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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-2012 Iran, but did not experience significant international sanctions. By comparing the size of the middle class in 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, merchandise imports and exports, investment, industry value added, informal and vulnerable employment 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 Classifications:** F51; I31; P36

## ملخص

تبحث هذه الدراسة في تأثير العقوبات الاقتصادية الدولية، المفروضة على إيران بسبب برنامجها النووي، على تطور الطبقة المتوسطة. وتحديدًا، تبحث في كيفية تطور الطبقة المتوسطة في إيران في غياب هذه العقوبات بعد عام 2012. وللإجابة على هذا السؤال، نستخدم نموذج تحكم تركيبي لإنشاء سيناريو افتراضي لإيران، باستخدام متوسط مرجح لبلدان أخرى مماثلة تعكس حال إيران قبل عام 2012، ولكنها لم تتعرض لعقوبات دولية كبيرة. وبمقارنة حجم الطبقة المتوسطة في إيران الافتراضية مع إيران الفعلية التي واجهت عقوبات اقتصادية كبيرة، تشير نتائجنا إلى أن حجم الطبقة المتوسطة السنوي كان سيزداد بنحو 11 نقطة مئوية في المتوسط، بدون عقوبات ما بعد عام 2012. وتُعد نتائجنا قوية عبر اختبارات مختلفة، بما في ذلك اختبارات العلاج الوهمي وتحليلات الفرق في الفروق التركيبية. ويُظهر التحليل الأخير أن متوسط تأثير العقوبات المقدر على حجم الطبقة المتوسطة في إيران من عام 2012 إلى عام 2019 ذو دلالة إحصائية عالية. وأخيرا، نقدم أدلة على أهمية الناتج المحلي الإجمالي الحقيقي للفرد، وواردات وصادرات السلع، والاستثمار، والقيمة المضافة للصناعة، والعمالة غير الرسمية والهشة باعتبارها قنوات مختارة رئيسية تؤثر من خلالها العقوبات سلباً على حجم الطبقة المتوسطة.

## 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 United Nations, the US, European Union, and their allies, after 2012, affected the size of the 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 (middle) 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 shows the share of the middle class in Iran's total population from 1996 to 2019, using a commonly accepted income threshold—per capita expenditures above $11 PPP, or twice the World Bank's $5.5 poverty line for upper-middle-income countries (Kharas 2017; Salehi-Isfahani 2021; World Bank 2018). 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 came to a halt and began to decline during the period of severe international economic sanctions that started in 2012. Besides the economic sanctions, however, other factors such as quality of governance in Iran may also have contributed to this change. To what extent were the sanctions responsible for this decline?

[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.

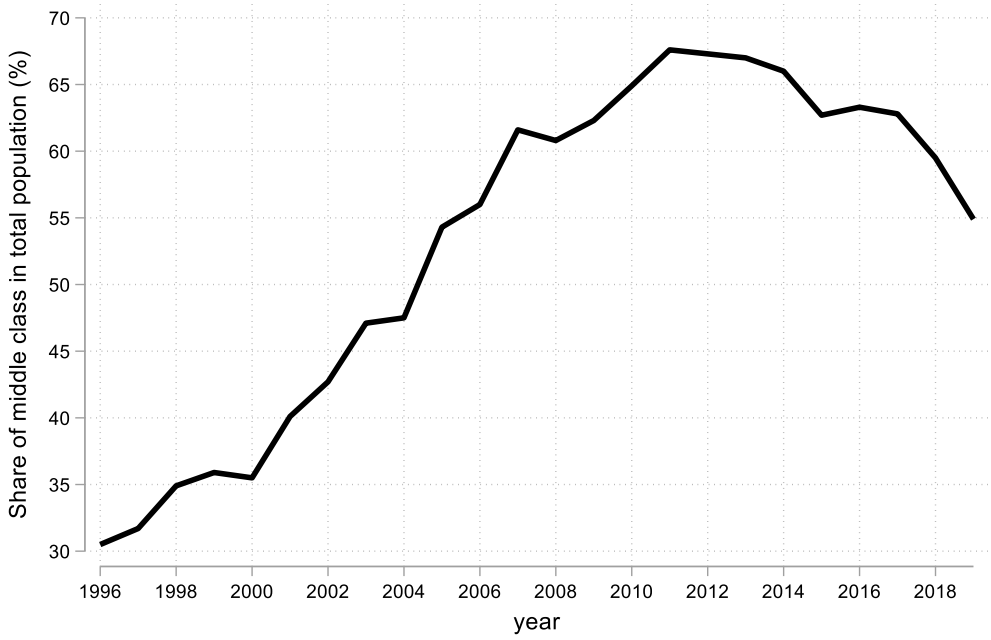


**Figure 1.** Iran's middle class as a percentage of total population
Note: Middle-class variables estimate the number of people living in households earning or spending between $11 and $110 per person per day (2011 $ purchasing power parity (PPP) prices) and are taken from Kharas (2017).

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 (Iran) both with and without the treatment (sanctions) 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 present a qualitative analysis of Iranians' perceptions of their social class status before and after sanctions, using data from the World Values Survey. This analysis supports the SCM-based estimate of the middle-class decline in Iran. Finally, we explore the possible channels 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 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, which was Iran's largest trade partner and its largest oil consumer (Morris 2012), or Russia, which had expanded its security and military cooperation with Iran (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 scaled back 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. Furthermore, several studies of the welfare effects of economic sanctions based on Iran's annual Household Income and Expenditure Surveys, have revealed a downward trend and deterioration of standards of living after 2012 (Salehi 2020). Our focus is on the development of the middle class before and after these major sanctions. Below we explain why the focus on this segment of Iranian society is important.

### 2.2. Significance of the middle class in economic and political development of Iran

Iran's traditional middle class, before the modernization period of the Pahlavi dynasty (1925-1979) consisted of the merchant (Bazar) class and the mid-ranking clerical class. With the advent of cultural westernization, industrialization and introduction of modern bureaucracy, the Pahlavi Kings facilitated the emergence of a modern middle class which included civil servant, professionals, technicians, office workers and managers. Two attributes of the modern middle class that differentiated it from the traditional middle class was their more secular and westernized worldview and their higher dependence on the state, particularly after the influx of large oil revenues in 1970s (Zahirinejad 2014; Farzanegan et al. 2021a). The skills and entrepreneurship of this modern middle class played an important role in Iran's industrial and infrastructure development both before and after the 1979 Islamic revolution.

Overall, the middle class has played an important role in both economic and political development of Iran. Equally important is the role that the government policies have played in the emergence, expansion and contraction of the Iranian middle class. The industrial development policies of the Pahlavi regime and the growing per capita income that was supported by high oil revenues in 1970s generated a significant middle class. This emerging urban and educated social class became very vocal in its demand for political reforms in the final years of Shah's regime and played an important role in the victory of the Islamic revolution (Alaedini and Ashrafzadeh 2016).

The economic and educational policies of the Islamic republic in the first two decades after the Islamic revolution led to a further increase in the size of the middle class as millions of marginalized and low-income people were lifted from poverty in both rural and low-income urban areas. This educated and empowered middle class served as the political power base of President Mohammad Khatami (1997-2005) who carried out several liberal political and social reforms (Zahirinejad 2014). They were also the main participants in several episodes of pro-democracy protests such as the Green Movement of 2009 and the 2022 Woman, Life, Freedom mobilization, resulting to significant social changes for the women. Moreover, The Iranian middle class has played a key role in promoting entrepreneurship, particularly in sectors such as technology, services, and manufacturing. The rise of Iranian tech start-ups like *Digikala* (the Iranian equivalent of Amazon) and *Snapp* (a ride-hailing service similar to Uber) has been largely driven by middle-class entrepreneurs and skilled professionals (Bozorgmehr 2018; Sharif 2015).

### 2.3. 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 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. 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 (e.g., the consumer prices inflation rate increased from 10% in 2010 to more than 36% in 2013 or from 8% in 2017 to 40% in 2019)[2]. 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 (Afesorgbor 2019). 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.)[3] 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

[2] https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=IR

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

state-owned enterprises and well-connected private businesses have stepped forward to purchase the bankrupt businesses (Rizvi 2012). These business bankruptcies, which were triggered by the negative economic growth under post-2012 economic sanctions, forced many middle-class wage earners into the ranks of informal and vulnerable employment.

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 (Oechslin 2014). 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 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 individuals in households with daily per capita incomes between $11 and $110 (2011 PPP) (Kharas 2017). This range identifies people who: (a). Have moved beyond subsistence, with incomes sufficient to cover basic needs (e.g., food, housing, health); (b). Possess discretionary income for non-essential spending, such as consumer durables (e.g., appliances), education, or leisure activities and (c). Are not vulnerable to falling back into poverty with minor economic shocks, unlike those below $11/day, nor are they part of the wealthy elite above $110/day.

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.

Kharas (2017) estimates the middle-class size by integrating household survey data, national income statistics, and economic projections. Using World Bank's PovcalNet surveys from 145 countries, he adjusts underreported consumption data to align with national accounts and then models income distribution with Lorenz curves parameterized by Gini coefficients and mean consumption. Expenditures are converted to 2011 PPP dollars for global consistency, and the share of each country's population (from UN/World Bank data) within the $11–$110 range is calculated. For projections, Kharas applies GDP growth rates (e.g., from IMF forecasts), assuming distribution means grow with per capita GDP while Gini coefficients remain stable unless updated by new surveys. This absolute approach differs from relative definitions (e.g., a percentage of median income) and is designed to be globally comparable across countries and time.

While there are also other definitions and indicators of middle class, the Kharas approach is preferred for several reasons. First, relative measures mask absolute income losses due to sanctions (or economic crisis in general). Cantó and Ruiz (2015) argue that during a recession, actual income losses are more important in shaping individual perceptions of economic insecurity than general income volatility. This suggests that relative measures, which might focus on movement within the income distribution, could understate the impact of significant income drops. Afesorgbor and Mahadevan (2016) note sanctions often cause absolute welfare declines (e.g., below poverty thresholds), missed by relative definitions. A relative measure (e.g., 20th–80th percentile) would shrink with Iran's falling median income under sanctions, suggesting a rather stable size middle class despite real declines below livable standards. This obscures the sanctions' true impact.[4] Another reason to prefer the Kharas absolute measure is related to synthetic control estimation. The $11/day lower threshold is a fixed, real purchasing power standard. Sanctions reduce incomes, and SCM can measure how many people drop below $11/day compared to the synthetic control. This directly captures sanctions' economic bite—our core focus. The 20th–80th percentile (relative measure of the middle class) shifts with income distribution. If sanctions shrink everyone's income but inequality holds (or rises), the middle 60% stays the same size. The SCM would

[4] To justify adopting an absolute measure like Kharas's $11/day threshold rather than a relative measure for evaluating sanctions' impact on Iran's middle class, consider the shortcomings of defining the middle class as the middle 60% (20th to 80th percentiles). For Iran's 80 million population in 2012, this relative measure fixes the middle class at 48 million people, based solely on rank. Pre-sanctions in 2010, with a median daily income of $15, this group might span $10 to $25, with most surpassing $11/day, enabling a middle-class lifestyle (e.g., purchasing appliances or funding education). After 2012 sanctions slashed oil revenues and drove inflation, the median could fall to $10/day, shifting the range to $6–$16/day. The relative measure still labels 48 million as "middle class," yet many now dip below $11/day—some as low as $6—losing the income to sustain such a standard. By ignoring absolute income drops, relative measures fail to detect this erosion of living standards, whereas Kharas's absolute benchmark reveals the tangible socioeconomic toll of sanctions, making it better suited to our analysis of how sanctions have affected relative size of Iran's middle-class.

see no change, missing the real decline in living standards. The Kharas's $11/day threshold, on the other hand, is fixed. If inequality rises and incomes fall, more people drop below $11/day. The SCM would detect this decline against a counterfactual, linking it to sanctions' economic pressure.

*Predictor variables:*

We have introduced several predictors of the size of the middle class 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 the imposition of the 2012 international sanctions. 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, for example, 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 (2025) 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 (2025) 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 2025). 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 (2025). 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 the middle-class groups that have stronger connections with government administration. For example, Farzanegan et al. (2021) shows a positive response of the size of the middle class to positive changes in oil revenues. The latter oil rents increases enlarge the 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 (2025). One important channel through which economic growth may affect the size of the middle class is by intensifying international trade and globalization.

Finally, we use two indicators for the quality of governance taken from the World Governance Indicators (WDI 2025). 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. The higher values of these indicators imply 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). The inclusion of these dimensions of governance quality as covariates is important because it helps identify a counterfactual Iran that matches Iran's pre-sanctions quality of governance. In other words, the synthetic Iran will not differ from actual Iran in terms of governance quality, ensuring that any significant divergence in the size of the middle class after sanctions cannot be attributed to governance quality.

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 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 SCM compared to traditional regression-based approaches. The 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. The 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 at a level which was not seen before.[5] These sanctions include an embargo on the crude oil export of Iran which, on average, has accounted for 80% of total export revenues from 1980-2011 (OPEC 2024). These severe oil sanctions, coupled with financial and banking sanctions, especially on the Central Bank of Iran, were completely unprecedented before 2012. 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 (OIC). We exclude countries which have had significant exposure 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. The 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

[5] 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.

having been a target of severe economic sanctions. In light of these explanations our SCM model is the following:

Let $Y_{1t}$ denote Iran's middle-class size in year t, and $Y_{jt}$ the same for donor country $j$ (from a pool of MENA/OPEC/OIC countries), with $t$=1996,…, 2011 as pre-intervention periods before sanctions in 2012. Let $X_1$ $(Z_1', Y_{1,1996}, Y_{1,1998}, Y_{1,2000}, Y_{1,2002}, Y_{1,2004}, Y_{1,2006}, Y_{1,2008}, Y_{1,2010})'$ be a (k × 1) vector of Iran's pre-2012 characteristics, where $Z_1$ includes predictors (e.g., GDP per capita, oil rents, demography, governance, etc.) averaged over 1996–2011, and $Y_{1t}$ are middle-class sizes for the specified pre-2012 years. Similarly, $X_0$ is a $(k \times j)$ matrix of these variables for $J$ donors. Following Abadie et al. (2010), we estimate weights $W = (\omega_2, \ldots, \omega_{J+1})'$, with $\omega_j \geq 0$ and $\sum_{j=2}^{J+1} \omega_j = 1$, via a nested optimization. Inner optimization is given by:

$$W^*(V) = \arg\min_W (X_1 - X_0 W)' V (X_1 - X_0 W),$$

Where V is a $(k \times k)$ symmetric, positive semidefinite matrix weighting the predictors and lagged outcomes and outer optimization is given by:

$$V^* = arg \min_V \sum_{t=1996}^{2011} (Y_{1t} - \sum_{j=2}^{J+1} \omega_j^* (V) Y_{jt})\text{^}2$$

Where $\omega_j^*(V)$ are weights from the inner step. This selects $V^*$to minimize the mean squared prediction error (MSPE) of middle-class size over 1996–2011, ensuring synthetic Iran closely tracks Iran's full pre-sanctions trajectory. We will use a pre-treatment fit index (Adhikari and Alm 2016) for judging about reliability of synthetic Iran.

Post-2012, the effect is estimated as $\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} \omega_j^* Y_{jt}$ for t = 2012,…, 2019.

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 OIC; including 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%).[6]

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 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.

[6] 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 the 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 sanctions.[7]

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

[7] 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/

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, 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[8]. 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.

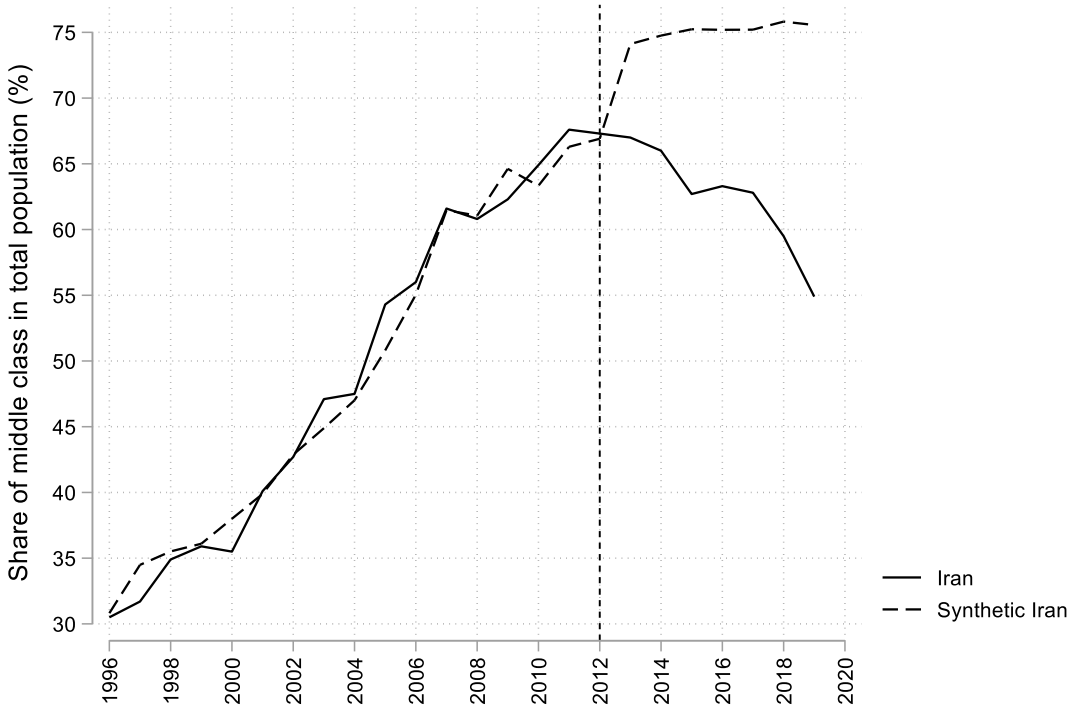


**Figure 2**. The size of the middle class: Iran versus Synthetic Iran

[8] There is cross-country evidence that sanctions have increased outmigration in target countries with restricted political freedom (Gutmann, Langer, and Neuenkirch 2024). In Iran, this effect may be amplified by internal conflicts triggered by sanctions and corruption (Farzanegan and Gutmann 2024; Farzanegan and Albarawi 2025).

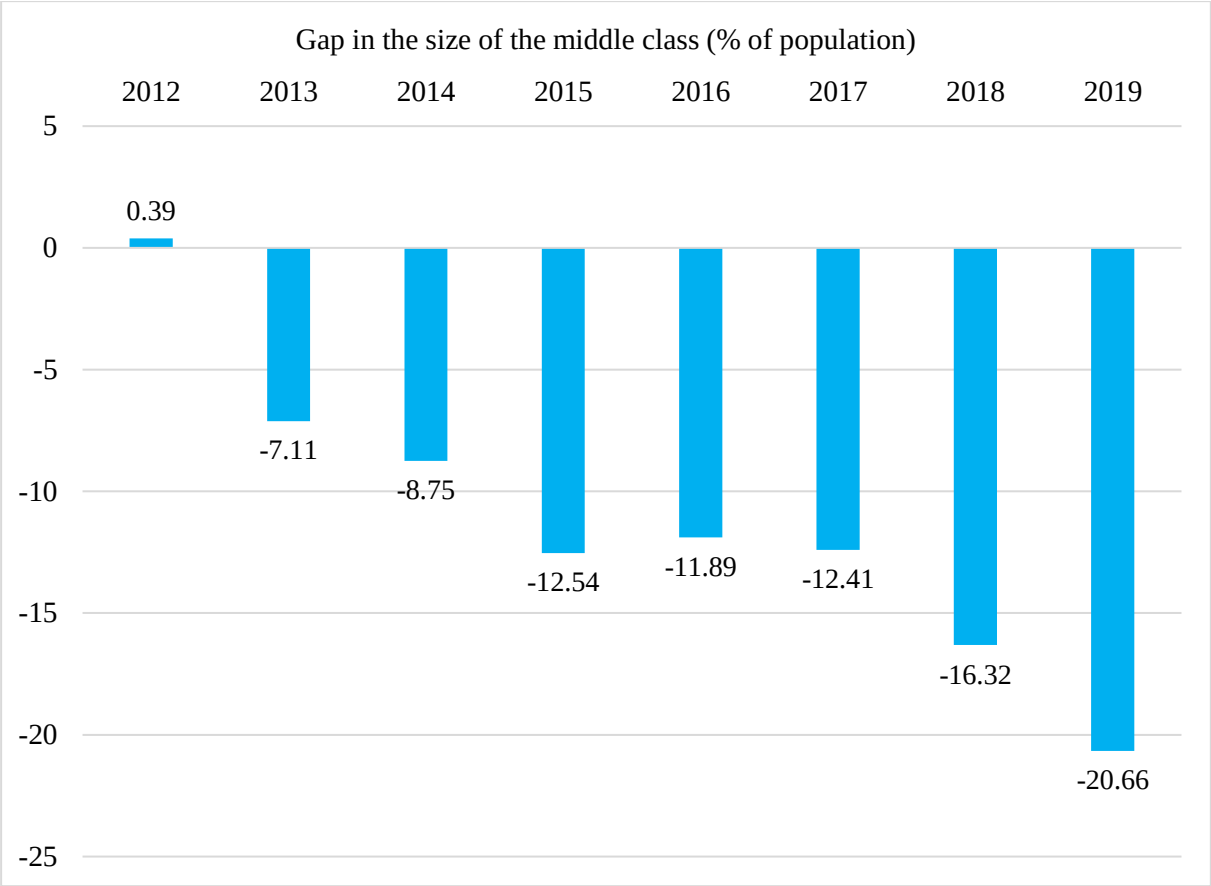


**Figure 3**. Loss of middle-class population share after 2012, as a result of increased sanctions

Our findings, regarding the decline of the middle class after the 2012 sanctions, are consistent with the results of the World Values Survey (WVS), which were conducted before and after major sanctions in Iran. This survey includes a question on how the respondents perceive the income of their households. The responses of Iranian participants in 2005 (before sanctions) and (early) 2020 (under sanctions & before COVID19 in Iran) is reported in Figure 4.

The survey asks respondents to identify the income decile to which they believe their household belongs. We combined the results into three categories (excluding no responses or do not know responses). 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 two survey years, we observe a significant decline in the share of the respondents that self-identify as middle-income 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.

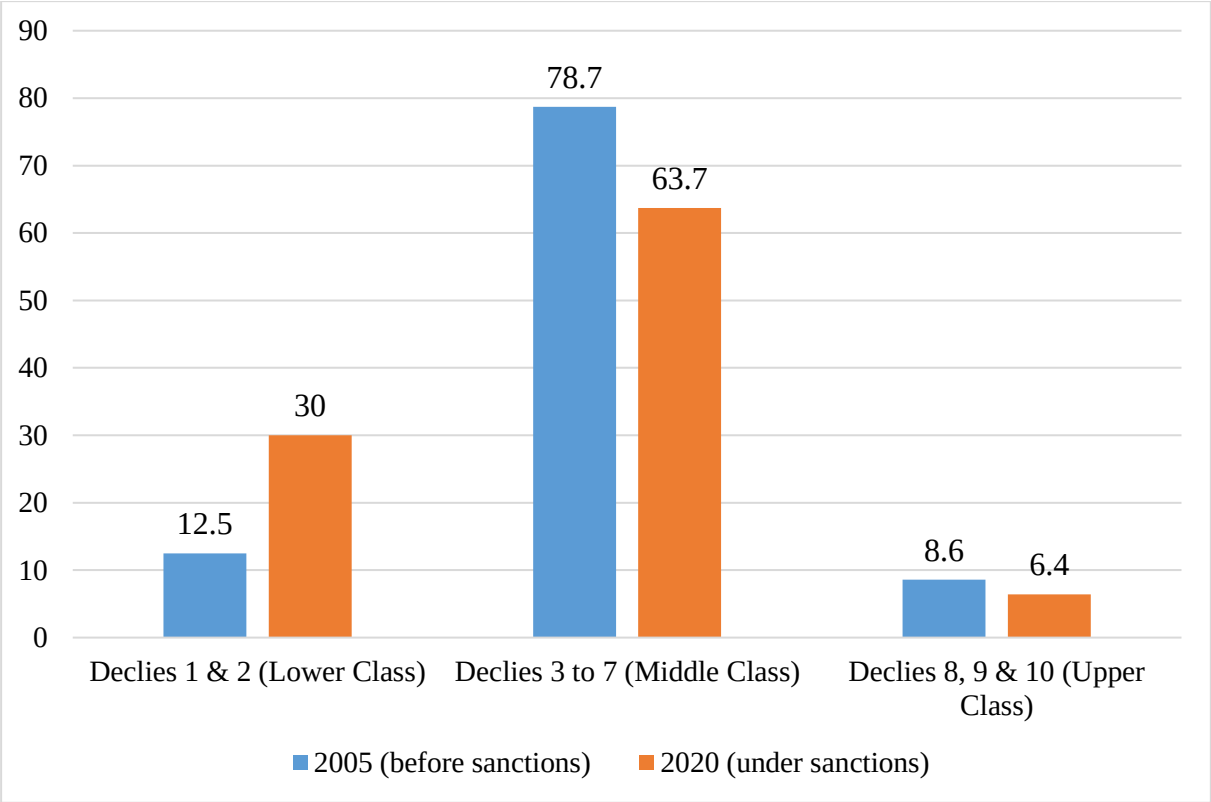


**Figure 4.** To which income category your household belongs? Self-perceptions according to World Values Survey Results for Iran.

## 5. Discussion and Selected Channels

### 5.1. Consequences of shrinking the size of middle-class under sanctions

Huntington (1991, p. 66) highlights the critical function of the middle class in easing tensions over resource distribution that can destabilize democratic systems. He contends that economic growth fosters the growth of the middle class, asserting that "economic development promotes the expansion of the middle class ... Democracy is premised ... on majority rule, and democracy is difficult in a situation of concentrated inequalities in which a large, impoverished majority confronts a small, wealthy oligarchy." A substantial and prosperous middle class serves as a mediator between the wealthy and the impoverished, reducing the push for redistribution. By keeping policies aligned with the preferences of the affluent, it deters the rich from resorting to oppressive measures and enhances the prospects for democracy (Acemoglu and Robinson 2005, p. 258). A weakened middle class can no longer act as a catalyst for political reforms or as a counterbalance to economic and political elites. Historically, the middle class in many countries—including Iran—has been the main driver of reform movements. However, its economic decline can reduce its political agency, as financial insecurity shifts priorities toward basic living costs, diminishing constructive political engagement, increasing risk of riots and violence. The latter is also addressed by Acemoglu and Robinson (2005), showing that the middle class is crucial in forming a coalition with the poor to pose a revolutionary threat against the rich. If the middle

class shrinks, the poor become a larger relative group. Without a sizable middle class to mediate, the rich face a stronger, unbuffered revolutionary pressure from the poor. A reduced middle-class size increases the rich's preference for repression over democratization to prevent revolution. In the case of Iran, we observe a higher intensity of violence and repression over the recent protests such as violent crackdown against widespread protests which started over an abrupt fuel price increase on November 15, 2019[9] or authorities' brutal crackdown on the "Woman Life Freedom" uprising at the end of 2022 (Farzanegan and Fischer 2025).

The shrinking middle class has led to greater economic dependence on state-affiliated institutions. While many private businesses have suffered under sanctions, state-linked firms—particularly those connected to the Revolutionary Guards (IRGC)—have benefited by expanding their trade networks through indirect channels. This has strengthened the state's economic power relative to the private sector. This effect is also discussed by Eichenberger and Stadelmann (2022).

Sanctions have worsened economic inequality in Iran, as evidenced by the Gini index rising from 34 in 2011 to 37.4 in 2018, with high inflation and falling real wages driving many middle-class individuals into lower income brackets (as we also quantified in our study), effectively reducing the size of this pivotal group. This aligns with the Acemoglu and Robinson (2005) framework's insight that a diminished middle class can exacerbate distributional conflicts, potentially fueling social discontent and revolutionary pressure from the poor. However, this has not yet translated into organized political pressure against the ruling regime in Iran, likely because economically strained households lack the resources—financial, organizational, or otherwise—to mobilize effectively and sustainably, a factor that may delay the revolutionary threat predicted by Acemoglu and Robinson model. Nevertheless, this shrinking middle-class buffer could still heighten instability over time, either by empowering the poor to demand greater redistribution or by prompting the rich to favor repression over concessions, consistent with the model's dynamics in Acemoglu and Robinson analysis.

In summary, weakening the middle class through sanctions does not automatically lead to greater political pressure. On the contrary, it can undermine the economic foundation of a politically active middle class, while relatively strengthening the government's economic power. However, as the economic hardship of the recent years has pushed many middle-class households into the lower class, the newly emerging "poor middle class" are likely to have an active role in future protests against poverty, inequality, and social injustice (Shojaei 2024).

[9] https://www.hrw.org/news/2020/11/17/iran-no-justice-bloody-2019-crackdown

### 5.2. Selected channels for the effects of sanctions

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 2025). 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 2025). 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 5 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 6 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.

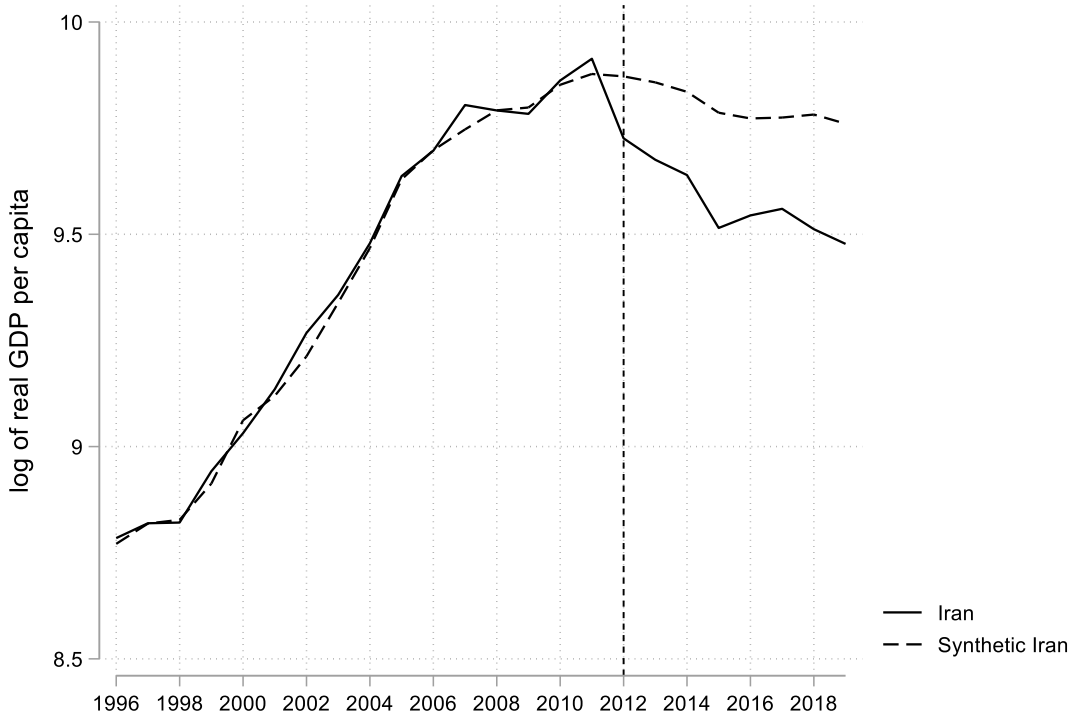


**Figure 5.** The real GDP per capita: Iran versus synthetic Iran

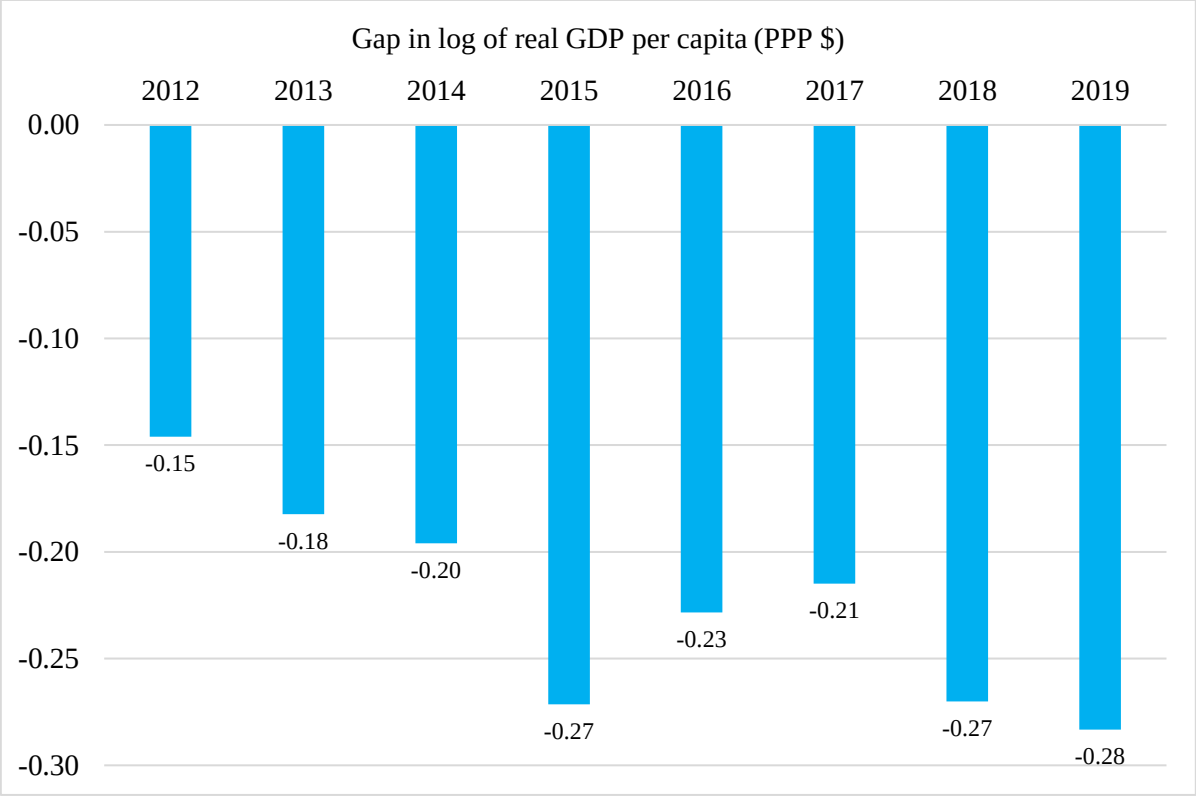


**Figure 6.** Loss of (log) income per capita after 2012, as a result of increased sanctions

Another channel which can connect the imposed sanctions with the 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. They also disrupted the international banking transactions that were needed to facilitate payment 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 maintain 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 lines, leading to job losses and decreasing economic activities, which will negatively affect 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 the 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 (2025). Figure 7 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 terms 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 8 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. The largest loss is observed in 2013 and 2019 ($31 billion) 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 over the 8 years of 2012-2019. This negative average effect is highly statistically significant (at 99% confidence intervals, with t-statistic of -2.90).

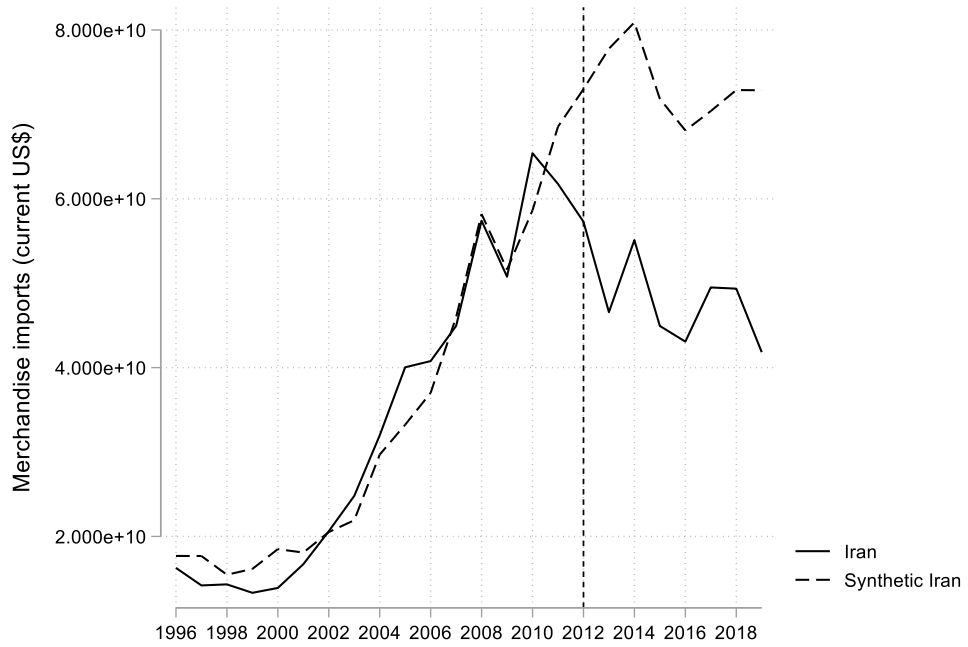


**Figure 7.** The merchandise imports ($): Iran versus synthetic Iran

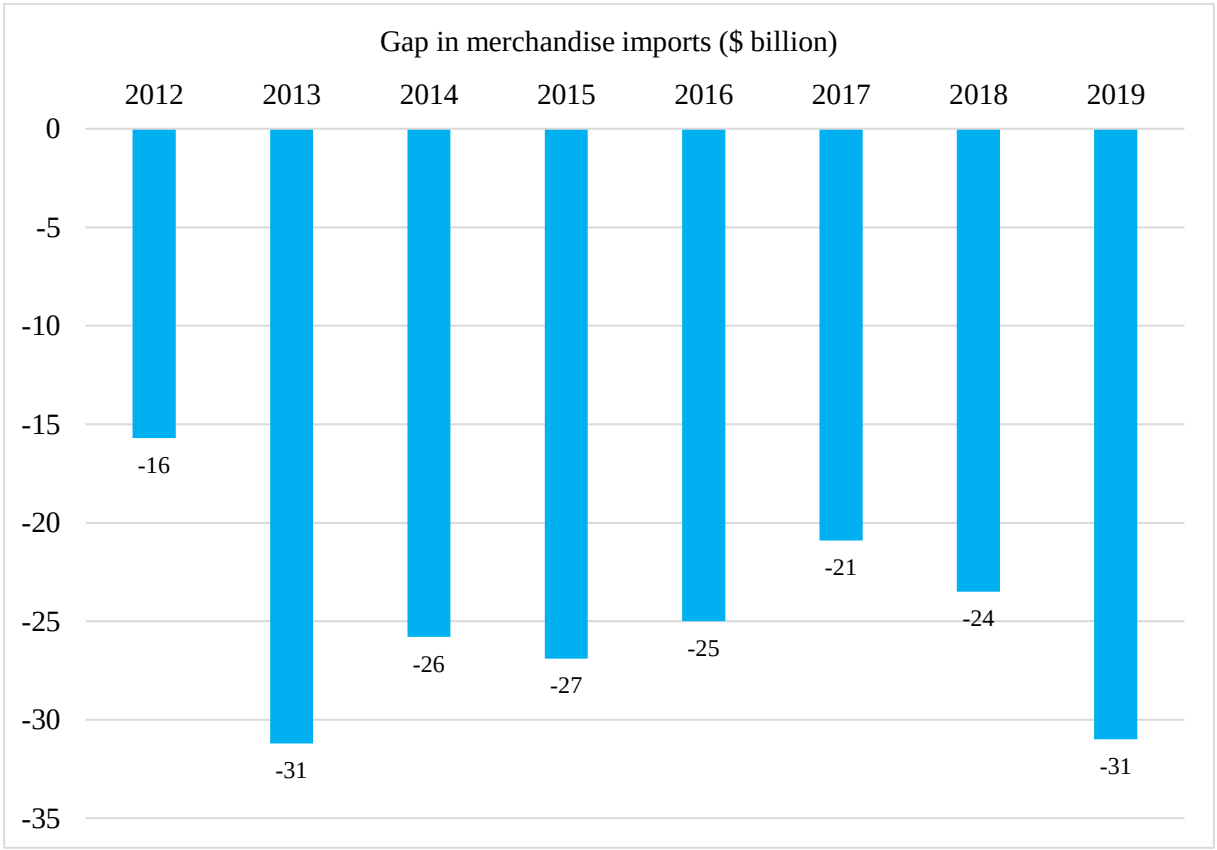


**Figure 8.** Loss of merchandise imports after 2012, as a result of increased sanctions

We also examined the effects of post-2012 sanctions on Iran's merchandise exports, which include petroleum and crude oil exports. The average estimated gap between Iran and its synthetic counterparts

from 2012 to 2019 is approximately $18 billion. The largest estimated gap is observed in 2013 ($44.9 billion). The second largest export loss was estimated for 2019 ($32 billion). The average annual export loss is moderately less than average annual import loss. This is mainly due to Iran's positive performance during the JCPOA (2016–2017) compared to its counterfactual. We observe that Iran's recorded exports in these two years were, on average, $4 billion higher than expected under the synthetic scenario. This performance was mainly due to the reactivation of Iran's oil exports under the JCPOA, which was later halted following the reimposition of sanctions by the Trump administration. Figure 9 compares the losses in imports and exports for Iran (i.e. the underperformance of foreign trade of Iran compared to its counterfactual scenario at the absence of sanctions).

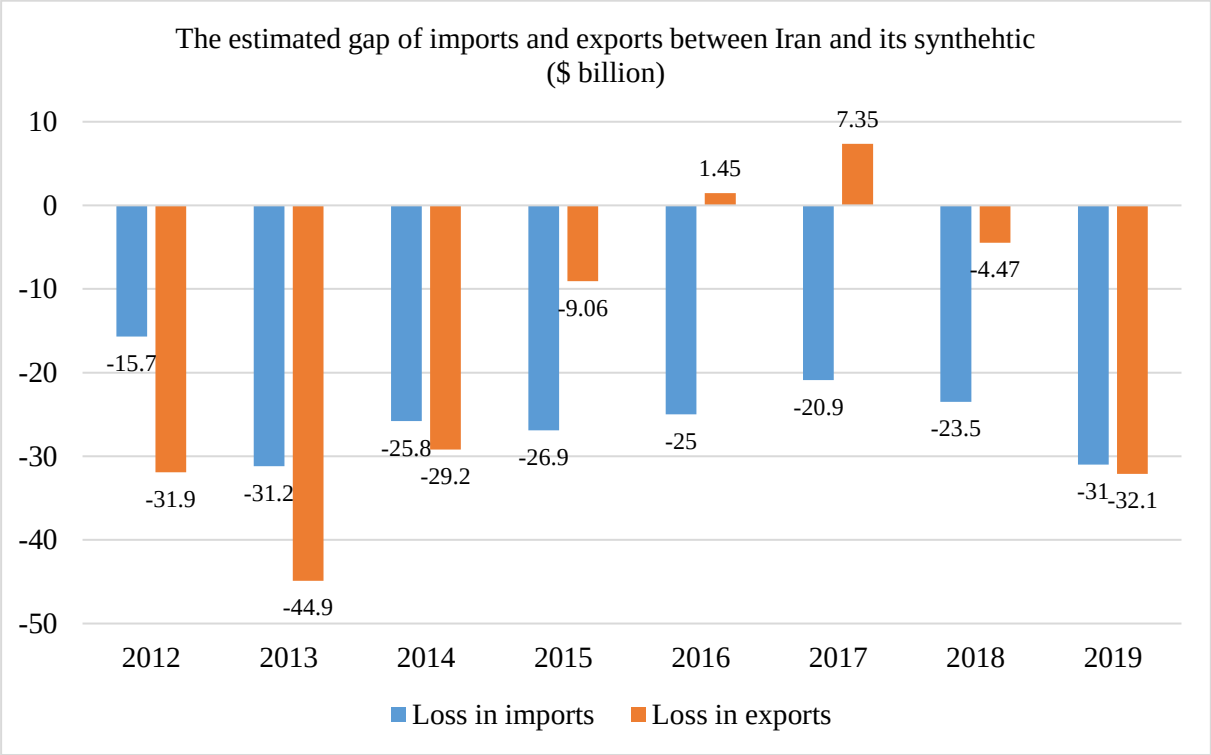


**Figure 9.** Loss of merchandise imports and exports after 2012, as a result of increased sanctions

The decline in foreign trade is not the sole avenue through which sanctions have impacted Iran's middle class; another critical channel is the evolution of capital formation, as measured by Gross Fixed Capital Formation (GFCF). The GFCF, an essential economic indicator from the WDI (2025), quantifies investments in fixed assets—such as infrastructure, machinery, equipment, and buildings like schools, hospitals, and housing—reflecting a country's commitment to enhancing productive capacity and physical capital. These investments drive economic growth, job creation, productivity, urbanization, and access to public goods, all of which are vital for sustaining and expanding the middle class. In Iran, sanctions since 2012 have severely disrupted GFCF by restricting access to foreign investment, technology, and trade, leading to a sharp decline in capital investment. This reduction has curtailed job opportunities, stifled wage growth, and hampered infrastructure development—key pillars of middle-

class stability—while also limiting housing access and human capital development through diminished funding for industrial equipment, residential projects, and public services like education and healthcare. Thus, GFCF's sensitivity to sanctions makes it a crucial lens for understanding their socioeconomic toll on Iran's middle class.

To quantify this impact, we employed SCM and SDID analyses, using GFCF as the outcome variable and the same donor sample as our initial middle-class study. Synthetic Iran was constructed from Saudi Arabia (81.3%) and Indonesia (18.7%), with a pretreatment fit index of 0.08 (equivalent to an R-squared of 92%), confirming a robust pre-2012 match. Figure 10 illustrates the trajectories of Iran's GFCF and its counterfactual, revealing stark divergences post-sanctions. Both SCM and SDID estimate substantial GFCF losses for 2012–2019: SDID indicates an average annual loss of $88 billion, significant at the 99% confidence level, while SCM estimates $86 billion, also significant at the 99% level. Figure 11 highlights the annual GFCF gap, which narrowed slightly in 2016–2017 due to the Iranian nuclear deal but widened again after the Trump administration reimposed sanctions, underscoring the persistent and profound effect of these external pressures on Iran's economic foundation and, by extension, its middle class.


**Figure 10.** The gross fixed capital formation (US$): Iran versus synthetic Iran

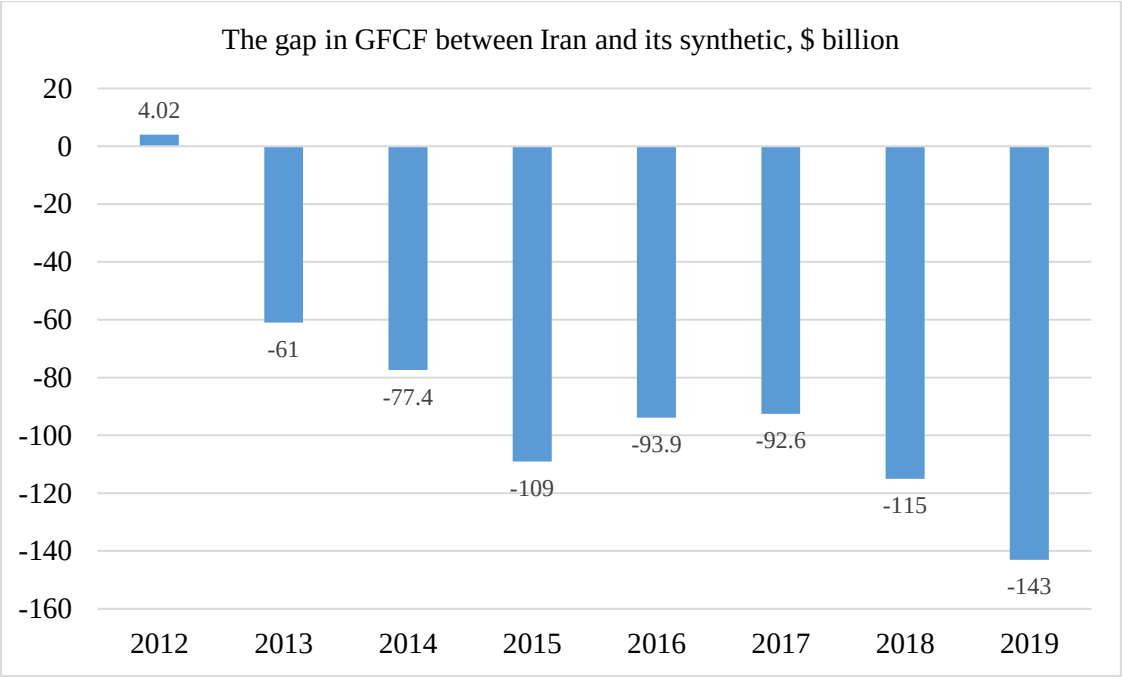


**Figure 11.** Loss of gross fixed capital formation after 2012, as a result of increased sanctions

To further explore how sanctions have diminished Iran's middle class, we examine the evolution of "Industry (including construction), value added ($)," a WDI (2025) indicator that captures the economic output of critical sectors—mining, manufacturing, construction, and utilities—essential for employment and income stability. This measure powerfully illustrates the impact of sanctions by highlighting how restrictions on raw materials, machinery, and export markets since 2012 have crippled Iran's industrial base, causing production to falter and businesses to contract. This decline directly slashes jobs in manufacturing and construction—sectors that traditionally support Iran's skilled and semi-skilled workers, whose steady incomes underpin middle-class status—while setbacks in industries like automotive and petrochemicals further erode wages and employment prospects. For example, reduced construction activity limits housing and infrastructure development, shrinking opportunities for stable livelihoods. By focusing on net output without factoring in asset depreciation or resource depletion, this indicator sharply reveals the immediate economic contraction driven by sanctions, offering a clear perspective on how these disruptions undermine the income and purchasing power, vital to Iran's middle class.

We analyzed this using the SCM, with the donor sample mirroring earlier analyses. Synthetic Iran for this outcome comprises Indonesia (34.7%), Azerbaijan (33.1%), Saudi Arabia (28.2%), and the United Arab Emirates (4.1%), achieving a pretreatment fit index of 0.06 (R-squared of 94%), which confirms a robust match with Iran's industrial value added from 1996 to 2012. Figure 12 traces the trajectories of Iran's industry value added indicator and its counterfactual, exposing significant post-2012 divergences. Both SCM and SDID analyses estimate substantial losses for 2012–2019, with SDID showing an average annual loss of $99 billion and SCM indicating $90 billion—both statistically significant at the

99% confidence level. Figure 13 details the annual gap, which narrowed during the 2016–2017 Iran nuclear deal period but widened after the Trump administration's withdrawal, reinforcing the profound and persistent toll of sanctions on Iran's industrial vitality and, consequently, its middle class.

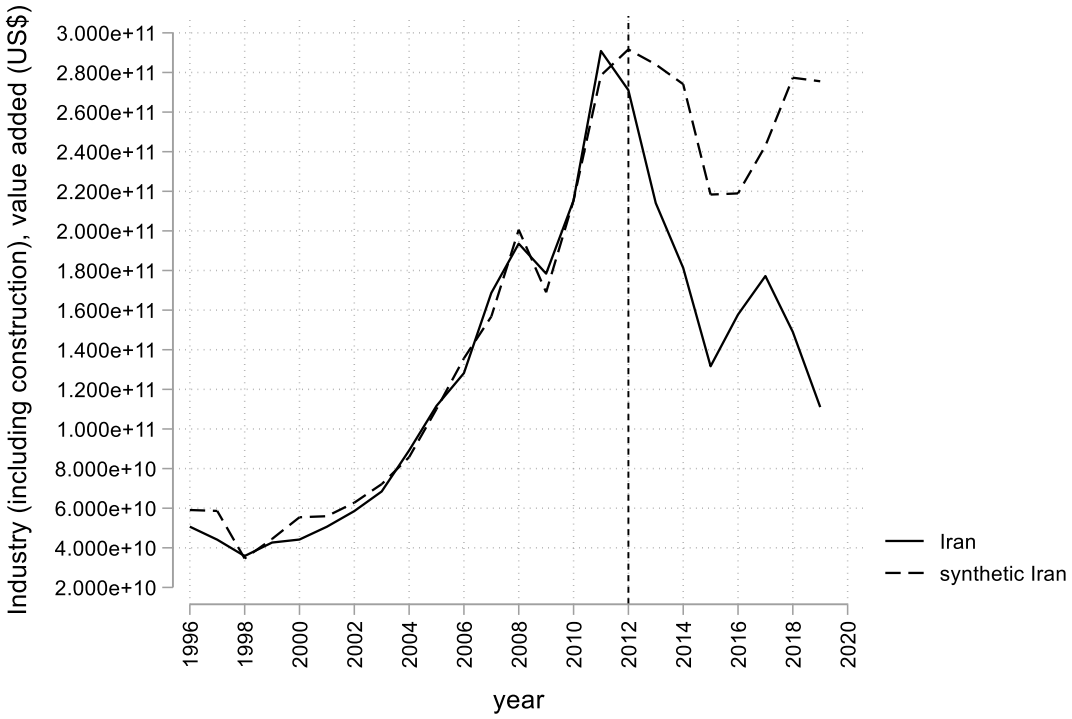


**Figure 12.** The industry value added (US$): Iran versus synthetic Iran

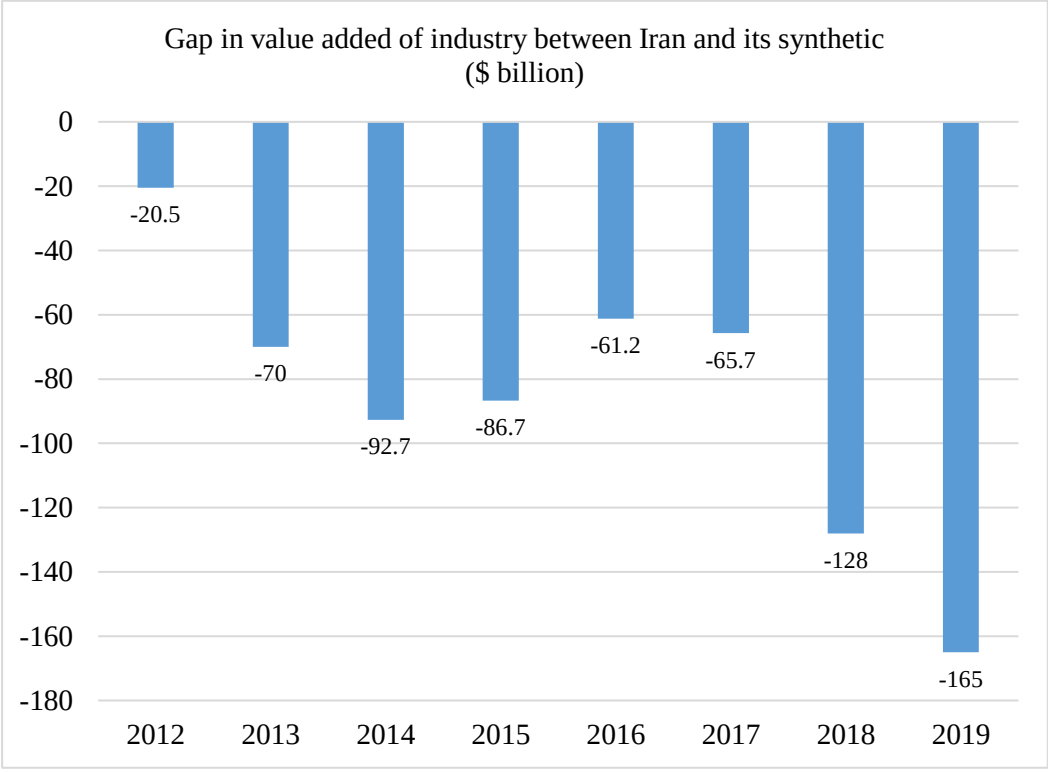


**Figure 13.** Loss of industry value added after 2012, as a result of increased sanctions

We also examine two other outcomes related to job market development under sanctions. The first interesting indicator is the share of self-employment in total employment and its evolution before and after major sanctions in Iran. The "self-employed, total (% of total employment)" indicator, as a measure of informal employment (La Porta and Shleifer 2014), is highly relevant for understanding the negative impact of sanctions on Iran's middle class, particularly given its trend reversal from decreasing before 2012 to increasing after the imposition of stricter sanctions. Before 2012, a declining self-employment ratio suggested growing formal sector jobs—typically salaried positions with stability and benefits that bolster the middle class—reflecting economic modernization. However, post-2012 sanctions disrupted this trajectory by constricting Iran's formal economy (Farzanegan 2013; Moghaddasi Kelishomi and Nisticò 2024), especially in industry and trade, forcing many workers out of stable wage employment into self-employment, such as own-account work or contributing family roles. This shift, tracked by the International Labour Organization's modeled estimates, signals a rise in precarious, profit-dependent livelihoods lacking social protections, as sanctions curtailed industrial output and investment (as also shown in this study), shrinking formal job opportunities. For Iran's middle class, this trend—evidenced by WDI (2025) data—means reduced income security and resilience, pushing households toward poverty and informal work rather than middle-class stability. The indicator's sensitivity to economic shocks like sanctions highlights its importance in showing how formal employment's decline undermines the socioeconomic foundation of Iran's middle class.

Our SCM analysis using the self-employment share on total employment as the dependent variable, results in a synthetic Iran which is based on Morocco (40.25), Lebanon (35.1%), Tunisia (12.5%), and Nigeria (12.1%). The pretreatment fit index is 0.009 (i.e. R-squared of 99%), indicating a strong match between Iran and its synthetic version for this outcome before 2012. Figure 14 shows the development of self-employment share of the labor force in Iran and its counterfactual. The effect of sanction is evident by comparing the trend of synthetic Iran with Iran, after 2012.

The SDID analysis yields an average treatment effect on the treated (ATT) of 3.44 for the outcome "Self-employed, total (% of total employment)" in Iran over the period 2012–2019. This ATT indicates that, following the imposition of sanctions starting in 2012, the percentage of total employment that is self-employed increased by approximately 3.45 percentage points on average in Iran compared to what would have been expected without the sanctions, as estimated by the synthetic control. The estimated average effect is statistically significant at the 95% confidence interval. In simpler terms, the sanctions are associated with a significant rise in informal, self-employed work, likely reflecting a shift away from formal employment and underscoring their negative impact on Iran's economic structure during this period. Figure 15 shows the annual gap in this outcome between Iran and its counterfactual, estimated with SCM method (with an average annual gap of 3 pp).

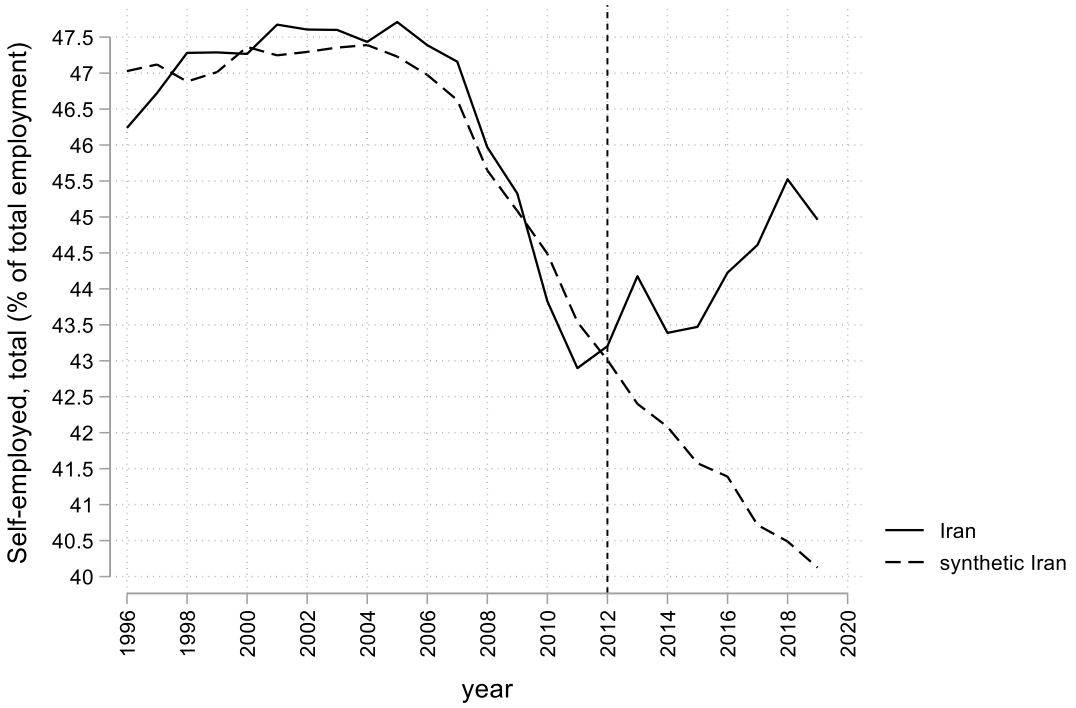


**Figure 14.** Self-employed, total (% of total employment): Iran versus synthetic Iran

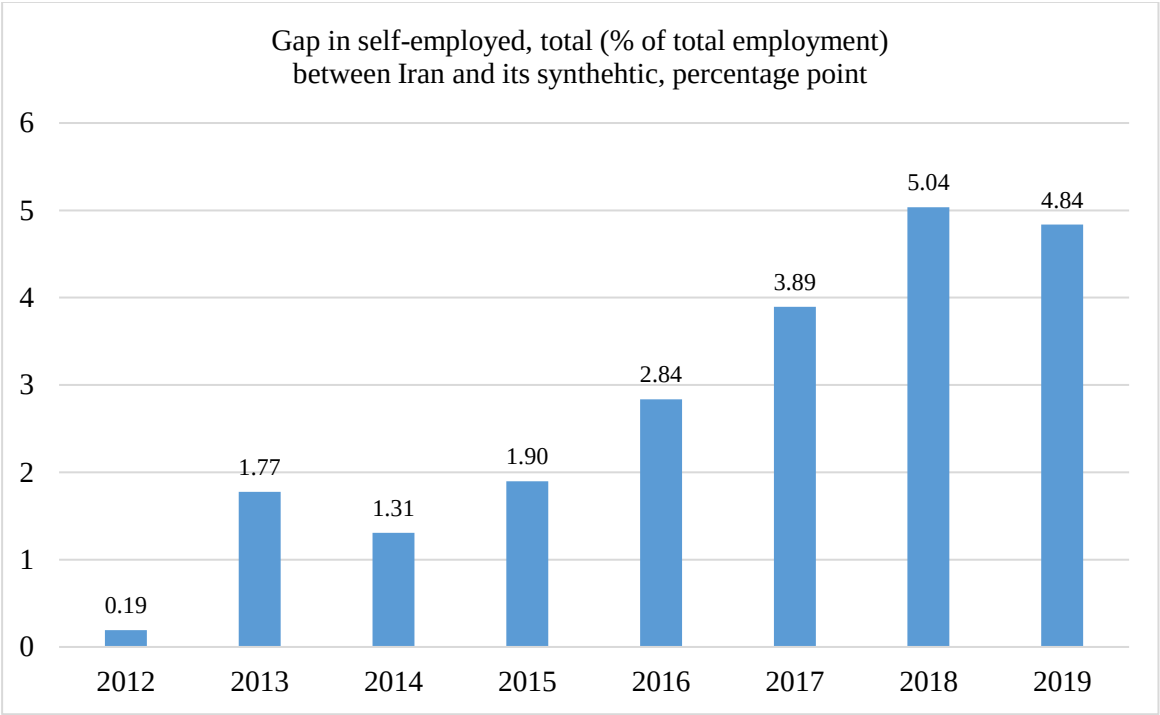


**Figure 15.** Excess informal employment after 2012, as a result of increased sanctions

Finally, we examine the share of vulnerable employment in total employment. Vulnerable employment as a share of total employment is a narrower indicator, specifically comprising only own-account workers and contributing family workers. This excludes self-employed employers and cooperative

members, focusing solely on those considered most economically precarious due to their lack of hired employees or formal wages. For our purpose—assessing the negative effects of sanctions on Iran's middle class—this distinction matters. The self-employment data we have already analyzed (with the ATT of 3.4 pp from 2012–2019) captures a wider shift toward informal work, including some potentially stable self-employed roles (e.g., small business owners with employees). However, vulnerable employment targets the most insecure segments—own-account workers and contributing family workers—who face higher poverty risks, lack social protections, and are less likely to sustain middle-class living standards. The WDI (2025) notes that these groups are particularly susceptible to economic shocks, like sanctions, which aligns with our interest in how Iran's middle class might shrink as formal jobs disappear. Using this outcome, the synthetic Iran is estimated based on Nigeria (42.1%), Bahrain (30.9%), Tunisia (11.4%), Indonesia (8%), and Morocco (7.5%). The pretreatment fit index is 0.007, indicating a strong match between Iran and its synthetic before 2012. Figure 16 shows the result for this variable.

The SDID analysis for "Vulnerable employment, total (% of total employment)" in Iran shows an ATT of 2.76 for the period following the 2012 sanctions (2012–2019). This ATT indicates that sanctions led to an average increase of approximately 2.76 percentage points in the share of total employment classified as vulnerable—covering own-account workers and contributing family workers—compared to the synthetic control scenario without sanctions. With statistical significance at 90% CI, this finding points to a meaningful rise in precarious, informal work linked to the sanctions, suggesting a tangible shift that could undermine Iran's middle class by pushing more workers into unstable livelihoods lacking social protections. This complements the broader self-employment trend we analyzed, reinforcing the narrative of sanctions driving economic insecurity. Figure 17 shows the excess increase in share of vulnerable employment in Iran under sanctions.


**Figure 16.** Vulnerable employment, total (% of total employment): Iran versus synthetic Iran

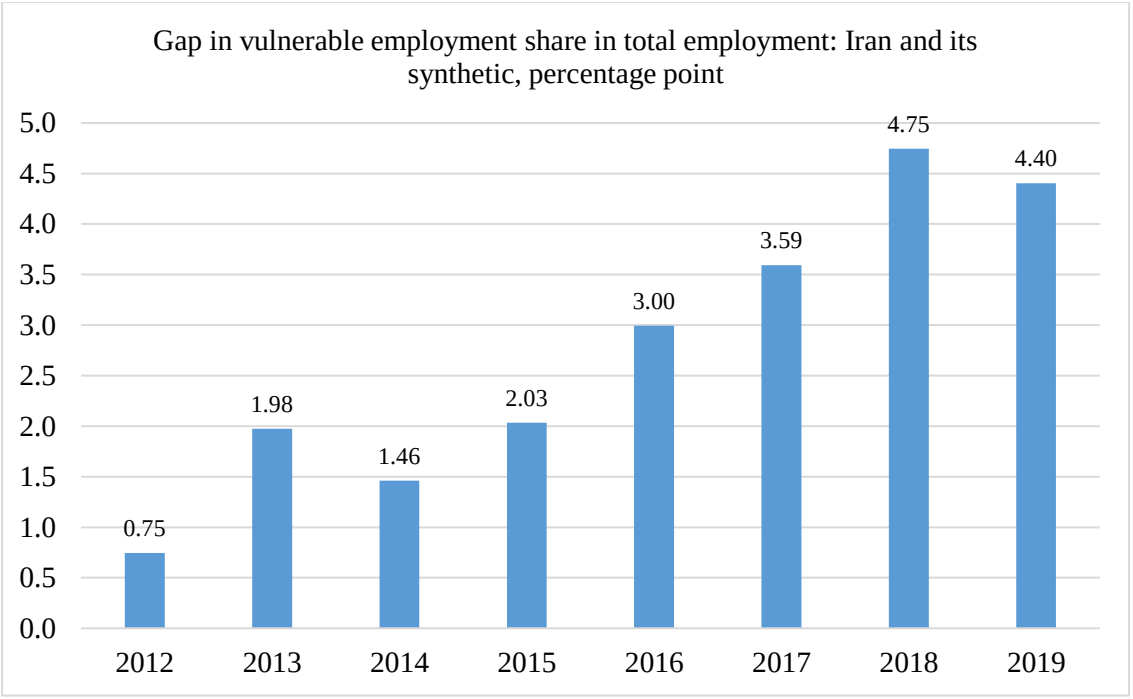


**Figure 17.** Excess vulnerable employment after 2012, as a result of the increased sanctions

## 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 starting 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 the middle class in Iran between 2012-2019. Finally, we discussed the potential factors underlying the significant decline in size of the middle class and provide evidence for the relevance of real GDP per capita, imports and exports, gross fixed capital formation, value added of industry, informal employment, and vulnerable employment as selected channels through which sanctions affect the size of the 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.

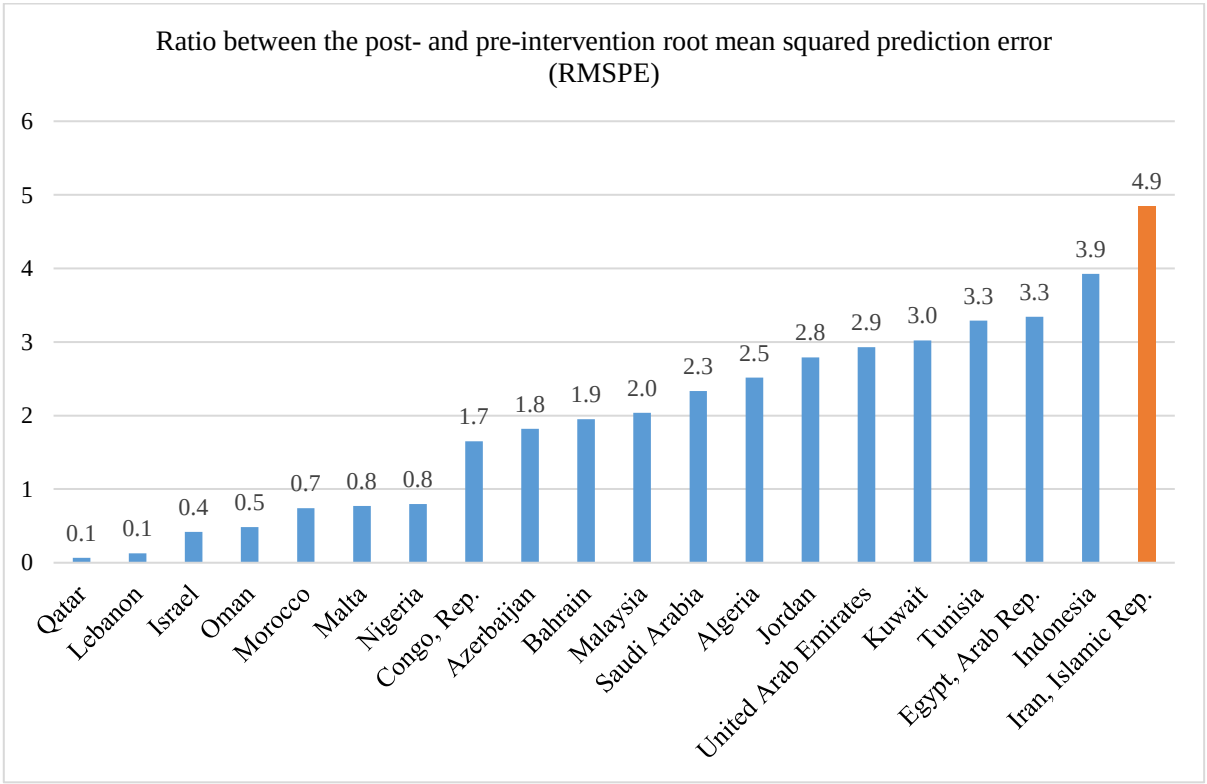


**Figure A1**. Ratio between the post- and pre-intervention root mean squared prediction error (RMSPE)

***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.

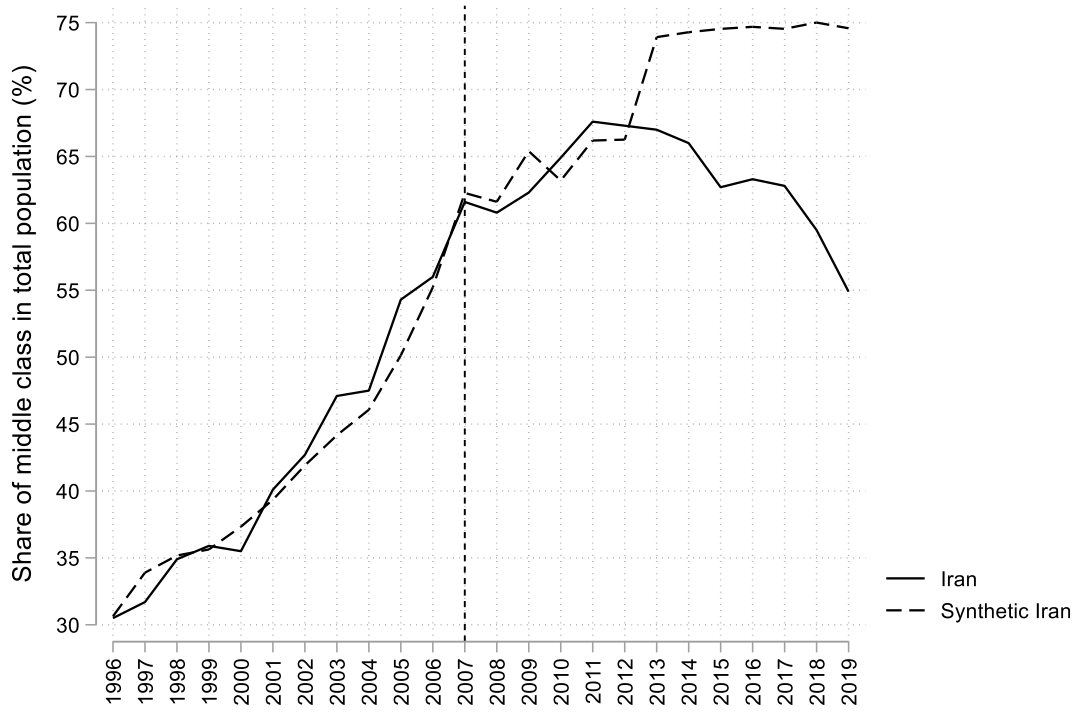


**Figure A2**. In-time placebo effect of 2007 size of the middle class of Iran vs. synthetic Iran.

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.

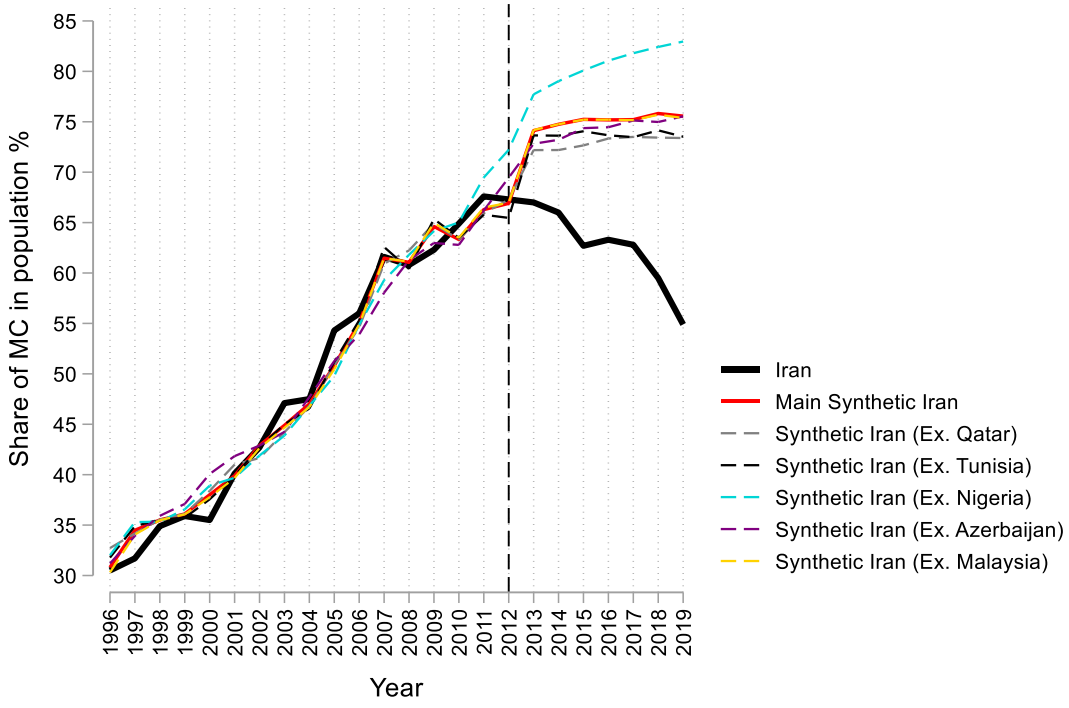


**Figure A3.** Leave-one-out distribution of the synthetic control for Iran.

***Synthetic Difference-in-Differences (SDID)***

SDID is a panel-based approach where certain countries (e.g., Iran) receive treatment while untreated countries serve as controls. Introduced by Arkhangelsky et al.( 2021), SDID blends the strengths of difference-in-differences (DID) and SCM, estimating the treatment effect as the difference-in-differences between treated units and their synthetic controls across pre- and post-treatment periods. Unlike SCM, which constructs a counterfactual solely from a weighted combination of untreated units to match pre-treatment outcomes, SDID enhances this by also optimizing time-specific weights across pre-treatment periods, leveraging both cross-sectional and temporal variation. This dual-weighting approach reduces bias from unobserved heterogeneity and improves robustness over SCM, especially

in settings with limited pre-treatment data or dynamic trends, while retaining SCM's flexibility in handling single-treated-unit cases. In our analysis, Iran is the sole treated country, and synthetic controls are constructed as an optimally weighted combination of untreated units (unit-specific weights) and pre-treatment periods (time-specific weights), as detailed in Arkhangelsky et al. (2021). 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)[10], estimated at approximately -11.76 percentage points over 8 years (2012–2019) without covariates and -10 and -9.4 with selected covariates, both highly statistically significant at the 99% and 95% confidence intervals, respectively.

For ATT of -10, we applied the "optimized" option in SDID. This is the default method, following Arkhangelsky et al. (2021). It adjusts the outcome variable by applying SDID to the residuals after regressing the outcome on the covariates across all units. This approach optimizes weights while accounting for covariate effects but can be sensitive to high covariate dispersion.

For ATT of -9.4 we applied the "projected" option. This method, based on Kranz (2021), adjusts the outcome by estimating covariate effects only from untreated units and then projecting these onto all units. It is often faster and more stable, especially in cases with complex covariate structures.

Our preferred ATT is the first one (-11.76) which shows the overall effect of sanctions on the size of middle class in Iran. By excluding covariates, SDID relies solely on its ability to generate optimal unit and time weights from the outcome variable itself (Equations 4 and 6, in Clarke et al. 2024, pp. 562-563). This ensures that the method's primary advantage—constructing a counterfactual that matches pre-treatment trends without additional assumptions about covariate relationships—is fully leveraged, maintaining its theoretical purity and robustness. Clarke et al. (2024) highlights potential complications when including covariates, such as sensitivity to covariate scaling and variance in the optimization process (p. 564). For instance, the "optimized" approach can lead to non-optimal solutions if covariates have large magnitudes or variances, requiring standardization to mitigate numerical issues (p. 565).

Excluding covariates avoids these pitfalls entirely, eliminating the need to specify or preprocess additional variables, which could introduce bias if the relationship between covariates and outcomes is misspecified or varies over time differentially across groups (Kranz 2022).

Another advantage of this approach is avoidance of bias from covariate adjustment. Clarke et al. (2024) notes that covariate adjustment in SDID (e.g., via residuals as in Equation 7, p. 564) differs from SCM, where covariates are matched directly. Arkhangelsky et al. (2021) treat covariate adjustment as a preprocessing step, but Kranz (2022) warns that if covariate-outcome relationships differ across

[10] The ATT is calculated as a pre- vs. post-treatment difference-in-differences (DiD): Pre-treatment: Average outcome for Iran vs. synthetic control before 2012. Post-treatment: Average outcome for Iran vs. synthetic control after 2012. The ATT is the difference in these differences, isolating the treatment effect (sanctions) from trends. The ATT represents the average annual effect of the sanctions on the size of Iran's middle class, compared to what it would have been without sanctions, averaged across 2012–2019.

treatment and control groups over time, this can bias treatment effect estimates. Excluding the covariates sidesteps this risk, relying instead on the assumption that pre-treatment outcome trends capture the relevant heterogeneity, which aligns with SDID's design to handle non-parallel trends (Clarke et al. (2024), p. 561).

Also, Clarke et al. (2024) emphasizes that SDID's effectiveness hinges on modeling pre-treatment trends adequately, requiring sufficient pre-treatment periods rather than covariate adjustments (p. 593). The method's double robustness—stemming from optimal weighting of both units and time periods—reduces reliance on covariates to achieve a good counterfactual match (p. 593). If pre-treatment trends are well-aligned without covariates, adding covariates may introduce unnecessary complexity without improving the estimates.

The mean of these three estimated ATTs is a 10.4 pp average annual loss in the size of Iran's middle class during 2012–2019. This ATT, based on SDID, closely aligns with our earlier SCM-based estimate of the average annual decline in Iran's middle-class size following international economic sanctions.

**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)* | -10.04 | 4.81 | -2.09 | 0.037 | -19.48 | -0.60 |
| Post 2012 sanctions on Iran (including covariates)** | -9.40 | 4.04 | -2.32 | 0.020 | -17.32 | -1.46 |

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. * The optimized type is applied for matching covariates. ** The projected type is applied for matching the covariates.

***Narrower income range for middle class***

Our original analysis is based on per capital daily spending range of 11-110 $ 2011 PPP, calculated by Kharas (2017). In an additional check we use data from Poverty database of Our World in Data (OWD)[11], calculating the share of population who live between 10-40 $ 2017 PPP as outcome variable.

The OWD data shows that, on average from 1998 to 2019, 46.3% of Iran's population lives below $10/day PPP and 96.5% below $40/day PPP. This implies that 50.1% of Iran's population falls between $10 and $40/day, closely aligning with the 55% average share in the Kharas $11–$110/day range for Iran over the same period. This similarity also holds for other developing countries in our donor sample (e.g., Tunisia), where nearly all households fall below $40/day. Thus, while the $110/day upper limit may appear high, the Kharas data effectively captures an upper bound around $40/day in these contexts, with the $11/day threshold separating the vulnerable populations from the middle class.

We conducted a robustness check using the OWD, re-estimating our SMC analysis for the $10–$40/day range, a narrower upper limit. We include the same covariates as in the Kharas based middle class analysis. Due to OWD data limitations—coverage is incomplete from 1996 to 2019 and MENA/OPEC countries are underrepresented in the OWD database—we expanded the donor pool to include some European countries. Despite these constraints and modifications, the results are similar to our findings based on Kharas (2017) data and show a comparable negative effect of sanctions. Given that 96.5% of Iran's population lives below $40/day, the $11–$110/day and $10–$40/day ranges overlap almost entirely in practice, explaining the consistency of our findings. This robustness across upper limits reinforces our original results with the Kharas range, offering broader data availability and applicability. The correlation coefficient between Kharas measure of middle class and OWD (interpolated) share of population between $10-$40 (2017 PPP) is 0.92 for case of Iran and 0.52 for the whole panel data sample (statistically significant at 1% level). The SCM results using this new outcome variable is shown in Figure A4. The pre-treatment fit index of this model is 0.018, indicating a strong match between pre-2012 characteristic of Iran and its synthetic version.

Based on SDID estimations, we observe an ATT of -8.27 which is statistically significant at 5% level (with t statistics of -2.57 and p-value of 0.010). Specifically, it indicates that, on average, the share of Iran's population in this income bracket decreased by 8 percentage points in the post-sanction period (2012–2019) compared to what it would have been without the sanctions, as inferred from the synthetic control.

[11] https://ourworldindata.org/poverty


**Figure A4.** The share of population between $10-$40 per day: Iran versus synthetic Iran