs which could be essential for the development of the middle class. We examine the effect of major economic sanctions by re-estimating the synthetic control and using merchandise imports (in current US$) from WDI (2024). Figure 6 shows the gap between merchandise imports of Iran and its synthetic. We observe a widening gap during post 2012 sanctions. While both Iran and its synthetic show similar development in a term of merchandise imports by 2011-2012, they diverge from each other under sanctions. Synthetic Iran with this outcome is based on Algeria (62.7%), Bahrain (12.2%), Malaysia (12.2%), Azerbaijan (6.9%) and UAE (6%). The pretreatment fit index is 0.097, indicating a very good match between Iran and its counterfactual before 2012 sanctions.

Figure 7 shows the estimated imports gap between Iran and its synthetic. The average annual loss in imports over the 8 years following 2012 sanctions is estimated to be 25 billion US$. The largest loss is observed in 2013 and 2019 (31 billion US$) which were during the peak sanctions of the Obama and Trump administrations. The estimated average annual negative effect of sanctions on merchandise imports of Iran using a more demanding approach of synthetic difference in differences is about 19 billion US$ over the 8 years of 2012-2019. This negative average effect is highly statistically significant (at 99% confidence intervals, with t statistics of -2.90).

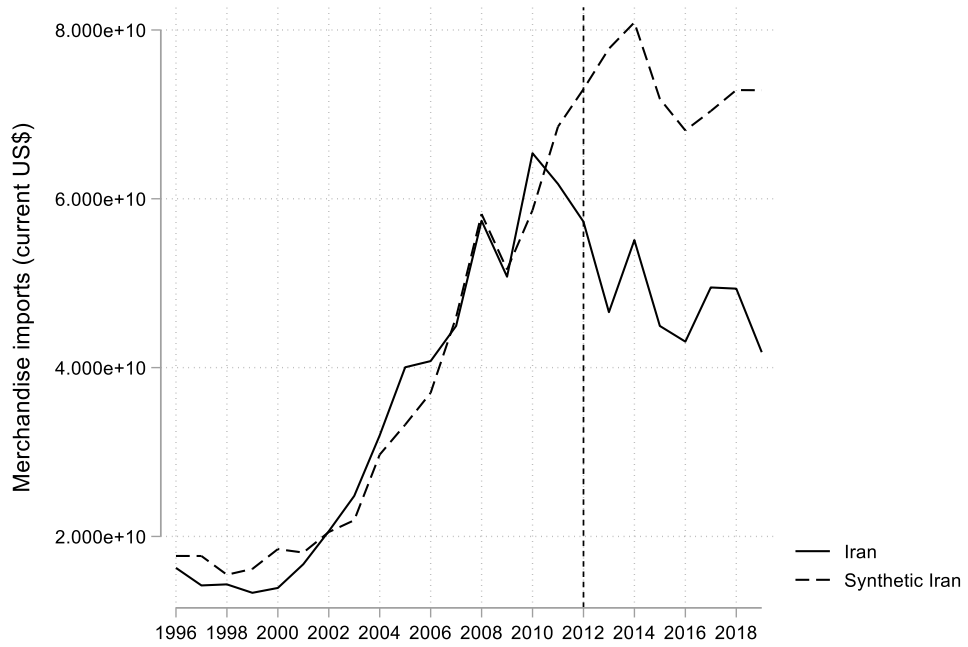

Figure 6. The merchandise imports (current billion us$): Iran versus synthetic Iran

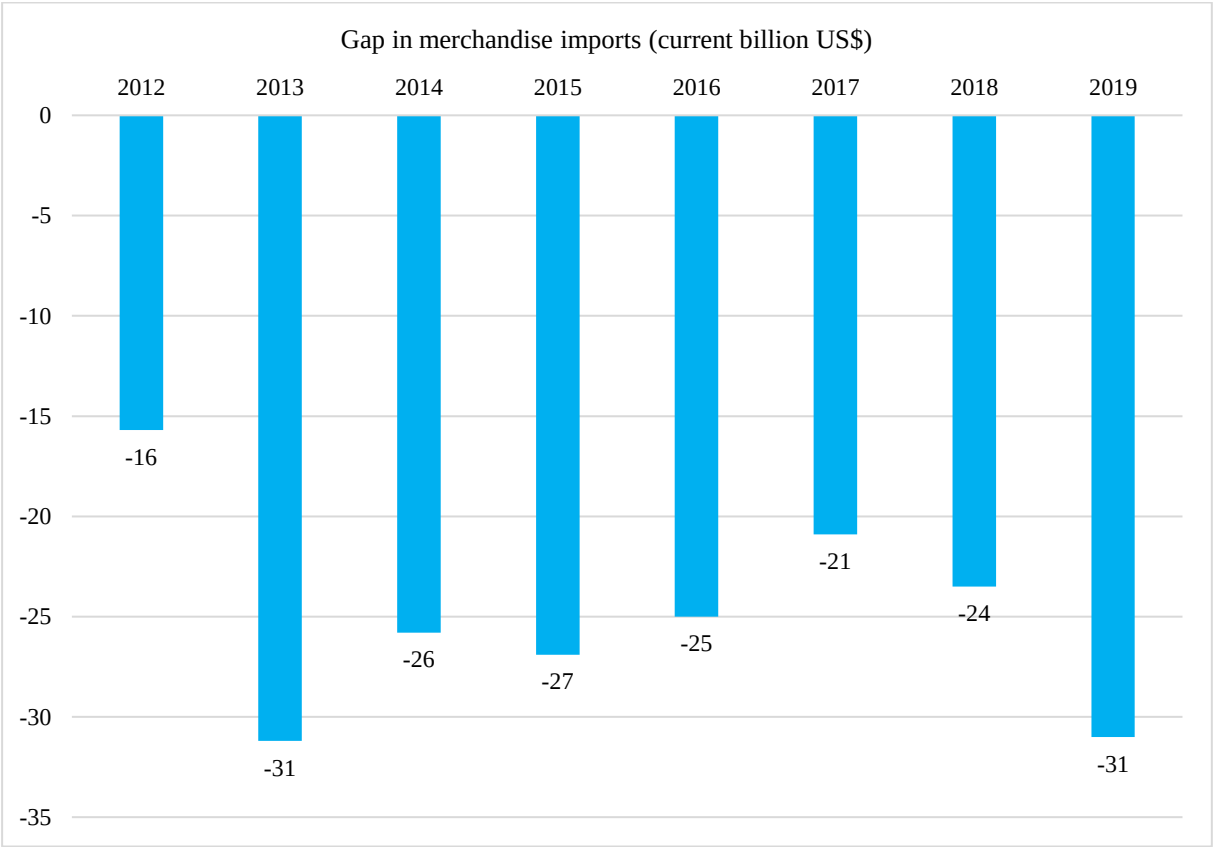

Figure 7. Loss of merchandise imports after 2012, as a result of increased sanctions

Our findings, regarding the relative decline of the middle after the 2012 sanctions, are consistent with the results of the World Values Survey (WVS), which were conducted in several years in Iran. These surveys, which are conducted periodically in many countries include two questions on how the respondents perceive the income and social status of their households. The responses of Iranian participants in three surveys that were conducted in 2000, 2005 and 2020 are reported in Figures 8 and 9 [6].

One of the questions asks respondents to identify the income decile to which they believe their household belongs. We combined the results into three categories as demonstrated in Figure 8. For this purpose, we defined the middle class as the respondents that self-identified as belonging to income deciles 3 to 7. When we compare the results for the three survey years, we observe a significant decline the share of the respondents that self-identify as middle class. The results further show that the decline in the middle-class category has been associated with an increase in the percent of respondents that had self-identified as belonging to the lower-class deciles.

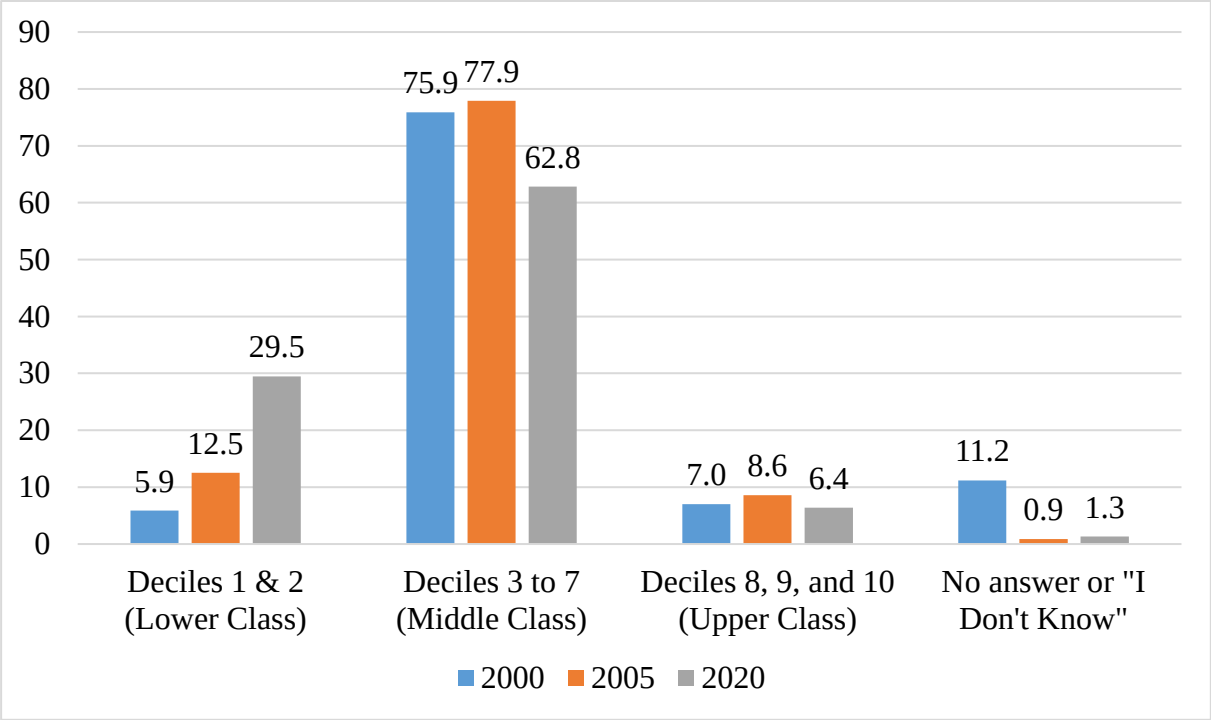

Figure 8. To which income category your household belongs? Self-perceptions according to World Values Survey Results for Iran.

Note. Survey Question: On this card is a scale of incomes on which 1 indicates the "lowest income decile" and 10 the "highest income.

[6] The World Values Survey organization has conducted seven survey waves since 1981 but Iran has been included in only three of them. The data used for generation of Figures 8 and 9 are extracted from wave 4, wave 5, and wave 7 surveys respectively. For more details see: https://www.worldvaluessurvey.org/WVSContents.jsp.

We observe a similar result when we look at the results for the second question, which asks respondents to directly identify their social class without linking it to a specific income category. This allows participants to select a social class based on a combination of income and other factors such as education and lifestyle, which affect an individual's overall standard of living. The results for this question are reported in Figure 9 and they are also consistent with our findings. We observe that the share of respondents that identified as upper class or upper-middle class was significantly smaller in the 2020 survey relative to the 2000 and 2005 surveys. The share of respondents that self-identified as lower-middle class was not significantly different between the 2005 and 2020 surveys. The present of respondents that self-identified as working class, on the other hand, was sharply higher in 2020 in comparison to the 2000 survey[7].

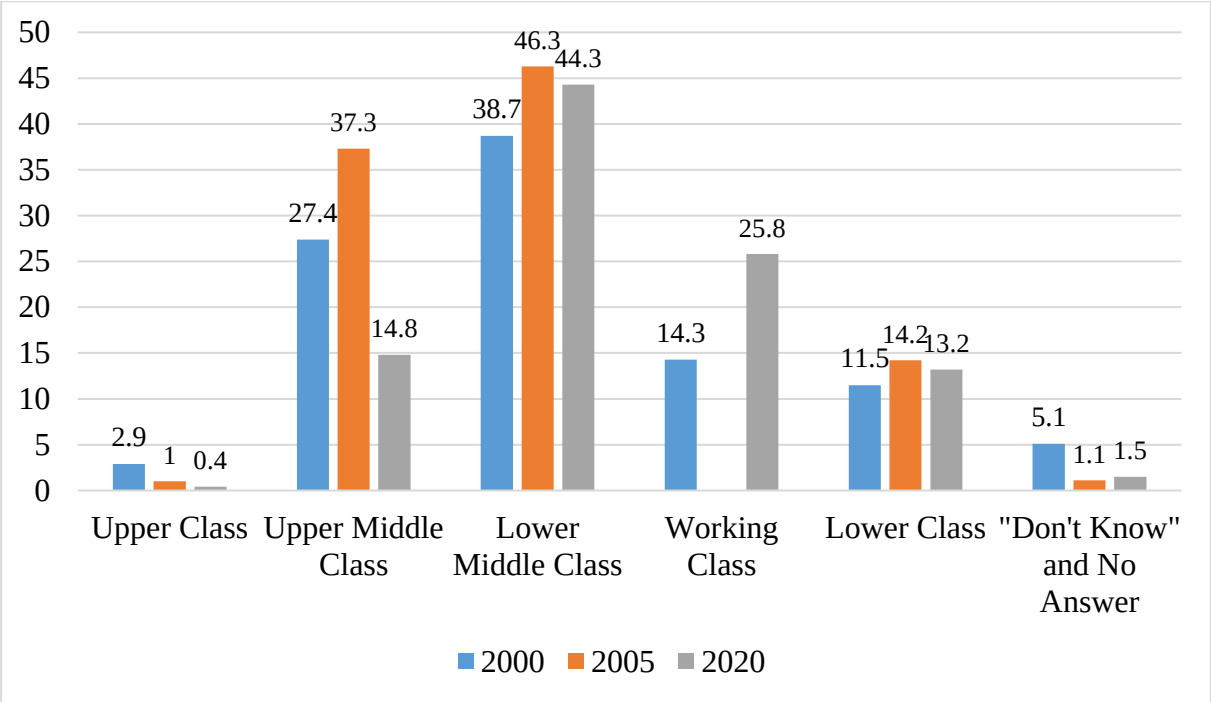

Figure 9. To which social class your household belongs? Self-perceptions according to World Values Survey results for Iran

Note. Survey Question: People sometimes describe themselves as belonging to the working class, the middle class, or the upper or lower.

[7] The 2005 survey (WVS Wave 5) did not include a separate category for the working class.

6. Conclusion

This study endeavors to address the inquiry of how the size of the middle class in Iran might have evolved in the absence of the international economic sanctions imposed on the country in 2012. This question holds significant importance, considering the substantial body of evidence that links the development of the middle class to positive long-term developmental and political outcomes. It is imperative to establish a robust estimation of the causal effects of economic sanctions on the development of the middle class, given its pivotal role as a driver for economic stability, social cohesion, and political resilience within a nation. A flourishing middle class tends to advocate for accountability from public institutions, thereby bolstering democratic values. Moreover, it fosters social cohesion by providing avenues for upward mobility. Additionally, it is essential for economic stability, as a thriving middle class constitutes a reliable consumer base and mitigates income inequality.

To achieve this objective, we utilized a counterfactual analysis employing the synthetic control method. This involved estimating the decline in the size of the middle class in Iran following the implementation of international economic sanctions orchestrated by the US and subsequently supported by the EU and other allies, primarily due to concerns regarding Iran's nuclear program. Our results reveal that prior to the 2012 sanctions, the trajectories of the middle-class size in actual Iran and its synthetic counterpart were comparable. However, a notable divergence occurred thereafter, indicating a significant impact of the sanctions on the trajectory of the size of the middle class.

The main results indicate that the *average annual loss in the size of middle class of Iran* from 2012 to 2019 was estimated to be 11 percentage points. In other words, if there had been no international sanctions, the size of the middle class in Iran would have been approximately 11 percentage points larger per year. In 2019, the gap between the size of middle class in Iran and its synthetic reached its maximum level of 20 percentage points. We also conducted various sensitivity checks, including in-space and in-time placebo analyses, as well as leave-one-out synthetic control and synthetic difference-in-differences method which is more demanding in a term of robustness. These robustness checks confirm the initial findings of a significant negative causal effect of the international economic sanctions on the size of middle class in Iran between 2012-2019. Finally, we discussed the potential factors underlying the significant decline in size of middle class and provide evidence for the relevance of real GDP per capita and imports as selected mechanism through which sanctions affect the size of middle class negatively.

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Appendix A

Inference Procedures and Sensitivity Analysis

In-Space Placebo Test

To test the robustness of our main estimations, we employ placebo or falsification tests, also known as randomization inference tests in statistical fields (Bertrand, Duflo, and Mullainathan 2004). The premise of placebo tests is straightforward: if the synthetic control method (SCM) is applied to other countries not subjected to the treatment (international sanctions), a similar significant and negative outcome for the middle class should not be observed as it is for Iran. If similar trajectories are observed in other countries, the estimated effect for Iran cannot be attributed to the sanctions.

We calculate a pseudo p-value based on the rank of the treatment unit's post-/pre-root mean square prediction error (RMSPE) ratio compared to the untreated placebo units' post-/pre-RMSPE ratios, following the methodology of Abadie, Diamond, and Hainmueller (2010). As shown in Figure A1, Iran has the highest ratio of post-treatment RMSPE to pre-treatment RMSPE (4.9). The inference procedures yield a pseudo p-value of approximately 0.05 (1/20), indicating that no other placebo runs match or exceed the effect observed for Iran when considering the pre-intervention fit (RMSPE). This implies a 95% confidence level in the main findings, providing strong evidence for a causal effect of the international sanctions on the middle class in Iran.

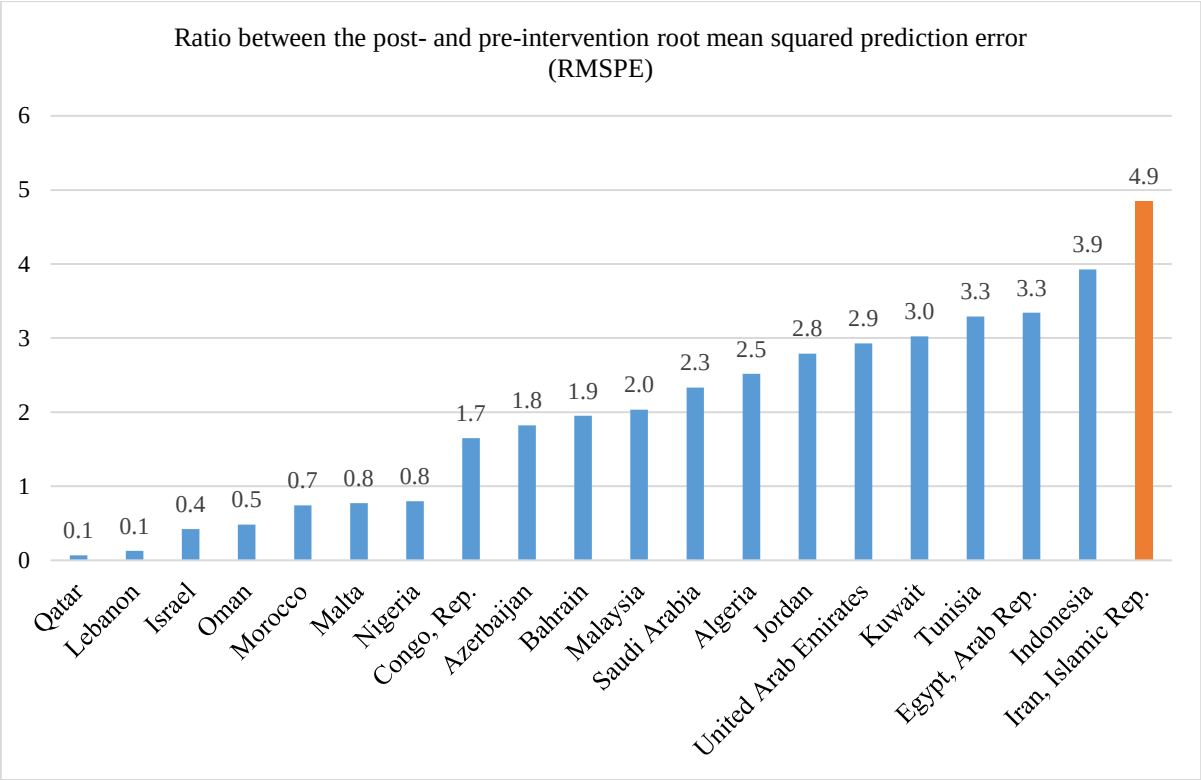

Figure A1. Ratio between the post- and pre-intervention root mean squared prediction error (RMSPE)

Change in Time Dimension (In-Time Placebo)

What happens to the results produced by the synthetic control method if different years are selected as treatment shocks? To assess the reliability of the findings, we conducted an "in-time placebo" examination in addition to the "in-space placebo" test, following the methodology of (Abadie, Diamond, and Hainmueller 2015). We re-estimated the SCM model by changing the treatment year from 2012, when the international sanctions began, to 2007, a year not associated with any significant events. This analysis investigates whether a similar divergence between the size of the middle class of factual Iran and its synthetic counterpart occurs during a period without major sanctions. Figure A2 presents the results of the "in-time placebo" study.

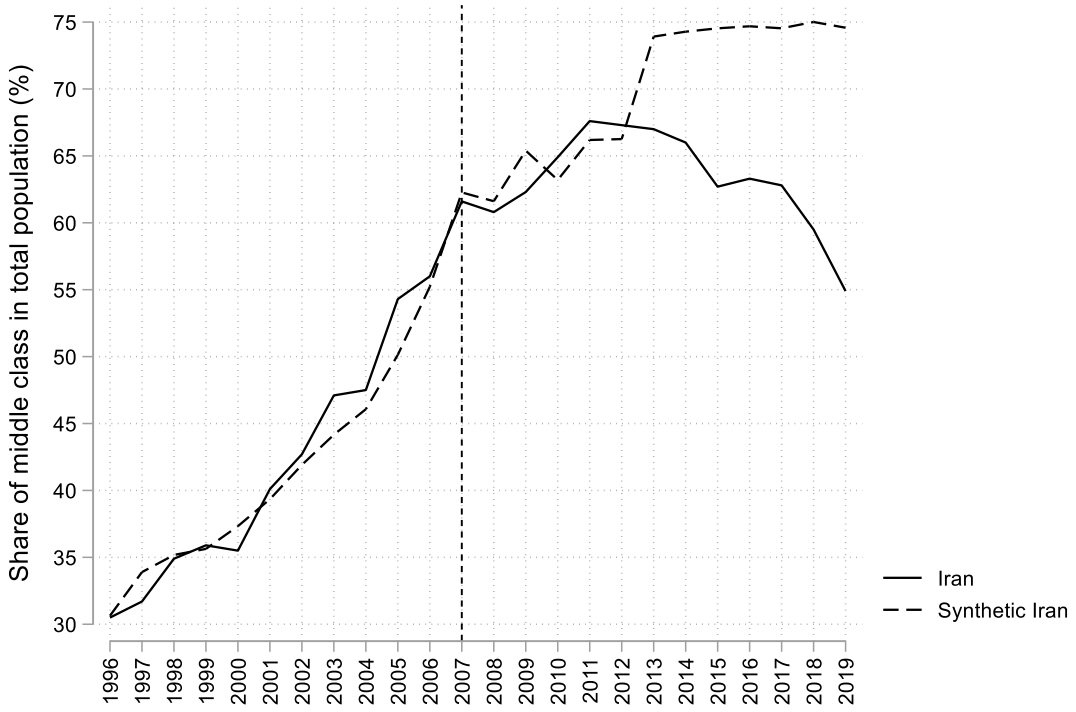

Figure A2. In-time placebo effect of 2007 size of the middle class of Iran vs. synthetic Iran.

In Figure A2, there is no divergence between the actual size of the middle class for the factual Iran and its synthetic and there is no effect estimated for 2007.

Leave-One-Out Synthetic Control

To what extent is the main result sensitive to the inclusion of specific countries in the donor pool? To address this issue, we conducted a leave-one-out analysis, systematically excluding the most influential countries from the donor sample. For the main results, synthetic Iran was generated using a combination of five countries: Qatar (30.7%), Tunisia (24.45%), Nigeria (20%), Azerbaijan (19%), and Malaysia (5.8%).

The leave-one-out analysis produced five alternative counterfactual versions of Iran, in addition to the main synthetic version shown in Figure 2. These counterfactual versions were estimated by sequentially excluding Qatar, Tunisia, Nigeria, Azerbaijan, and Malaysia. Figure A3 illustrates that the size of the middle class in these additional counterfactual versions shows significant gaps compared to the factual Iran. The synthetic control result depicted in Figure 2 remains robust despite the exclusion of dominant countries from the donor pool, ensuring the reliability of the initial findings.

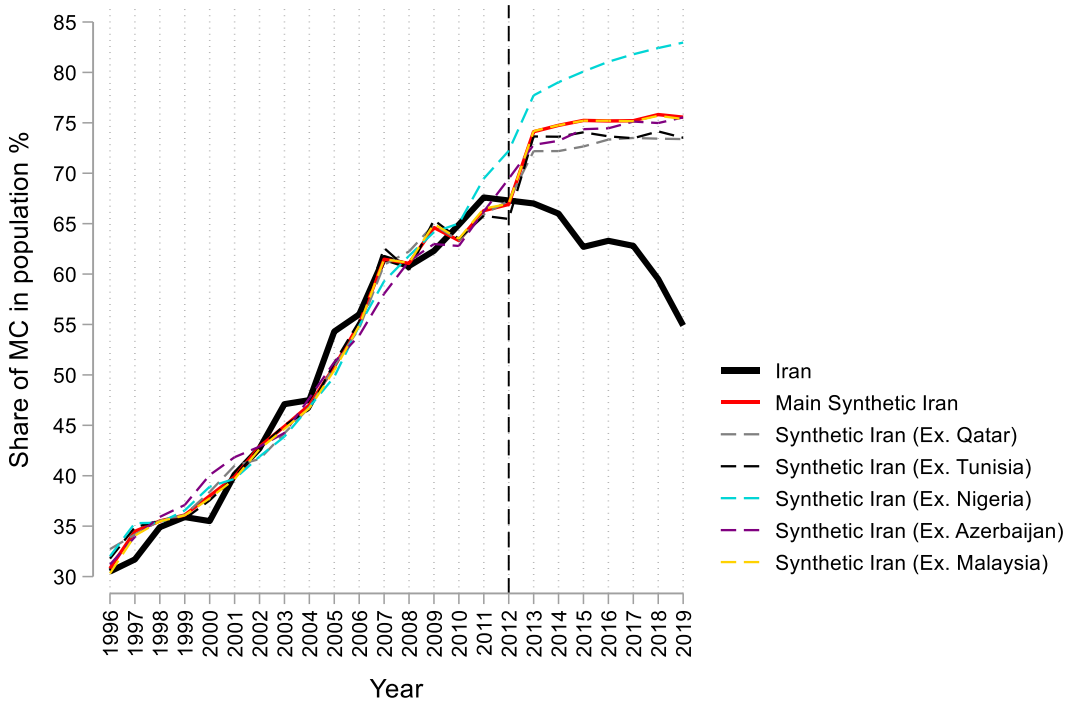

Figure A3. Leave-one-out distribution of the synthetic control for Iran.

Synthetic Difference-in-Differences

Synthetic difference-in-differences is a panel-based approach where certain countries (e.g., Iran) receive treatment while the remaining countries serve as controls. This method calculates the treatment effect as the difference-in-differences between the treated units and their synthetic controls, both before and after the treatment. The synthetic controls are constructed as an optimally weighted combination of the untreated units (unit-specific weights) and pre-treatment periods (time-specific weights). Arkhangelsky et al. (2021) introduced and detailed this procedure.[8] In our analysis, Iran is the sole treated country, and inference is derived from placebo procedures (see Algorithm 4 on placebo variance estimation in Arkhangelsky et al. (2021)). Table A1 presents the average treatment effect on the treated (ATT), estimated at approximately -11.76 percentage points over 8 years (2012-2019) without covariates and -9.39 with selected covariates, which are highly statistically significant at the 99% and 95% confidence interval, respectively. The mean of these two estimated ATTs is 10.5 pp average annual loss in the size of middle class of Iran during 2012-2019. This ATT based on SDID

[8] For a discussion on the advantages of the Synthetic Control Method (SCM) over regression-based solutions (such as matching on key variables or propensity score matching) and other quasi-experimental designs like the Difference-in-Differences method, refer to https://bookdown.org/mike/data_analysis/synthetic-control.html.

closely aligns with our earlier estimate of the average annual decline in the size of Iran's middle class following the imposition of international economic sanctions based on SCM analysis.

Table A1. Synthetic Difference-in-Differences Estimator

Share of middle class in total population (%)	ATT: Average annual effect of sanctions on the size of middle class (% of population) between 2012-2019	Std. Err.	t	P>t	[95% Conf. Interval]	
Post 2012 sanctions on Iran (excluding covariates)	-11.76	3.70	-3.17	0.002	-19.03	-4.49
Post 2012 sanctions on Iran (including covariates)*	-9.39	4.04	-2.32	0.02	-17.32	-1.45

Note: The 95% confidence intervals and p-values are derived from Large-Sample approximations, and for theoretical derivations, refer to Arkhangelsky et al. (2021). The inference is based on a placebo procedure, with 100 repetitions used for the placebo standard error, which is higher than the default value of 50. *Included covariates are log of GDP per capita, share of urban population in total population, and age dependency ratio. SDID needs balanced panel dataset without missing observation.