



An estimation of the economic cost of recent sanctions on Iran using the synthetic control method



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HIGHLIGHTS

- We use the synthetic control method to estimate the effect of recent international sanctions on Iran's real GDP.
- We estimate that Iran's real GDP suffered a hit of more than 17% in the period between 2011 and 2014.
- We perform placebo studies to evaluate the credibility of the result.

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ABSTRACT

International sanctions imposed on Iran, targeting primarily Iran's key energy sector and its ability to access the international financial system, have harmed Iran's economic growth, specifically since 2011 through 2014. Using the synthetic control method, this paper estimates that sanctions during this period reduced Iran's real GDP by more than 17% with the largest drop occurring in 2012.

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Since the Islamic revolution of 1979 in Iran, sanctions have been the main feature of the US–Iran political relationship. Throughout the 1980s and 1990s, a wide range of sanctions and trade restrictions were imposed on the Islamic Republic targeting its regional power in the Middle East, but more recently, sanctions have been more focused on the country's nuclear program. Before the late 2000s, the US had kept a higher level of intervention in Iran's nuclear program compared to the European countries and other UN members. The turning point came in 2010–2012, a period of a cooperation among the majority of these countries and the US, and the imposition of more sanctions, trade restrictions, and embargoes focused on the nuclear program (EUCC, 2012, UNSCR1929, CISADA, 2010).

Iran is one of the most significant countries in the oil industry worldwide. In 2014, with 157.53 billion barrels, the share of Iran's crude oil reserve of the OPEC was 13.1%. OPEC in that year held 81% of the global share (OPEC statistical bulletin, 2016). This put Iran in third place in the OPEC ranking and fourth place on a global scale. Iran is also one of the most important countries in the gas production industry. In 2012, Iran's marketed production of natural gas was 202.43 billion standard cubic meters, 26% of the total OPEC production and highest among all other OPEC countries.

Using the synthetic control method, we attempt to estimate the effect of the intensification of sanctions on Iran's GDP during the period 2011 to 2014. 2011 was Iran's first full year under these heavy sanctions, and in 2015, the Iran nuclear deal framework was established, and the Iran Deal was signed setting in motion the loosening of sanctions (JCPOA, July 2015). Before 2011, in spite of the ongoing US sanctions, Iran's GDP had a positive trend from 1990 to 2011. However, our estimates show that the GDP suffered a hit of more than 17% over the period under question. We find that these effects were particularly severe in 2012—the same year of the enforcement by the European Union of an oil embargo and added financial boycotts against Iran.

1. Method and data

In small-sample social comparative studies, where interventions affect aggregate entities such as countries or states, it is often difficult to find suitable controls that are unaffected by the intervention, and also have similar characteristics to those of the affected unit (Lijphart, 1971; Collier, 1993; Abadie et al., 2010).

Instead of using a single control unit, the synthetic control method (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2012) uses a weighted average of a set of potential control units to

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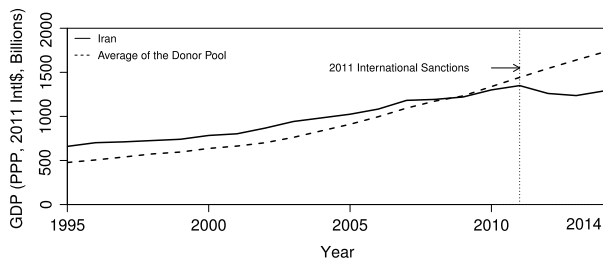


Fig. 1. Real GDP, Iran vs. the average of the pool.

provide a synthetic control unit that more closely resembles the affected unit in terms of predictors. Here we use the synthetic control method to construct a synthetic control unit for Iran representing expected GDP figures under a scenario in which there had been no sanctions after 2011. We refer to this control unit as “Synthetic Iran”.

The empirical analysis is based on annual country level panel data for the period 1980–2014. As international sanctions were imposed in 2011, this yields a pre-intervention period of more than 30 years. We divide our pre-sanction period to a training period from 1980 to 1994 and the validation period from 1995 to 2014 (see [Abadie et al., 2012](#)). Our donor pool includes eight OPEC member countries: Algeria, Ecuador, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, and the United Arab Emirates.¹ Also, in order to increase the size of the pool, we add donors from major non-OPEC oil producer countries (i.e. Canada and China) as well as the rest of non-OPEC Iran’s neighbors with close economic similarities (i.e. Oman, Bahrain, and Turkey). The variables used in our analysis are listed in the data [Appendix](#) along with descriptions and data sources. The outcome variable of interest, Y_{jt} , is the real GDP for country j at time t . GDP is Purchasing Power Parity (PPP)-adjusted and measured in constant 2011 international dollars. Because our donor countries are heavily dependent on rents from natural resources, for the pre-sanction predictors, we rely on a standard set of economic growth indicators for these countries.

2. Synthetic Iran and the effect on GDP

2.1. Construction of the Synthetic Iran

[Fig. 1](#) plots the real GDP of Iran versus the average of the donor pool from 1995 to 2014. This period includes our validation period, 1995 to 2011, as well as the post-sanction period, 2011 to 2014.

For the entire pre-sanction period there is a noticeable difference between Iran’s GDP and the average of the pool. As one of the wealthiest countries in the OPEC, and compared to other countries in our pool, Iran’s GDP is above average during nearly the entire pre-sanction period. After the sanctions, GDP drops and falls below the average of the pool. As the graph suggests, the average does not do a good job of resembling Iran’s GDP for the pre-sanction period. This would also be true of any of the individual donor countries. However, as shown in the next section, it turns out that the synthetic control can very closely reproduce Iran’s value of GDP for a long period of time before the sanctions.

[Table 1](#) provides the list of the donor countries and share of each in the construction of the Synthetic Iran. Iran’s counter-factual is best reproduced by a weighted average of Canada, United Arab Emirates, Turkey, Algeria, Saudi Arabia, and China. The share of

Table 1

Donor pool countries and share of each in the construction of the Synthetic Iran.

County	Weight	Country	Weight
Algeria	0.138	Nigeria	0.002
Bahrain	0.000	Oman	0.001
Canada	0.268	Qatar	0.002
China	0.027	Saudi Arabia	0.112
Ecuador	0.000	Turkey	0.194
Kuwait	0.001	UAE	0.254
Libya	0.001		

Table 2

GDP predictor means before the sanctions.

Predictors	Iran	Synth	Pool
Total natural rent (% of GDP)	11.1	11.1	16.8
Agriculture (bn\$)	16.6	16.8	24.8
GDP-2010 (t\$)	1.3	1.3	1.5
Trade (% of GDP)	32.8	36.2	54.7
Population (m)	51.2	52.4	101.5
Industry (% of GDP)-not participating	33.9	19.6	21.8
Services (\$)-not participating	94.2	49.9	47.2

Note: the last column is the population-weighted average of all the countries in the donor pool. All the variables are averaged over 1995–2011. We augmented this matching with a lagged value of GDP as a predictor. Weights on the last 2 predictors in the construction of the synthetic control is zero, this explains the discrepancy between the means.

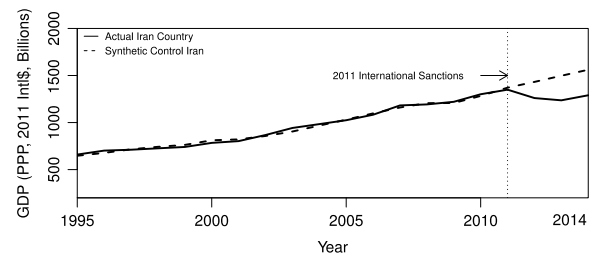


Fig. 2. Real GDP: Iran vs. Synthetic Iran

other countries in the pool are either zero or very small. Canada has the highest weight followed by UAE.

[Table 2](#) compares the pre-sanction fit of Synthetic Iran and a population weighted average of the countries in the donor pool.

We observe that the pool average does not demonstrate similarities to Iran in terms of pre-sanction predictors. However, the Synthetic Iran provides means much closer to the actual Iran. Overall, [Table 2](#) suggests that Synthetic Iran provides a better comparison than the population weighted average of the pool.

2.2. The effect of 2011 sanctions

[Fig. 2](#) displays the paths of the real GDP of Iran and Synthetic Iran from 1995 to 2014. Synthetic Iran closely resembles Iran’s GDP over the pre-sanction period.

Our estimate of the effect of international sanctions imposed in 2011 is the difference between the GDP of actual Iran and the Synthetic Iran from 2011 to 2014 period. The discrepancy between the two after 2011, suggests a large negative effect of the sanctions on the country’s GDP.

[Fig. 3](#), the gap plot, also depicts annually the effect of the sanctions. The gap plot provides the exact value of the gap between the two paths shown in [Fig. 2](#). Both figures show that while the GDP of Synthetic Iran grows, the GDP of actual Iran drops notably after 2011 with the gap between the two growing in magnitude. Iran’s GDP in 2014 was 1289.9 billion dollars, which we estimate to be 271.3 billion dollars less than the value it would have been had there been no sanctions imposed in or after 2011. This is equal to a

¹ To construct the synthetic control unit, we left Venezuela and Iraq out of the donor pool due to economic fluctuations in these countries during the period of the analysis. However, we find the result is insensitive to this exclusion. We also left Angola out due to data limitations.

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