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The effect of international sanctions on the size of the middle class in Iran☆

Mohammad Reza Farzanegan [a,b,c,*], Nader Habibi [c,d]

[a] Economics of the Middle East Research Group, Center for Near & Middle Easter Studies (CNMS), School of Business and Economics, Philipps-Universität Marburg, Marburg, Germany
[b] CESifo, Munich, Germany
[c] ERF, Cairo, Egypt
[d] Crown Center for Middle East Studies & Department of Economics, Brandeis University, Waltham, MA, USA

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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 its middle class. Specifically, it investigates how Iran's middle class would have evolved absent sanctions post-2012. Using the Synthetic Control Method (SCM) with nested optimization, we construct a counterfactual scenario for Iran based on a weighted average of comparable countries that mirror pre-2012 Iran but without significant sanctions. Our SCM results indicate that sanctions led to an average annual reduction of 17 percentage points in the size of Iran's middle class from 2012 to 2019. Our Synthetic Difference-in-Differences (SDID) analysis, however, provides a more conservative estimate of a 12 percentage points average annual loss, reinforcing the robustness of the findings. These estimates capture the total effect of sanctions, encompassing both their direct economic shocks, and Iran's policy responses. These results are validated through extensive sensitivity checks, including in-space and in-time placebo tests, leave-one-out analyses, and bias-corrected SCM. We also identify real GDP per capita, merchandise imports and exports, investment, industry value added, informal and vulnerable employment as key channels through which sanctions negatively impact the middle class.

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* Corresponding author. Economics of the Middle East Research Group, Center for Near & Middle Easter Studies (CNMS), Deutschhausstr. 12, 35032 Marburg, Germany.
E-mail addresses: farzanegan@uni-marburg.de (M.R. Farzanegan), nhabibi@brandeis.edu (N. Habibi).

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1. Introduction

The middle class has acquired a sacred position in Western nations and emerging market economies alike. It is valued for 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, with politicians often presenting 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 where its poor and low income population ascend into the middle class (Kharas and Gertz, 2010). The emergence of the middle class, in turn, contributes to sustainable development and technological progress in several ways by increasing entrepreneurship, innovative thinking, and other pro-development values within the marketplace and in educational spaces (Banerjee and Duflo, 2008; Chun et al., 2017; Pleninger et al., 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 monetary 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 requires a counterfactual Iran, which upholds characteristics 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 (SCM) 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.

Fig. 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. This period included temporary and partial sanction relief following the implementation of the Joint Comprehensive Plan of Action (JCPOA) on January 2016 (Batmanghelidj and Rouhi, 2021). This was upended after Donald Trump won the November 2016 election, leading the 2018 U.S. withdrawal from the agreement and the reimposition of "maximum pressure" sanctions, which intensified Iran's economic decline (Ghet, 2022). A timeline summarizing the key developments from 1996 to 2019 is presented in Table 1. Besides the economic sanctions, however, other factors such as quality of governance and adoption of bad economic policies may have further contributed to changes in the size of Iran's middle class. Our analysis estimates the total effect of sanctions on the middle class, which includes not only their direct economic impacts (e.g., reduced oil exports and financial isolation), but also the indirect effects of endogenous policy responses by the Iranian government (e.g., shifts in domestic spending or efforts to bypass trade restrictions).

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. Thus, the challenge of causal analysis is the creation of a synthetic unit that best replicates the factual unit of interest under treatment.

Our approach, based on the 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 sanctions. We also present a qualitative analysis of Iranians' perceptions of their social class status before and after the sanctions, using data from the World Values Survey. This analysis reinforces the SCM-based estimate of the middle-class decline in Iran by pairing quantitative losses with qualitative self-perceptions among Iranians. Finally, we explore the possible transmission channels behind the estimated effect, thereby contributing to a better understanding of how sanctions affect the middle class, directly and indirectly.

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, including sensitivity checks. Section 5 discusses these results and examines selected channels through which sanctions may impact the size of the middle class (with details available in the online appendix). Finally, we conclude the paper in Section 6.

[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.

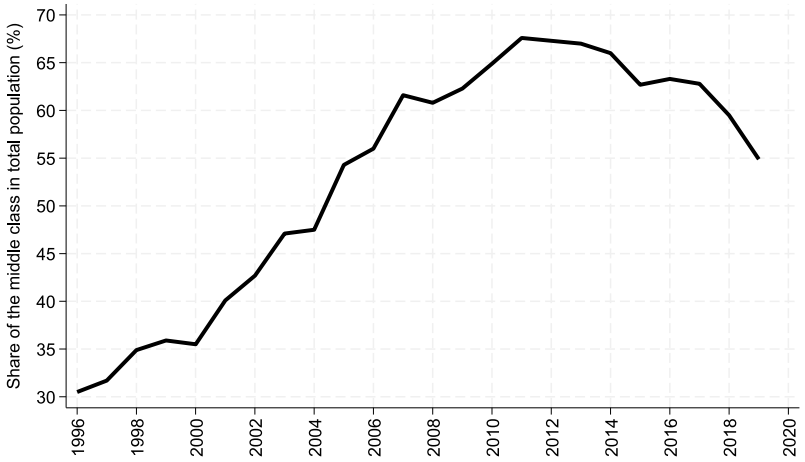

Fig. 1. Iran's middle class as a percentage of total population
Note: Middle-class variables estimate the number of people living in households earning or spending between $11 and $110 per person per day (2011 $ purchasing power parity (PPP) prices), calculations taken from Kharas (2017).

Table 1
Key developments related to Iran (1996–2019).

1997	Mohammad Khatami elected president; reformist agenda begins
2005	Mahmoud Ahmadinejad elected; confrontational foreign policy and populist economics intensify
2009	Disputed presidential election and Green Movement protests
2012	EU/US ban Iranian oil imports; US imposes secondary sanctions on Iran's central bank and financial sector, severely restricting oil revenues and international transactions
2013	Hassan Rouhani elected; initiates nuclear negotiations aiming for sanctions relief
2015	Joint Comprehensive Plan of Action (JCPOA) signed
2016	Partial lifting of nuclear-related sanctions; brief recovery in oil exports and economy.
2017	Donald Trump becomes the President of the USA and promises to terminate US participation in the JCPOA
2018	US withdraws from JCPOA; reinstates all prior sanctions and imposes new ones under 'maximum pressure' strategy, targeting oil, banking, shipping, and access to foreign reserves
2019	Impact of US sanctions deepens; inflation spikes, output contracts; major protests erupt in response to fuel price hikes

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 listed in Table 1 (Laub, 2015). First, the U.S. adopted 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 in the nation. During 2012, both the United States and European Union strengthened the financial and energy sanctions against Iran, without any significant resistance by China, which was Iran's largest trade partner and its largest oil consumer (Morris, 2012), and Russia, which expanded its security and military cooperation with Iran (Katz, 2012).

Key economic indicators show that the Iranian economy suffered strong adverse macroeconomic shocks after 2012 as these sanctions reduced oil export revenues sharply, disrupting trade and investment in all sectors of the economy (Azarbayejani et al., 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 et al., 2022). The limited sanction 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 et al., 2020). Many U.S and international sanctions remain in effect as of 2025. After comparing the severity and scope of the economic sanctions in various periods we concluded that 2012 was the

inflection 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-Isfahani, 2023). 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 (Farzanegan et al., 2021; Zahirinejad, 2014). 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 the economic and political development of Iran. Equally important is the role 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, 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 previously marginalized and low-income individuals were lifted from poverty in both rural and low-income urban areas.[2] 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 in 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 Neuenkirch and Neumeier, 2015; Gutmann et al., 2021, 2023; Liou et al., 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 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 of a nation 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 $110 per day in 2011 PPP terms) to identify the middle class and measure its relative population share. While a small number of upper-class households might enter the middle class as their per capita income falls below $110, this figure will be much smaller than the number of 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 true in the case of 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, 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).[3] While public sector wages have traditionally 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, resulting in a growing transfer of retirees dropping down from the middle class to the lower class (Barardehi et al., 2024).

The third channel is the international trade linkages in the business sector (Afesorgbor, 2019). The sanctions have disrupted the

[2] Despite the destructive economic effects of the revolution and the eight-year war with Iraq (Farzanegan, 2022a), income inequality declined significantly during the first decade after the 1979 revolution. Farzanegan and Kadivar (2023) explain the reasons behind this decline.

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

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 larger firms (through backward linkages).[4] As a result, some workers and middle-class entrepreneurs (small business owners) have also experienced downward mobility into the lower-class category. Additionally, business bankruptcies have contributed to a rise in inequality as some state-owned enterprises and well-connected private businesses have consolidated markets by purchasing 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 informal and consequently more vulnerable employment.

This adverse trade shock was driven primarily by a sharp decline in oil export revenues after 2012. Iran's crude oil exports fell from approximately 2.2 million barrels per day in 2011 (the year before implementation of EU/US ban on crude oil export of Iran) to about 500,000 barrels by 2019 (FRED, 2024). The development of Iranian crude oil exports from 2000 to 2019 is shown in Fig. 2. Using the OPEC Reference Basket in nominal and real terms ($/b), we calculated the annual revenues from crude oil exports for Iran from 2000 to 2019. Fig. 3 shows this trend. It is evident that the revenues of crude oil exports were significantly reduced following the 2012 international sanctions, both in nominal and real terms. Given that petroleum export revenues (including crude oil and refined products) accounted for about 80 % of total export earnings from 1980 to 2011 (OPEC, 2024), the collapse severely constrained the government's access to foreign exchange. Consequently, total merchandise imports declined by over 30 %, from $62 billion in 2011 to $42 billion in 2019 (WDI, 2025).

The fourth transmission channel is the adverse impact of sanctions on the quality of governance and efficiency of government services needed 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 recruitment of 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 embezzlement and the loss of large amounts of public funds in various clandestine dealings (Farzanegan and Zamani, 2025; 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 the IRGC holds an active role in counter-sanction activities. These steps have resulted in an additional increase in nepotism, corruption, and inefficiency (Salehi-Isfahani et al., 2024, p.77).

3. Data and methodology

3.1. Data

3.1.1. Outcome variable: middle class

Our focus is on the share of the middle-class population in the total population, defined as individuals in households with daily per capita incomes between $11 and $110 (in 2011 PPP terms) (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 neither part of the wealthy elite receiving over $110/day nor vulnerable to falling back into poverty with minor economic shocks, unlike those earning less than $11/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 et al. (2012) and 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. This analysis also provides 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 middle-class size by integrating household survey data, national income statistics, and economic projections. Using the 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, allowing the share of each country's population (from

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

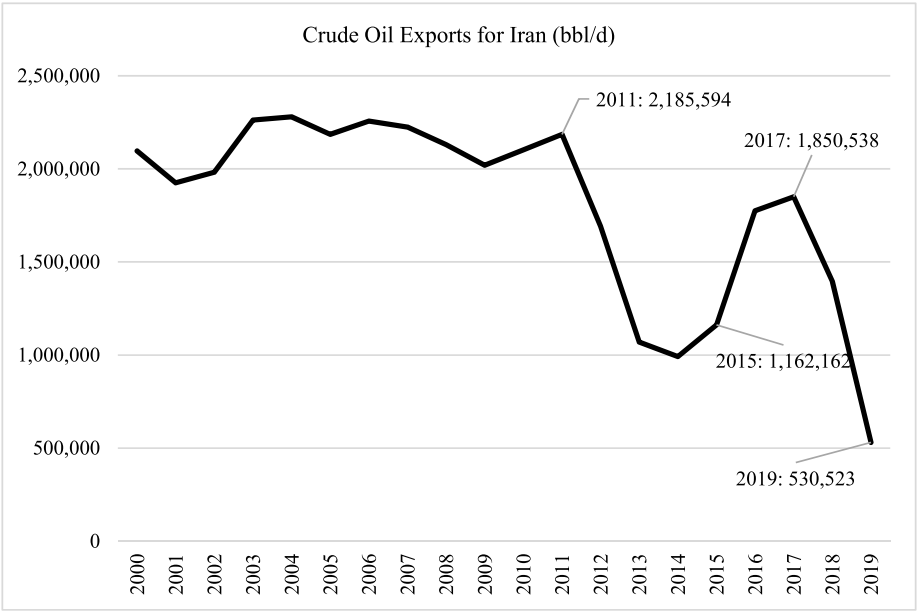

Fig. 2. Crude oil exports of Iran (2000–2019).

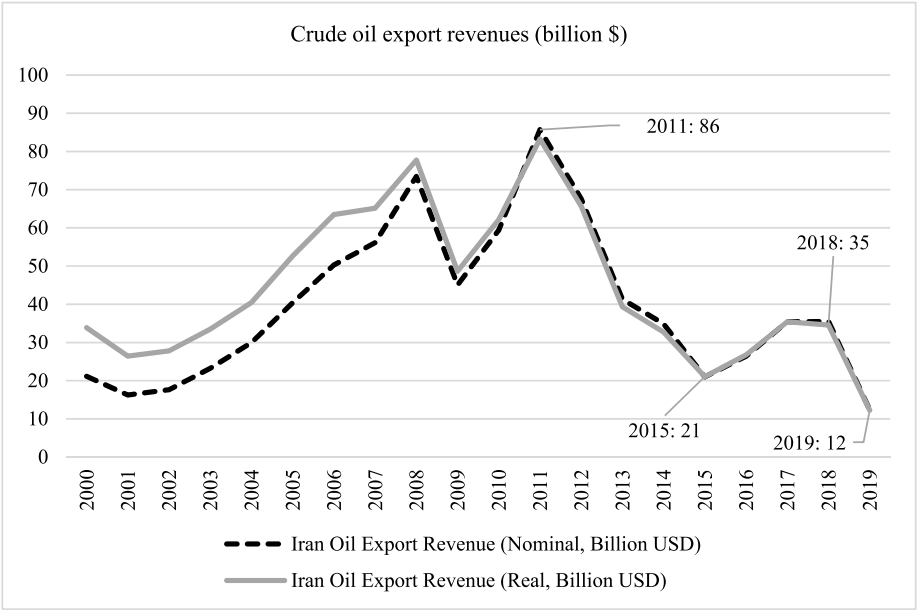

Fig. 3. Crude oil export revenues of Iran (2000–2019).

UN/World Bank data) within the $11–$110 range to be 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 (e.g., a fixed percentage around the median) can mask absolute income losses resulting from sanctions or economic crises more generally. 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 not shrink with Iran's falling median income under sanctions, suggesting a rather stable middle

class size despite real declines below livable standards. This obscures the sanctions' true impact.[5] 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. Conversely, a relative measure like the 20th-80th percentile is a moving target. If sanctions cause a general economic decline that adversely affects all income strata, a relative measure could misleadingly show a stable middle class, as households fall in unison. This would completely mask the widespread erosion of living standards and economic security that is central to our investigation. Thus, the absolute measure is not only preferred, but also essential for correctly identifying the tangible harm caused by the sanctions.

3.1.2. 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. This value is an expenditure-side real GDP at chained PPPs and is useful for comparing relative living standards across countries and time. The data used is from the Penn World Table version 10.01 (Feenstra et al., 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 et al., 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 economic booms (Ravallion, 2010).

We also include three indicators to control for the demographic structure and health of the population from WDI (2025), including the proportion of urban residents to the total population, the age dependency ratio, and life expectancy figures. 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 while offering 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 of urbanization affecting economic growth. It is likely, then, that economic growth caused urbanization, which itself is associated with higher middle class representation.

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 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 et al., 2007).

Life expectancy at birth (years) from WDI (2025) is a key health indicator and a core component of the United Nations' human development index. Bloom et al. (2003) show theoretically and empirically that increases in life expectancy result in higher savings rates at every age. External events, such as war and sanctions, are shown to reduce life expectancy significantly (e.g., Farzanegan, 2023; Gutmann et al., 2021; Moradi-Lakeh et al., 2025; Sajadi et al., 2024). Thus, life expectancy can be another channel through which such negative shocks may influence the development of the 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 rents from the production of oil, gas, minerals, coal, and lumber. The rents from natural resources can have both positive and negative effects on the

[5] 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. Before 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 up inflation, the median per capita income 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.

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 distortions that resource dependency introduces, such as a higher risk of conflict (Ishak and Farzanegan, 2022; Ross, 2004), corruption and the weakening of democratic institutions (Arezki and Gylfason, 2013), the strengthening of autocratic systems, dampening entrepreneurial activities (Farzanegan, 2014), and Dutch disease (Corden and Neary, 1982), among others. Dutch disease can have a strong adverse effect on the growth of the middle class through its adverse effect on industrial and manufacturing outputs. As a result, fewer manufacturing jobs, which offer middle-class wages 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 development for the middle class is the proportion of GDP attributed to household consumption, as documented in the Penn World Table version 10.01 (Feenstra et al., 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. If a nation's GDP maintains a relatively high proportion of household consumption, it 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, we find a negative within-country correlation. A one percentage point increase in this ratio is associated with a decline of GDP per capita by about 1.2 % (with robust t-statistic of −7.2).

Additionally, we include the proportion of GDP attributed to government expenditures, adjusted for differences in the cost of living between countries and for inflation. The data is from Penn World Table version 10.01 (Feenstra et al., 2015). A larger share of government spending in GDP may have a crowding out effect on the share of private sector investment, restricting the private business formation and thus expansion of the 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 the expansion of middle-class groups that have stronger connections with government administration. For example, Farzanegan et al. (2021) show positive changes in oil revenues elicit a positive effect on the size of the middle class. The aforementioned oil rent increases enlarge the middle class through an 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, both from World Governance Indicators (WDI, 2025). One is the voice and accountability index, which measures perceptions of the quality of political institutions; the other indicator is the perception of control of corruption. 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 also control for previous records of the 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 before international sanctions.[6]

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. It is important to clarify that the effect we estimate is the total effect of the sanctions. This total effect encompasses two integrated components: the direct economic shock from the sanctions (e.g., reduced oil exports, financial isolation) and the indirect impact of the Iranian government's endogenous policy responses to the sanctions. As we discussed in Section 2, these policy reactions, such as creating front companies in third countries to bypass trade restrictions and altering domestic spending, are an integral part of the causal channel through which sanctions ultimately impacted the middle class. Our analysis, therefore, evaluates the consequences of the sanctions as a whole, including the policy environment that they engendered.

Abadie et al. (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 weighing 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.

[6] Following an anonymous referee's recommendation, we included three additional predictors: the log of net FDI inflows, the KOF Globalization Index, and the population growth rate. The SCM based on these extended predictors yields the same gap between Iran's middle-class size and its synthetic counterpart after 2012. The pre-treatment fit index also remains unchanged at 0.043. Results are available upon request.

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 grounded comparisons. The SCM in our study achieves this by matching the pre-international sanctions outcome of middle-class size, incorporating pre-international sanction trends, and accounting for additional predictors (as explained earlier), all helping to construct a counterfactual scenario that reflects how Iran's middle class would have evolved in the absence of the international sanctions.

Our analysis covers the period of 1996–2019. The treatment year is 2012, when international sanctions (driven mainly by the US and EU) were imposed on Iran at levels previously unseen.[7] These sanctions include an embargo on crude oil exports of Iran, which, on average, accounted for 80 % of total export revenues during 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 samples, our focus has been on the Middle East and North Africa (MENA) region as defined by the World Bank, members of OPEC, and a few other countries from the Organization of Islamic Cooperation (OIC). Our rationale for selecting the donor pool from the MENA region, OPEC, and the OIC is grounded in seeking structural similarity. These countries share comparable stages of economic development, institutional characteristics, and geopolitical contexts with Iran, making them plausible candidates for constructing a counterfactual. We exclude countries which have had significant exposure to major sanctions or major events, such as war during the pre- and/or post-2012 years. For example, we have excluded Syria, Iraq, Libya, Nigeria, and Yemen due to their exposures to civil war, major conflicts, and other forms of 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 its similar experiences as a target of severe economic sanctions. This principled selection provides a credible set of potential comparators from which the synthetic control algorithm can build its counterfactual.[8]

Considering these explanations, our SCM model uses the following terms:

Let Y_{1t} denote Iran's middle-class size in year t, and Y_{Jt} the same expression for donor country J (from a pool of MENA/OPEC/OIC countries), with $t = 1996, 1997, \ldots, 2011$ as pre-intervention periods before sanctions in 2012. Let $X_1 \left(Z'_1, Y_{1,1996}, Y_{1,1998}, Y_{1,2000}, Y_{1,2002}, Y_{1,2004}, Y_{1,2006}, Y_{1,2008}, Y_{1,2010}\right)'$ be a $(k \times 1)$ 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. Let Y_{1t} denote 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:

$$W^*(V) = \underset{W}{\operatorname{argmin}} (X_1 - X_0 W)' V (X_1 - X_0 W),$$

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

$$V^* = arg \min_V \sum_{t=1996}^{2011} \left(Y_{1t} - \sum_{J=2}^{J+1} \omega_J^*(V) Y_{Jt} \right) \hat{2}$$

Where $\omega_J^*(V)$ are weights from the inner step. This allows 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.

$$\text{Post} - 2012, \text{the effect is estimated as } \widehat{\alpha}_{1t} = Y_{1t} - \sum_{J=2}^{J+1} \omega_J^* Y_{Jt} \text{ for } t = 2012, \ldots, 2019.$$

The effect of 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 sanctions had not been imposed.

4. Results

4.1. Main results

The final donor pool consists of 18 countries, excluding those with missing observations and/or affected by major events, such as war or sanctions (i.e., Djibouti, Equatorial Guinea, Gabon, Iraq, Libya, Syria, Nigeria, Venezuela, West Bank & Gaza, and Yemen). This donor sample focuses on the MENA region, OPEC, and the OIC, comprising Algeria, Azerbaijan, Bahrain, Congo, Rep., Egypt, Arab Rep., Indonesia, Israel, Jordan, Kuwait, Lebanon, Malaysia, Malta, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, and the United Arab Emirates. In the main specification, the counterfactual Iran, in terms of the size of the middle class, is generated from the following five

[7] 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. The results, which are shown in sensitivity checks, support the relevance of 2012 as the effective treatment year for major sanctions.

[8] The robustness of our findings to this specific donor pool is tested in our sensitivity checks, where we expand the pool to include European countries and still find a similar and statistically significant negative effect of the sanctions.

Table 2
The means of predictors during the pre-international sanctions period (1996–2011) for size of the middle class.

Predictors (1)	Iran (2)	Synthetic Iran (3)	Unweighted average of variables for other countries excluding Iran (4)	Difference (2–3) (5)	Difference (2–4) (6)
Middle Class (2010) %	64.90	65.02	60.89	−0.12	4.01
Middle Class (2008) %	60.80	61.81	57.91	−1.01	2.89
Middle Class (2006) %	56.00	54.87	53.85	1.13	2.15
Middle Class (2004) %	47.50	46.81	49.52	0.69	−2.02
Middle Class (2002) %	42.70	41.90	46.93	0.80	−4.23
Middle Class (2000) %	35.50	38.91	45.95	−3.41	−10.45
Middle Class (1998) %	34.90	35.34	44.04	−0.44	−9.14
Middle Class (1996) %	30.50	32.02	42.88	−1.52	−12.38
Log real GDP per capita	9.38	9.58	9.72	−0.20	−0.34
Share of urban population in total population (%)	66.38	68.78	74.15	−2.40	−7.76
Age dependency ratio (% of working-age population)	51.25	47.20	51.79	4.04	−0.54
Life expectancy at birth, total (years)	70.92	73.11	73.54	−2.19	−2.63
School enrollment, secondary (% gross)	80.16	80.43	80.56	−0.27	−0.40
Total natural resource rents in GDP (%)	25.31	16.25	17.18	9.06	8.13
Share of private consumption in GDP	0.47	0.47	0.48	−0.01	−0.02
Share of government spending in GDP	0.21	0.17	0.18	0.05	0.03
Log of merchandise trade	25.00	24.27	24.34	0.73	0.65
Voice & Accountability Index	−1.31	−0.83	−0.49	−0.48	−0.82
Control of Corruption Index	−0.55	−0.06	0.08	−0.49	−0.63

Note: We conducted an ANOVA test to check the statistical significance of difference between Column 5 (Difference between Iran and Synthetic Iran) and Column 6 (Difference between Iran and the simple average of other countries). The difference between Columns 5 and 6 is statistically significant ($Chi^2 = 7.1007$; $p = 0.008$). This means the synthetic control (Column 3) provides a significantly better match to Iran (Column 2) than the unweighted average of other countries (Column 4). The lower differences in Column 5 are not due to chance. There is no statistically significant difference between Iran and Synthetic Iran on all included predictors ($Chi^2 = 0.0049$; $p = 0.944$), supporting the finding that the pre-treatment match is statistically valid.

countries, listed by their respective weights in synthetic Iran: Tunisia (41.2 %), Qatar (21.7 %), Malaysia (17.8 %), Azerbaijan (12.4 %), and Indonesia (6.9 %).[9]

Table 2 presents the average values of the covariates for Iran, both in its actual state and its synthetic counterpart, prior to the 2012 international sanctions. Synthetic Iran closely resembles the actual Iran in terms of pre-sanctions size of the middle class.

As shown in column 5 of Table 2, the difference in the size of the middle class between Iran and its synthetic counterpart (Difference (2–3)) 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 the 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 of 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 nested 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). Nevertheless, we also applied "bias-corrected" synthetic control gaps to adjust for discrepancies in predictor variable values between a treated unit (Iran) and its donor pool, proposed by Abadie and L'Hour (2021), Ben-Michael et al. (2021), and Wiltshire (2024). We specified ridge, elastic, and lasso to estimate bias using ridge regression, elastic net regression, and lasso regression. The results (see sensitivity checks) on bias corrected gap between size of the middle class in population of Iran and its synthetic show a close similarity to original estimated gap.

In addition to comparing factual Iran with its synthetic counterpart, Table 2 presents the unweighted averages of variables for other countries in the donor sample, excluding Iran, during the pre-2012 sanctions period. This highlights the significant differences that arise when SCM weights are not constructed, as shown in the last column (Difference (2–4)). Notably, there are non-negligible differences, especially in the predicted outcomes, between the factual Iran and the average of other countries without using the optimal weights. 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.

To determine whether the comparison unit created using the SCM is an effective counterfactual, it is essential to measure how well

[9] In one of our sensitivity tests, 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 Tunisia (41.2 %), Qatar (21.7 %), Malaysia (17.8 %), Azerbaijan (12.4 %), and Indonesia (6.9 %), 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.

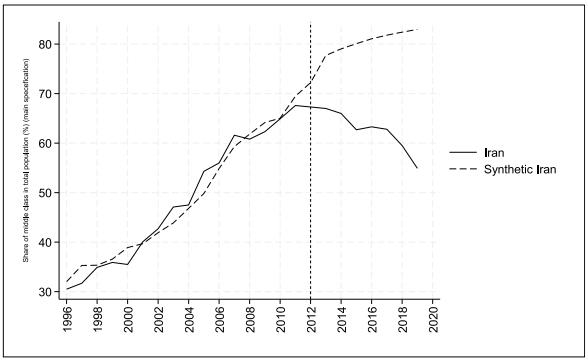

Fig. 4. The size of the middle class: Iran versus Synthetic Iran. Note: Nested optimization is applied.

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 0.043, indicating a close match between Iran and its synthetic control regarding the size of the middle class before the 2012 sanctions.[10]

Fig. 4 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 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 the following 8 years from 2012 to 2019 is estimated to be approximately 17 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 17 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 28 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.[11] The in-space placebo test and synthetic difference-in-difference estimations also show that the negative effect of sanctions on the size of the middle class in Iran is statistically significant.[12]

A potential concern is that oil-producing countries in our donor pool might have benefited from Iran's sanctions (due to higher oil prices or exporting more when sanctions reduce Iran's exports). However, this channel is unlikely to have significantly biased our results for three key reasons. First, an examination of our synthetic control's composition reveals it is not dominated by petro-states; most of its weight (~70 %) is derived from diversified economies such as Tunisia, Malaysia, and Indonesia. Second, the premise of a significant positive price spillover is not supported by empirical evidence. As Farzanegan and Raeisian Parvari (2014) demonstrate, the negative shock in Iranian oil supply did not cause a sustained increase in global oil prices, as other producers stabilized the market. Third, the primary swing producer that increased its output was Saudi Arabia, which holds a weight of zero in our synthetic Iran for main analysis. Given the lack of a significant price effect and the specific composition of the synthetic control, the risk of a material bias from spillovers is negligible, reinforcing the validity of our main findings.

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 (after sanctions & before COVID19 in Iran) are reported in Fig. 5.

The survey asks respondents to place their household's income on a 10-point scale representing national income deciles. To analyze the change in self-perceived status, we group the responses for deciles 3 through 7 as 'middle-income.' It is noteworthy that, in 2005, a large majority of respondents (78.7 %) identified within this broad middle category, a common phenomenon in survey research

[10] 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/.

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

[12] Moreover, we follow Ferman et al. (2020) to report 90 % uniform confidence intervals around the estimated gap, based on a permutation test with 19 units. For technical reasons, the gap is computed without nested optimization, resulting in a different synthetic composition than in Fig. 4. While this leads to some variation in the estimated gap, the main results remain robust. The gap is statistically significant for the period 2016–2019. The results are available upon request.

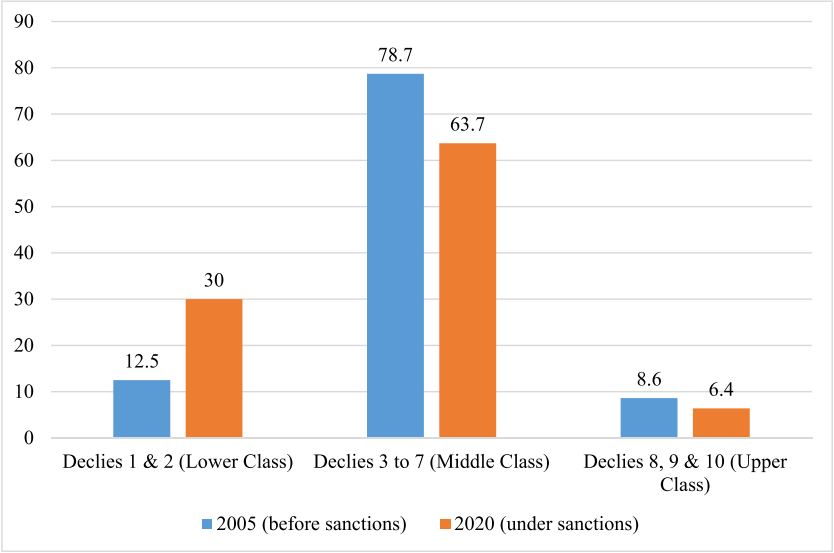

Fig. 5. To which income category does your household belong in? Self-perceptions according to World Values Survey Results for Iran.

reflecting the subjective nature of social class identity.

The critical finding from this survey is not the absolute level, but the stark trend between the two periods. After the major sanctions, the share of respondents self-identifying as middle-income fell sharply to 63.7 %. This significant decline in the perception of belonging to the middle class provides powerful, qualitative corroboration for the objective, quantitative decline that our primary SCM analysis documents.

4.2. Inference procedures and sensitivity analysis

4.2.1. 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 et al., 2004). The premise of placebo tests is straightforward: if the 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 et al. (2010). As shown in

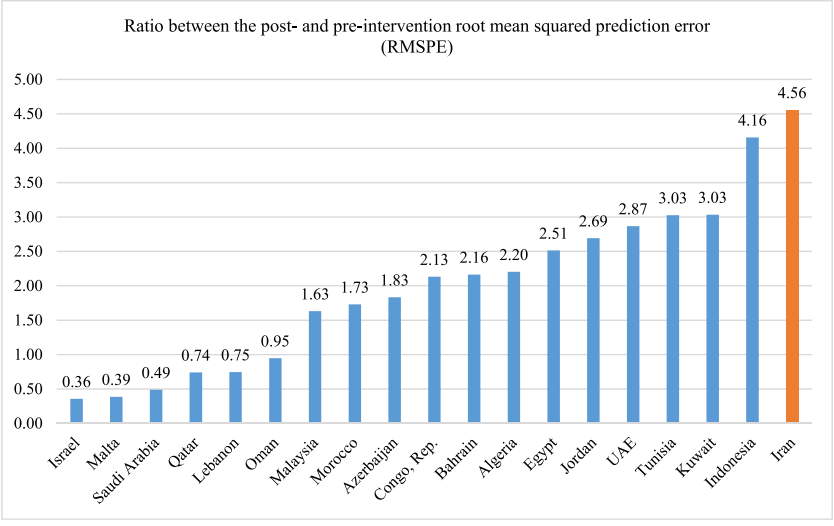

Fig. 6. Ratio between the post- and pre-intervention root mean squared prediction error (RMSPE).

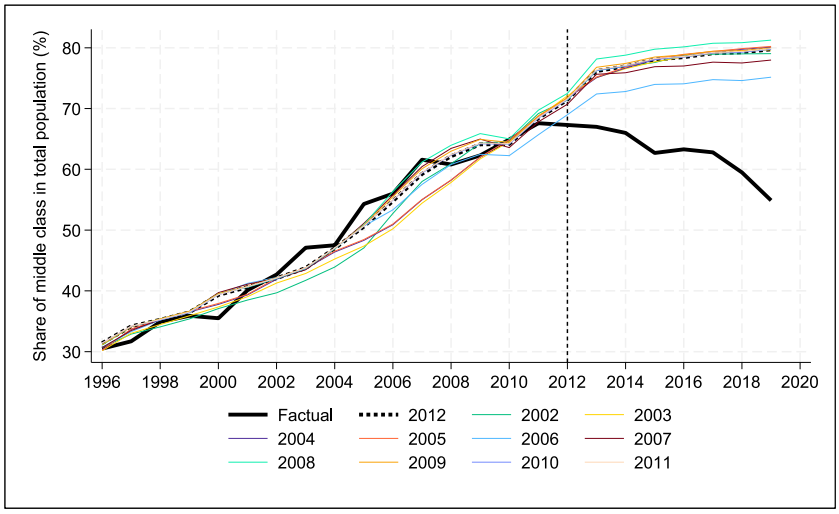

Fig. 7. In-time placebo test.

Fig. 6, Iran has the highest ratio of post-treatment RMSPE to pre-treatment RMSPE. The inference procedures yield a pseudo p-value of approximately 0.05 (1/19), indicating that no other placebo runs match or exceed the effect observed for Iran when considering the pre-intervention fit (RMSPE). This implies an approximately 95 % confidence level in the main findings, providing strong evidence for a causal effect of the international sanctions on the middle class in Iran.

4.2.2. 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 (Abadie et al., 2015). We follow the approach of Born et al. (2019) and estimate in-time placebos for the ten years preceding the treatment year (2002–2011). This analysis tests whether a similar divergence between the middle-class size in factual Iran and its synthetic counterpart emerges in a period without major sanctions.

Fig. 7 presents the results for the placebo years. No divergence is observed between factual and synthetic Iran, and no effect is estimated during this period. The divergence only appears around the onset of major international sanctions in 2012, supporting the choice of the treatment year.

4.2.3. 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: Tunisia (41.2 %), Qatar (21.7 %), Malaysia (17.8 %), Azerbaijan (12.4 %), and Indonesia (6.9 %).

The leave-one-out analysis produced five alternative counterfactual versions of Iran, in addition to the main synthetic version shown in Fig. 4. These counterfactual versions were estimated by sequentially excluding Tunisia, Qatar, Malaysia, Azerbaijan, and Indonesia. All synthetic versions track Iran closely before 2012, indicating good pre-treatment balance even when a key donor is excluded. Fig. 8 illustrates that the size of the middle class in these additional counterfactual versions. After the imposition of sanctions, actual Iran (black line) diverges significantly downward from all synthetic versions. The post-2012 gap remains sizable across all specifications. This suggests that the estimated negative effect of sanctions on Iran's middle class is not driven by any single donor country in the synthetic control.

4.2.4. 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

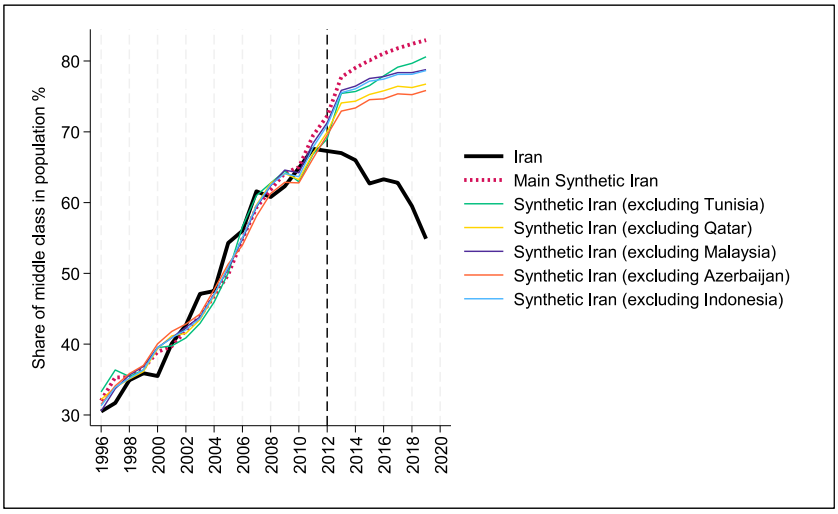

Fig. 8. Leave-one-out distribution of the synthetic control for Iran. Note: The black line shows the actual trajectory of Iran's middle class. The dotted pink line represents the main synthetic control for Iran (i.e. the weighted average of countries matching Iran's pre-2012 characteristics). The colored solid lines represent alternative synthetic Iran, each excluding one key donor country (Tunisia, Qatar, Malaysia, Azerbaijan, or Indonesia). (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 3
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 and 2019	Std. Err.	t	P > t	[95 % Conf. Interval]	
Post 2012 sanctions on Iran (excluding covariates)	−12.05	3.78	−3.18	0.001	−19.48	−4.62
Post 2012 sanctions on Iran (including covariates)*	−9.86	4.73	−2.08	0.037	−19.14	−0.57
Post 2012 sanctions on Iran (including covariates)**	−9.75	4.03	−2.42	0.016	−17.66	−1.84

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.

in Arkhangelsky et al., 2021).

Table 3 presents the average treatment effect on the treated (ATT),[13] estimated at approximately −12 percentage points over 8 years (2012–2019) without covariates and about −10 with selected covariates, both highly statistically significant at the 99 % and 95 % confidence intervals, respectively.

For ATT of −10, we applied the "optimized" and "projected" options in SDID. The optimized option 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; however, it may be sensitive to high covariate dispersion.

We find a largely similar effect using a "projected" option. This method, based on Kranz (2022), adjusts the outcome by estimating covariate effects only from untreated units and then projecting them onto all units. It is often faster and more stable, especially in cases with complex covariate structures.

Our preferred ATT is the first calculation (−12 pp) to show the overall effect of sanctions on the size of the 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,

[13] 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.

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 example, 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 mis-specified 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 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 10.5 pp average annual loss in the size of Iran's middle class during 2012–2019. In our case, SDID has produced more conservative (smaller) estimates than SCM, which shows an average annual reduction of 17 pp between 2012 and 2019.

4.2.5. *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 the Poverty database of Our World in Data (OWD),[14] calculating the share of the population who earn between 10 and 40 $ 2017 PPP as the 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 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 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. In response, we expanded the donor pool to include several 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' measurement of the middle class and OWD's (interpolated) measurement of the 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 Fig. 9. 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 the 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.

4.2.6. *Penalized SCM*

With respect to our main results on the effect of sanctions on the size of middle class (Fig. 4), we also apply "bias-corrected" synthetic control gaps to adjust for discrepancies in predictor variable values between the treated unit (Iran) and its donor pool. In other words, this synthetic control estimator minimizes the differences between each treated unit's characteristics and those of the donor units contributing to its synthetic counterpart (Abadie and L'Hour, 2021; Ben-Michael et al., 2021; Wiltshire, 2024).

We have applied ridge regression, elastic net regression, and lasso regression to prevent any overfilling bias in our estimates. The results of the bias-corrected gap between the proportion of the middle class in Iran and its synthetic are also shown in Fig. 10, indicating a close similarity to original estimated gap.

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

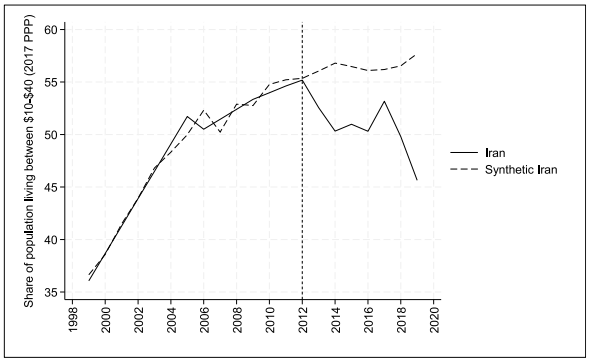

Fig. 9. The share of population between $10-$40 per day: Iran versus synthetic Iran.

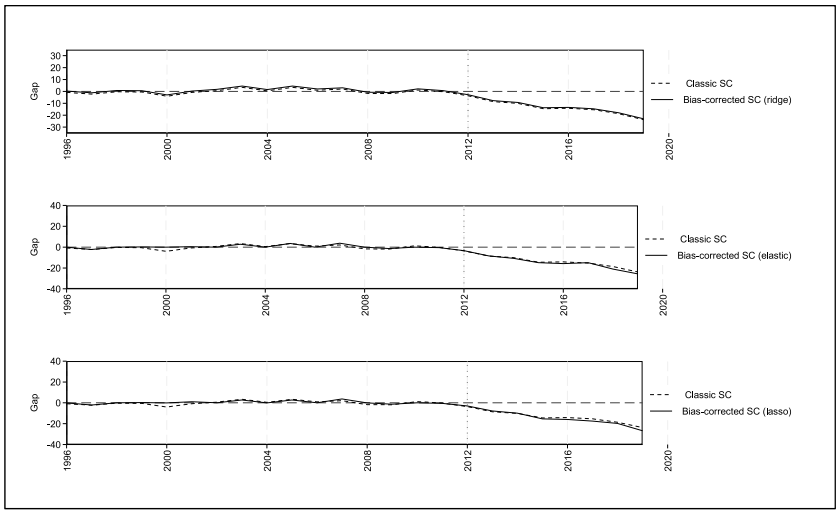

Fig. 10. The bias-corrected SC: the estimated gap between size of middle class of Iran and its synthetic. Note: To estimate the bias-corrected SCM with the available number of control units, we had to reduce the number of covariates. This may explain some moderate discrepancies between the classic SCM gap shown in this figure and the one in Fig. 4.

5. Discussion and selected channels

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

Huntington (1991, p. 66) highlights the critical role of the middle class in easing tensions over resource distribution, which 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 tensions and calls 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 while increasing the 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 relatively larger 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 such revolution. In the case of Iran, we

Table 4
Summary of sanctions' effects on key transmission channels (2012–2019).

Transmission Channel	Main Result (Avg. Annual Effect, 2012–2019)	Method	Statistical Significance	Appendix Reference
1. Income per capita	≈$3000 reduction in real income per capita	SDID	$p < 0.10$	Figure A.1
2. Merchandise imports p.c.	≈24 % reduction in imports per capita	SDID	$p < 0.01$	Figure A.2
3. Merchandise exports p.c.	≈8.5 % reduction in exports per capita	SDID	–	Figure A.3
4. Investment p.c.	≈37 % reduction in investment per capita	SDID	$p < 0.01$	Figure A.4
5. Industry value added p.c.	≈30 % reduction in industry value added per capita	SDID	$p < 0.05$	Figure A.5
6. Self-employment (% total)	≈3.4 pp increase in the share of self-employment	SDID	$p < 0.10$	Figure A.6
7. Vulnerable employment (% total)	≈2.7 pp increase in the share of vulnerable employment	SDID	–	Figure A.7

Note: This table summarizes the key findings for each transmission channel. The estimated effect for income per capita is calculated in real PPP dollars. For imports, exports, investment, and industry value added, the effect is shown as a percentage loss relative to the counterfactual. For employment metrics, the effect is an increase in percentage points (pp). SDID refers to the Synthetic Difference-in-Differences method. 100 repetitions for placebo standard errors are used. "-" shows lack of statistical significance at 90 % level of confidence. Full details are in online Appendix A.

observe a higher intensity of violence and repression in recent protests such as violent crackdown against widespread protests that started over an abrupt fuel price increase on November 15, 2019[15]; and, we observe authorities' brutal crackdown on the "Women, Life, Freedom" uprising at the end of 2022 (Farzanegan and Fischer, 2025).

Furthermore, sanctions can trigger a vicious cycle of economic decline and political repression. As economic hardship fuels popular discontent (Farzanegan and Gutmann, 2024), an autocratic system may intensify oppressive measures to maintain control, as observed in Iran.[16] This heightened repression, through actions like restricting civil liberties, cracking down on protests, or limiting access to information, is not just a political outcome but also a significant economic depressant. It stifles entrepreneurship, discourages investment, and can lead to a flight of human capital, all of which directly undermine the growth and stability of the middle class. Therefore, political repression acts as a crucial intermediary channel, amplifying the initial economic shock of the sanctions.

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 Islamic Republic 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 the 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 the 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 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).

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 that it has declined by a larger amount relative to how much it could have increased during 2012–2019 in the absence of these sanctions.

It is essential to recall a key aspect of causality here. The negative outcomes we document are a combination of the direct economic shock from the sanctions and the Iranian government's endogenous policy responses to that pressure. A targeted government may choose to reallocate resources away from public welfare and toward strategic political or military objectives, further harming the middle class.[17] Our analysis captures the total effect of this entire causal chain. While separating the direct impact of the sanctions from the indirect impact of the government's policy reaction is a formidable empirical challenge, the total effect remains a critical measure,

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

[16] The V-Dem index in Iran, calculated as an unweighted average of the Electoral Democracy Index, Liberal Democracy Index, Extent of Direct Popular Votes, Deliberative Democracy Index, and Egalitarian Democracy Index, declined from 0.157 in the period 1996 to 2011 to 0.137 in 2012–2019, indicating a deterioration in the quality of democratic institutions after 2012. Similarly, the Polity index fell from an average of −2.31 (1996–2011) to −7 (2012–2018). The World Bank's Voice and Accountability Index also declined, from −1.30 (1996–2011) to −1.45 (2012–2019).

[17] Dizaji and Farzanegan (2021) and Farzanegan (2022b) examine the relationship between sanctions and military spending in Iran.

as the policy response is a direct and foreseeable consequence of the sanctions themselves.

Having established the total negative effect of sanctions on Iran's middle class, we now investigate the key transmission channels through which this effect likely operated. While a formal mediation analysis is beyond the scope of this paper, our approach causally tests the impact of sanctions on several core economic variables known to be primary determinants of middle-class welfare (e.g., real GDP per capita, international trade, and investment). By applying the SCM to each of these channels as a distinct outcome, we can robustly identify whether the sanctions activated these powerful and well-established pathways, thereby providing strong evidence for their role as the key mechanisms of harm. This is the methodologically required approach, as each economic variable is driven by a different set of determinants, necessitating a re-optimized weighing of the donor countries to construct the most accurate possible counterfactual for each specific channel. The donor pool (MENA, OPEC, OIC) remains consistent throughout.

The key results for the seven channels examined are summarized in Table 4. This table highlights the estimated average annual effect on each channel between 2012 and 2019, its statistical significance, and the method used for estimation. For a full discussion of the methodology, results, and figures for each individual channel, the reader is referred to online Appendix A.

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 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 estimated 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, trajectories of the middle class size in actual Iran and its synthetic counterpart were comparable. However, a notable divergence occurred thereafter, indicating sanctions hold a significant impact on the trajectory of the size of the middle class.

The main results indicate that sanctions led to a significant annual decline in the size of Iran's middle class, as shown by both SCM and SDID estimates. These findings are validated through several sensitivity checks, including in-space and in-time placebo tests, leave-one-out analyses, and bias-corrected SCM. We also identify real GDP per capita, trade (imports and exports), investment, industry value added, as well as informal and vulnerable employment as key transmission channels through which sanctions negatively affect the middle class.

It is critical, however, to be precise about the interpretation of these findings. Our analysis does not exist in a political vacuum. The decline of the middle class should be understood as the outcome of a complex dynamic involving both the external pressure of sanctions and the internal policy choices of the Iranian government to prioritize strategic and ideological foreign policy goals, sometimes at the expense of the general population's economic welfare (e.g., Han, 2018; Janeba, 2024). The normative message of this paper is not to assign ultimate blame, but rather to empirically demonstrate that regardless of the political justifications, the implementation of such a severe sanctions regime has a devastating and measurable cost on the social fabric of the target country, hollowing out the very middle class that is essential for long-term stability and development.

Credit author statement

Mohammad Reza Farzanegan: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nader Habibi:** Writing – review & editing, Data curation, Qualitative and institutional analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejpoleco.2025.102749.

Data availability

Data will be made available on request.

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