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**The Impact of International Sanctions on  
The Economy of Iran**

*Bachelor thesis*

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## **Bibliographic note**

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## **Abstract**

The pursue of Iran's regional ambitions since the very existence of the Islamic republic has commonly collided with the interests of other regional players such as Saudi Arabia and Israel supported by the U.S. Consequently, Iran has been often a target of various U.S. sanctions. Later, after the continuing Iranian reluctance to abide by the international rules concerning its nuclear programme, the EU joined the U.S. in sanctioning Iran. In 2012, the oil embargo was imposed by the former which dramatically reduced the value of Iranian exports. In this thesis, we apply the synthetic control method to estimate the effect of international sanctions on the economy of Iran. We estimate the possible development of Iranian GDP per capita during the 2010-2015 period had it not been for the international sanctions. Our results show a steady growth of the GDP per capita in the absence of the sanctions. In 2015, the last year of the sanctions, the difference between our estimated GDP per capita and the actual one is 1,911 U.S. dollars.

## **Keywords**

synthetic control method, nuclear programme, GDP per capita, Iran, sanctions, trade, oil

## **Abstrakt**

Naplnování iránských regionálních ambicí se od samotné existence islámské republiky běžně střetávalo se zájmy jiných regionálních aktérů, jako je Saúdská Arábie a Izrael podporovaných USA. Írán byl proto často cílem různých sankcí USA. Později, po pokračující iránské neochotě dodržovat mezinárodní pravidla týkající se jejího jaderného programu, se EU připojila k USA a začala sankcionovat Írán. V roce 2012 EU uvalila ropné embargo, což dramaticky snížilo hodnotu iránského vývozu. V této práci jsme použili metodu syntetické kontroly k odhadu vlivu mezinárodních sankcí na iránskou ekonomiku. Odhadujeme možný vývoj iránského HDP na obyvatele v období 2010–2015 v případě, že by nebyly uvaleny mezinárodní sankce. Naše výsledky ukazují stabilní růst HDP na obyvatele při absenci sankcí. V roce 2015, posledním roce sankcí, je rozdíl mezi naším odhadovaným HDP na obyvatele a skutečným 1 910,7 USD.

## **Klíčová slova**

metoda syntetické kontroly, jaderný program, HDP na obyvatele, Írán, sankce, obchod, ropa

## **Declaration of Authorship**

I hereby proclaim that I wrote my bachelor thesis on my own under the leadership of my supervisor and that the references include all resources and literature I have used.

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Prague, 5 May 2020

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Signature

## **Acknowledgment**

I would like to express my deepest gratitude to PhDr. Jaromír Baxa, Ph.D. for his expertise and many useful comments. I would also like to thank my family and my university colleagues without whom I would not have fully enjoyed my studies.

## Bachelor's thesis proposal

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**Author**

Tomáš Kraváček

**Supervisor**

PhDr. Jaromír Baxa, Ph.D.

**Topic**

The impact of 2002's sanctions on the structure of the Iranian economy

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### **Research question and motivation**

In my thesis, I would like to focus on the structural changes in the Iranian economy due to the many sanctions that the Islamic republic has experienced in the 21st century.

Since the Islamic revolution in 1979, Iran had experienced several major crisis including the war with Iraq. Nonetheless, the economy recovered and particularly because of the vast oil reserves it has grown steadily. In the 2000s, Iran announced its ambition to pursue the nuclear program which has been thought by many to be used for nonpeaceful purposes. The West had adopted several sanctions that had severely hit the economy. Luckily for Iran, the administration of president Obama signed a nuclear deal with the Islamic republic in 2015 which had an almost immediate positive effect on the main macroeconomic variables. Nevertheless, the recent sanctions imposed by Trump's administration put Iran back into even worse crisis given that every country involved in trade with Iran is also affected by them.

My thesis addresses the development after the 2000s by looking primarily at the components of the GDP, where the production of oil, the literal lion's share, has been the primary target of the sanctions. Generally speaking, Iran has stated that through the modernization, mainly through its nuclear program, it wants to achieve economic sustainability. The hypotheses is that had it not been for the sanctions, the Islamic republic would easily adapt its economy to the needs of 21st century. The main questions are following. How diligent the regime was in adapting its economy under the sanctions and how would the economy look like had it not been for the sanctions?

### **Contribution**

Little has been done on the economic effects of the sanctions on Iranian economy. It goes without saying that the topic is a hot issue, particularly with the imposition of new sanctions on Iran. Only with deep knowledge of the economic history, we can precisely assess the development of the economy of Iran.

The primary literature, I will be using, will be the Economic Sanctions Reconsidered. In this weighty tome many issues concerning sanctions are discussed. I will focus on the



chapters evaluating the costs to the sender and target country as well as the total effectiveness of the sanctions imposed. When it comes to the principal methodology of my thesis, I would like to use a similar approach as my fellow colleague Mgr Dmitriy Pchelintsev did in his Evaluating the Effect of 2014 Sanctions against Russia Using Synthetic Control Methods. The synthetic control method appears in many papers, so it may be examined on a broad variety of subjects. I would like to study the most famous ones, i.e. Estimating the Effect of California's Tobacco Control Program, Comparative Politics and the Synthetic Control Method. As already said, there are only few papers discussing the economy of Iran under the various sanctions. The majority of them is rather a socio-political discussion than a thorough economic analysis of the structural changes. Nonetheless, I would like to use Iran's Economy and the US Sanctions as some basic description of the economy of the Islamic republic.

My thesis should examine the development since the announcement of the nuclear program in the 2000s. Moreover, I will focus on the structural changes measured by the changes in the composition of the GDP. The thesis should help to assess how diligent the regime has been in transforming the economy and how the economy would possibly look like had it not been for the sanctions.

### **Methodology**

I would like to combine the international data, e.g. from IMF or UN with the Iranian data provided by the Iranian central bank. The main method will be the synthetic control method, thus I would like to assess the periods when some sanctions were lifted and how the economy would develop had it not been for the sanctions. I would also like to consider the Kingdom of Saudi Arabia as a relevant comparable economy, clearly not affected by the sanctions and the major conflicts in the Middle East.

### **Outline**

Abstract

Introduction

- a. Why is my topic interesting
- b. Brief economic history of the Islamic republic Iran
- c. Brief overview on global sanctions
- d. How I add to existing research
- e. Main results and their meaning
- f. The structure of the thesis

## Literature review

- a. The economic history of Iran and the structure of its economy
- b. The history of sanctions on Iran
- c. The synthetic control method- how it can be used
- d. What hypotheses will be tested

## Methodology

- a. Description of data
- b. Why I use the independent and dependent variables I use, how they are measured
- c. How I perform tests

## Results

- a. Rejecting / not rejecting hypotheses
- b. My interpretation of the results

## Conclusion

- a. Interpretation of the results
- b. How can we possibly evaluate the recent sanctions imposed by the U.S.

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Orkideh Gharehgozli, *Economics Letters* Volume 157, August 2017, Pages 141-144 An estimation of the economic cost of recent sanctions on Iran using the synthetic control method

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## **List of acronyms**

**AIOC** Anglo-Iranian Oil Company

**CISADA** Comprehensive Iran Sanctions and Divestment Act

**CNPC** China National Petroleum Corporation

**FDI** foreign direct investment

**GDP** gross domestic product

**IAEA** International Atomic Energy Agency

**ILSA** Iran-Libya Sanctions Act

**JCPOA** Joint Comprehensive Plan of Action

**LNG** Liquefied Natural Gas

**MSPE** mean squared prediction error

**NIOC** National Iranian Oil Company

**OPEC** Organization of the Petroleum Exporting Countries

**UAE** United Arab Emirates

**UN** United Nations

**UNSC** United Nations Security Council

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# 1 Introduction

On 14th July 2015 after long negotiations, the U.S., the U.K., France, Germany, Russia, China, the EU, and Iran successfully reached an agreement known as the Joint Comprehensive Plan of Action (JCPOA). The Iranians agreed to play by the international rules, and consequently, in January 2016, all nuclear-related sanctions were lifted. It goes without saying that the accord was a tremendous success for the international community which had struggled for many years due to numerous difficulties even to come to the negotiation table.

Since the Islamic Revolution, the Islamic Republic of Iran has assumed an active political role in the Middle East, dramatically changing the balance of powers in this region. Iran as a majority Shia state has gradually become the main counterweight to Sunni Saudi Arabia and has supported several organizations deemed by many countries as terroristic. For this reason, the U.S. has imposed a wide range of sanctions and has designated Iran as a state sponsor of terrorism, eliminating virtually any direct contact with them. On the other hand, the European and the Asian countries have approached Iran differently, perhaps also for the relatively heavy dependence on Iranian crude oil. Indeed, the EU and China have been Iran's most important trading partners. Nevertheless, in 2010 after Iranian persistent reluctance to secure the peaceful nature of its nuclear programme, unprecedented sanctions started to be imposed. These multilateral punitive measures posed an existential threat to the Islamic republic.

There has been a heated debate about the effectiveness of sanctions for there is no consensus among the scholars. Some deem sanctions ineffective because the real target, mainly the government, always finds it ways to circumvent the restrictions at the cost of the general public. In this work, we primarily follow the analysis of Hufbauer et al. (2009).

Similarly, there are many ways how to study the impact of economic sanctions such as the common gravity model approach. Nevertheless, we choose a comparison approach. The idea is to compare Iran with some other similar country that was not affected by the sanctions. Generally speaking, there is no single state that would approximate the Iranian economy well, and thus more units must be taken into consideration. To do so, we use the synthetic control method developed by Abadie & Gardeazabal (2003) which has become increasingly popular among the researchers evaluating the impact of some particular intervention.



Undoubtedly, Iran with its second-largest hydrocarbon reserves in the world is a very specific economy heavily dependent on oil production. The problem for our analysis is that the other countries which we want to compare to Iran are problematic as well since they tend to have a higher likelihood of some structural shock due to the nature of their regimes, economy, and geopolitical position. The troublesome situation in the Middle East where the world powers try to pursue their interests plays also an important role.

This work ought to be the second to evaluate the effect of the sanctions on Iran through the synthetic control method. The first one is a work of Gharehgozli (2018) where solely the 2011-2014 period is examined and a slightly different approach is chosen. The purpose of this thesis is, however, to analyze the 2010-2015 period when the international sanctions were imposed and estimate the possible impact on Iranian GDP per capita. Our results show a dramatic impact of the sanctions, particularly after 2012 when the EU prohibited all oil imports from Iran. Also due to many other restrictions, Iran was not able to attract foreign investment and find equivalent substitutes for its crude exports. GDP per capita stagnated until 2016 when it experienced a growth rate of 13.4 percent. Overall, we perceive the sanctions as highly effective.

The structure of our thesis is the following. Chapter 2 provides basic insights into the nature of economic sanctions as well as the review of existing literature. In Chapter 3, the numerous sanctions imposed on Iran are examined as well as the literature on Iranian sanctions. Chapter 4 focuses on the Iranian economy and its trade relations, especially with China and the EU. Chapter 5 reviews the literature about the synthetic control method and also describes the methodology and the data. In Chapter 6, we present our results. The conclusion is provided in Chapter 7.

## 2 Sanctions as a potentially powerful political tool

### 2.1 *The nature of sanctions*

There is a wide range of literature about economic sanctions. Apart from many papers that mainly focus on special instances of the sanctions, several aggregate studies exist. Perhaps the most famous one is the book *Economic sanctions reconsidered* by Hufbauer et al. (2009). In this volume, which is the third edition of the greatly influential previous work, the authors examine some 200 cases of sanctions deriving lessons to those who can use these punitive measures.

Hufbauer et al. (2009) define economic sanctions as “*the deliberate, government-inspired withdrawal, or threat of withdrawal, of customary trade or financial relations*”. Sometimes, the countries that impose sanctions, the so-called senders, adopt a “carrot-and-stick” approach in order to positively incentivized the country on which the sanctions were imposed, in other words, the target country. Moreover, the authors define the foreign policy goal as “*the changes the sender state explicitly or implicitly seeks in the target state’s political behaviour*”.

According to Hufbauer et al. (2009), the sender states tend to be large entities that are willing to do an active foreign policy. Not only do these large countries impose sanctions to change the target’s behavior, but they also want to demonstrate resolve and moral outrage, deter all other countries from similar future behaviour. Needless to say, the sanctions may be imposed primarily so as to satisfy the domestic political scene rather than have some minor impact on the target country.

Historically, sanctions have been a relatively common political tool. Hufbauer et al. (2009) mention even ancient Greece where Athens imposed sanctions on Megara shortly before the Peloponnesian War in 432 BC. Nevertheless, their analysis starts during World War I when many sanctions, which are well documented, were imposed. Most of these sanctions together with those imposed later until the end of World War II were followed by military action. It was only in the postbellum period when the economic sanctions started to be preferred to the exercise of violence.<sup>1</sup> Overall, the U.S. has been most often in the role of the sender country,

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<sup>1</sup> Generally speaking, there were many reasons for the sanctions, but for the purpose of this work, it is important to describe the sanctions that were imposed in order to stop the proliferation of nuclear weapons. Particularly in

frequently accompanied by the United Nations, the UK, and the European Community/EU. Russia has also imposed sanctions, particularly on the former satellites and Soviet republics. Similarly, the Soviet Union was commonly the sender country and, as described in the next paragraphs, also played an important role to offset the American sanctions.

## **2.2 *The effectiveness of sanctions***

In the 90s, there was a big debate about the implementation and effectiveness of economic sanctions since the world experienced the Iraqi sanctions, the most severe sanctions since World War II. However, the debate continues today. The advocates of sanctions believe that apart from being relatively peaceful, they can play a useful signaling role. On the other hand, opponents argue that the costs to the sender country and the general public of the target country might be large whereas the targeted regime remains unharmed (Hufbauer et al., 2009).

Hufbauer et al. (2009) propose four reasons for the failure of sanctions. The first one is simply the inadequacy of sanctions for the task, i.e. the goal of the imposed measures may be too naive, the means not enough harsh, and the lack of sufficient cooperation from other countries. The second reason is the fact that the sanctions may unify the political scene of the target country and thus increase the support for the government and its policies. Another reason is the so-called “black knights”. Usually powerful or rich allies of the target countries and at the same time enemies or rivals of the senders, the black knights may largely offset the negative effect of the sanctions. E.g. the Soviet assistance to Cuba and Nicaragua, the Western help to former Yugoslavia during the Soviet sanctions and the help to Israel. The last reason for the possible failure of economic sanctions is the alienation of foreign partners and domestic business interests. Undoubtedly, when only few cooperate, the target country is still able to find substitutes.

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the 1970s and 1980s, the U.S. and Canada used the punitive measures to persuade several countries not to pursue nuclear arms. Some, like South Korea and Taiwan were successfully discouraged by the sanctions, whereas there is little evidence that South Africa, Brazil and Argentina abandoned their plans for becoming nuclear powers as results of the sanctions. Similarly, India and Pakistan succeeded in obtaining a nuclear weapon even though the sanctions had been imposed on them. The most recent examples of nonproliferation measures are the successful sanctions imposed on Libya, Iraq and as we will see Iran. The complete failure are the unsuccessful measures against North Korea (Hufbauer et al., 2009).

In their analysis, Hufbauer et al. (2009) examine the political and economic factors such as the nature of the targeted regime, the mutual relations between the sender and target country before the sanctions, the international cooperation, or the cost of the sanctions. Overall, they find that the sanctions are at least partly successful in 34 percent of all instances they document. Nevertheless, the relative effectiveness depends on the type of sanction goal. Thus, modest goals such as the release of hostages or political prisoners have a success rate of 51 percent whereas the goal of regime change and democratization succeeded only in 31 percent of cases. Eventually, the authors reject the statement that sanctions never work, although one must always observe the circumstances of the imposition of these measures.

On the other hand, Pape (1997) states that economic sanctions are not that useful for achieving noneconomic goals when used independently. He further criticizes the database of Hufbauer, Schott, and Elliot from the previous editions of *Economic sanctions reconsidered* arguing that the authors overestimate the success ratio. His paper proposes three hypotheses when the sanctions tend to be effective. First, economic sanctions ought to be more effective when their goals do not affect the territory, security, and wealth of the target entity. Another hypothesis is that effective sanctions need previous total economic dependency of the target country on the sender. The third hypothesis concerns equality, i.e. sanctions should be more effective against countries with highly uneven income distributions since the government is not able to protect the incomes of its supporters by taking salaries from the rest of the society which has nothing.

Recent works mainly focus on special cases such as Giumelli (2013) who examines the EU sanctions on Iran, Belarus, Syria, and Myanmar. He points out that after the Lisbon Treaty the EU started to more intensively pursue its foreign policies also by imposing tougher sanctions. Similarly to the previous works, he proposes a four-step process of evaluation which consists of the role of sanctions in an overall foreign policy strategy, the goals of this strategy, the effect of the sanctions and the costs to the EU, and the comparative utility of the sanctions. He concludes that the sanctions have positively contributed to change the foreign relations of the EU demonstrating that the EU has some weapons to influence the international scene.

## **2.3 The impact of sanctions**

### **2.3.1 Different studied variables**

Generally speaking, the economic literature is mainly concern with the impact of sanctions on the target country variables. Among this literature, there are works that focus on the humanitarian conditions of the target countries such as the availability of food and drinkable water (Weiss et al., 1997), the possibility of getting medicine and health care (Garfield, 2002) and more specifically (Gibbons & Garfield, 1999). Within these works, we may add Ali & Shah (2000) and Daponte & Garfield (2000) who study child mortality in Iraq as a result of the international sanctions.

Peksen & Drury (2010) study the impact of sanctions on democracy. Based on an examination of time-series cross-national data over a 28-year period, they conclude that the imposition of sanctions worsens the political situation in the target country by incentivizing the regime to further curtail the political liberties. According to the authors, the overall negative effect depends on the duration of the sanctions as well as the nature of them. Moreover, the authors propose to use smart sanctions such as targetting the financial assets of individuals, imposing arms embargoes, or travel bans on the local elite. They also propose foreign aid and economic assistance in order to incentivize the government to comply with the goals of the sanctions.

Another question researchers ask is how the sanctions affect trade. Caruso (2005) estimates the impact of sanctions on international trade implementing a gravity model approach. Using data on the U.S. and 49 target countries, he shows that comprehensive sanctions have a large negative impact on bilateral trade whereas moderate sanctions do not. Moreover, he looks at the effect of unilateral U.S. sanctions on bilateral trade between target states and other members of the G-7. Here, the extensive punitive measures have also a considerable negative effect, while moderate sanctions affect the trade to some extent positively.

On the other, Askari et al. (2004) using also a gravity model finds that American comprehensive sanctions reduced the bilateral trade between the U.S. and target countries, and, at the same time, increased trade between these countries and the EU or Japan.

A slightly different approach is chosen by Afesorgbor (2019) who also by using the gravity model compares the impact on bilateral trade of imposed sanctions to the simple threat of imposing sanctions. The result shows that the impacts differ both qualitatively and quantitatively. While sanctions result in a decrease in trade, a simple threat leads to an

increase. The author explains this by the fact that both the sender and target country stockpile before the actual imposition.

Needless to say, sanctions also affect foreign direct investment. According to Biglaiser & Lektzian (2011), there is strong evidence that the U.S. investors leave the targeted country prior to the sanctions. Nevertheless, the disinvestment is not everlasting, and the investors eventually return, although the sanctions are still imposed.

Furthermore, Neuenkirch & Neumeier (2015) study the impact of UN and U.S. economic sanctions on GDP growth. Their sample includes 68 countries over the period 1976-2012. The results show that the UN sanctions have a statistically and economically significant effect on growth, on average more than 2 percentage points annually, and the effect lasts for 10 years. Comprehensive UN sanctions have an even greater effect, reducing the target GDP growth by more than 5 percentage points. In comparison, US sanctions decrease GDP growth only by 0.5-0.9 percentage points.

Recently, there has been a growing literature on the newest sanctions imposed on Russia. Gurvich & Prilepskiy (2016) estimate the total negative impact on gross capital flow in the period 2014-2017 at about \$280 billion. Tuzova & Qayum (2016) point out that the negative effect of the international sanctions on the Russian federation was also significantly increased by 2014 oil price fall.

## **3 Sanctions on Iran**

### **3.1 *History of the sanctions***

#### **3.1.1 Sanctions in the 20th century**

Needless to say, Iran has been a target of many sanctions throughout history. In some cases, it is hard to assess the effect of the sanctions since not every country abided by them. These countries feared the possible economic impact and unlike the U.S. did not manage to find other alternatives where to purchase oil. Since the Iranian Islamic Revolution and the hostages' crises, Iran has been a target of the U.S. sanctions almost uninterruptedly.

Nevertheless, it was only after Iran's announcement of the nuclear program that the rest of the world, particularly, the European Union started to join the U.S. in their punitive measures.

The first sanctions imposed on Iran were the British ones. On 29th April 1951 after rising discontent with the political situation in Iran, the Shah Mohammed Reza Pahlavi decided to appoint a liberal democrat Mohammed Mosaddeq to be his prime minister. Mosaddeq wanted to reduce the power of the Shah by shifting it to the parliament, the so-called Majlis, and most importantly he wanted to increase the Iranian control of its oil industry which was at that time owned by Brits through the Anglo-Iranian Oil Company (AIOC). The political situation during this period was very difficult, on the one hand, there was the Shah, often perceived as a British puppet, on the other hand, there were many political parties with different aims such as the communist Tudeh party. Nevertheless, Mosaddeq with its National Front managed to form the government and on 1st May the Iranian oil industry was nationalized and the National Iranian Oil Company (NIOC) was born. The UK was firstly planning military action, but after a series of blockades, sanctions were imposed. These concerned mainly an embargo on British exports to Iran of steel, iron, sugar, oil processing equipment, and goods that could be resold for dollars (Gasiorowski, 1987). The sanctions were in force until the 1953's military coup organized by the US.

The next sanctions were imposed almost thirty years later. On 4th November 1979 already after the Islamic Revolution, a group of Iranian students overrun the U.S. embassy in Tehran and took approximately 100 hostages. They demanded the extradition of the Shah who had managed to flee to the US during the Revolution. After the Iranian supreme leader, Ruhollah Khomeini refused to meet an American delegation sent by President Carter, punitive measures started to be imposed. Nonetheless, the Carter administration preferred incrementalism,

bearing in mind that some very aggressive punitive measures could escalate the whole situation endangering the hostages and encouraging the radicals. First, the Americans halted the shipment of military spare parts to Iran, embargoed oil imports from Iran, and froze Iranian deposits in US banks and foreign subsidiaries. On 7th April President Carter broke diplomatic relations with Iran imposing an export embargo. A few days later, his administration prohibited all financial transactions between Iranian citizens and those of the US and further imposed import embargo. The hostages were realized on 20th January 1981 in partial exchange for Iranian assets. On the same day, Ronald Reagan also took office. Contrary to other Republican presidents in the following years, he decided to abide by the accord. Nevertheless, it was only in 1983 when business and trade agreements commenced restoring. It goes without saying that it is very difficult to assess the impact of these sanctions as Iran was in the political turmoil of the Revolution. In their book, *Economic sanctions reconsidered* Hufbauer et al. (2009) rank the sanctions as successful, although Iran was forced to release the hostages for many other reasons.

The Shah died in July 1980 and in September Iran was invaded by the Iraqi troops. The following war posed a serious threat to the very existence of the newly born Islamic republic, particularly, because the sanctions prohibited military supplies by the US. It is also interesting to observe the international cooperation with the US. The European Community and other US allies eventually imposed sanctions but with a delay. On the other hand, China and the Soviet Union were prepared to take the roles of the black knights. Nevertheless, the trade partners of Iran and probably also the US feared a potential oil crisis provoked by the sanctions. At that time, Iran supplied 20 percent of Japan's crude imports and 11 to 15 percent of the European Community's crude imports. American crude imports were also relatively high, amounting to 10 percent in 1978 (Maloney, 2015). Hufbauer et al. (2009) estimate the cost to Iran at \$3,349 million including the reduction of Iranian imports and exports and the loss from the freeze of the assets.

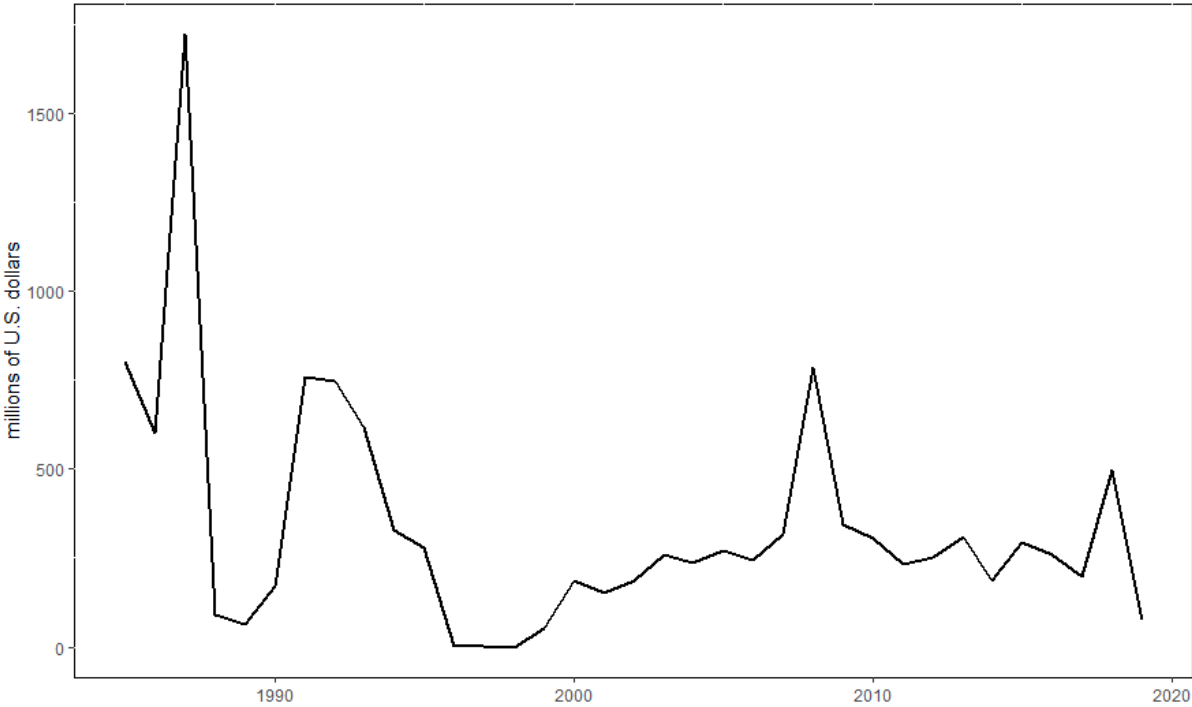
In 1983, 241 US Marines died during a bombing of American barracks in Lebanon. The next year, the US accused Iran of having been involved in those attacks, and also since Iran supported the Shia's Hezbollah they designated Iran as a state sponsor of terrorism. The designation meant some restrictive measures, i. e. restrictions on dual-use exports and opposition to multilateral lending (Maloney, 2015). Although those penalties were not as severe as during the hostages' crisis, the sanctions related to the terrorism were to be expanded in the following years.



According to Maloney (2015), Iran still maintained trade relations with the U.S. In 1986, Iran exported to the U.S. \$468.2 million in oil, \$14.1 million in pistachios, and \$51.7 million in carpets which constituted 30 percent of the whole carpet exports. Figure 3.1 shows the Iran-U.S. bilateral trade. The data are taken from the U.S. Census Bureau.

Nonetheless, in 1987, Iran was designated by the U.S. as a major narcotics producing country. This meant further sanctions among which also the reimposition of a U.S. embargo on Iran. Perhaps surprisingly, U.S. oil companies were still buying a great amount of Iranian crude because as long as the crude was refined and sold in third countries, they did not violate the legal restrictions. Therefore, by 1994, US companies were buying some 25 percent of Iran’s exports. Interestingly, some members of Reagan’s administration wanted to maintain trade with Iran to a certain level to have a source of information on the private sector in Iran. In 1992, new sanctions were codified in the Iran-Iraq Nonproliferation act that forbade any sale of technologies or goods that helped the development of biological, destabilizing conventional, chemical, or nuclear weapons (Maloney, 2015).

**Figure 3.1 The Iran-U.S. bilateral trade**



Even stricter measures came with Clinton’s administration. Iranian efforts to reschedule debts were undermined, loans by the World Bank and International Monetary Fund were blocked, the U.S. also discouraged Japan to invest several hundred million \$ into an aid project in southern Iran and Russia to sell defensive weaponry to Iran. The Americans also managed to

reduce flows of capital into the Islamic republic. Indeed, in 2001, the foreign direct investment (FDI) into Iran represented only 0.34 percent of all FDI into North Africa and the Middle East region. In March 1995, Iran awarded an upstream oil deal to an American company, the first one since the Revolution. Needless to say, this provoked heated debate within the U.S. Board members of at that time Conoco's parent company DuPont objected that the deal was permissible under existing U.S. law. The reaction of president Clinton was an executive order prohibiting U.S. companies to finance and develop projects in Iran's energy sector. Two months later, the order was extended by the prohibition of all trade, financial and commercial transactions involving U.S. companies and their foreign subsidiaries. Following this move, companies such as Shell dropped out of bid processes and the Iranian currency experienced a massive crash from 2,500 to the dollar in January 1995 to 6,500 to the dollar in May 1995. From 1995 on, the currency has been depressing its value even more (Maloney, 2015).

In August 1996, President Clinton signed the Iran-Libya Sanctions Act (ILSA). According to this document, the U.S. president had to take punitive measures against foreign companies that invested more than \$20 million during 12 months in Iran's energy sector. Some of these measures were, for instance, the prohibition of public purchases from the violating company, limitation of its ability to import goods to the U.S. and the virtual impossibility to obtain credit from the U.S. institutions (Kozhanov, 2011). On the other hand, Europe and Asia protested against such a universal measure. Moreover, the CEO of the French oil giant Total publicly dismissed ILSA (Maloney, 2015). In the same year, Congress passed the Antiterrorism and Effective Death Penalty Act. The law enabled to sue directly the governments. Thus, in 1998 Iran was sued for the embassy seizure and other violations that had happened during the Iran-Iraq war.

To sum up, Maloney (2015) notes that although Clinton's administration tried to ameliorate the relationship with Iran by lifting the restrictions on sales of food and pharmaceuticals, enabling the sale of spare airline parts or in 2000 lifting sanctions on carpets, caviar, and pistachio imports, under existing sanctions, the President had to oppose World Bank loans and other help in Iran provided by the international financial entities. Similarly, Congress continued passing legislation that targeted primarily Iran. In March 2000, after a heated debate between the members of Congress and the administration, the Iran Nonproliferation Act of 2000 was signed into law.

### **3.1.2 Bush's administration**

In the early months of Bush's administration, ILSA was renewed. On the other hand, Maloney (2015) argues that the U.S. did not prevent an Iran's bid to accession talks with the World Trade Organization and during the Bush's first term the mutual relationship did not experience any severe escalation, even though President Bush described Iran as a part of the axis of evil. After the horrific 9/11 terrorist attacks, new measures were adopted to tackle world terrorism. Namely, Executive Order 13224 which froze all assets of individuals and organizations deemed as terrorists. Although some of the organizations supported by Iran such as Hezbollah were immediately included in the list of countries affected by this order, the first sanctioned Iranian organization was the Mujahideen-e Khalq, an anti-governmental Islamic Marxist entity. This might be explained as an American reward to the Iranians for the cooperation during the early phase of the Afghan war (Maloney, 2015).

In 2003, the International Atomic Energy Agency (IAEA) confirmed previous concerns that Iran had secretly established a programme for uranium enrichment. The Islamic republic was accused of deliberately hiding the programme which meant a violation of the Nonproliferation Treaty (Giumelli, 2013). Therefore, Britain, France, and Germany, the so-called big three (E3), initiated talks with Iran in order to secure the peaceful nature of the nuclear programme. Unfortunately, these collapsed in late 2005 (Alcaro & Tabrizi, 2014). In the same year, Iranians elected Mahmoud Ahmadinejad, a populist and a hardliner with aggressive rhetoric, as a president. It seemed that the ex-Tehran mayor had no intention to abandon the pursuit of the nuclear programme. In August 2005, the seals at the Natanz enrichment facility were removed after Iran's decision to abandon its commitment to quit uranium enrichment and reprocessing. This move was considered as a further step to develop the nuclear weapon. As a result, the second Bush's administration intensified the punitive measures. Executive order 13382 was signed, which blocked the property of weapons of mass destruction proliferators and their supporters. Consequently, Iran's Atomic Energy Organization, Aerospace Industries Organization, the Shahid Hemmat Industrial Group, and Shahid Bakeri Industrial Group were designated as these proliferators. Together with Executive order 13224, which targeted terrorism, the two orders represented a very effective and powerful weapon to punish a wide range of entities. It was, therefore, in September 2006, when the Iranian financial institutions started to be designated by the U.S. Treasury Department under these two orders as sponsors of terrorism and proliferators of nuclear weapons. The first designated entities were the Bank-e Saderat and Iran's Qods Force, recently known for the assassination of its leader general

Qasem Soleimani. Banks across the world reduced transactions with Saderat, thus encouraging the U.S. to designate other Iranian banks. Not only were designated virtually all financial institutions, but the measures included other primarily official, semi-governmental, and military organizations. Undoubtedly, these measures prevented many firms from investing in Iran. In other words, one had to choose whether to trade with Iran or with the United States. During the Bush administrations, some sixty-two cases of sanctions were enforced against Chinese firms doing business with Iran as well as against European financial institutions. (Maloney, 2015).

Simultaneously with the U.S. measures, several sanctions resolutions were imposed by the United Nations Security Council (UNSC). These measures targeted solely individual persons and institutions linked to the nuclear programme. In March 2006, the first such measure, Resolution 1696, was approved. The document expressed concerns about the purpose of the Iranian nuclear programme and tried to persuade Iran to cooperate. Nevertheless, Iran was not willing to and, therefore, Resolution 1737 was adopted in late 2006 and Resolution 1747 the following year. The former focused on preventing supplies to Iran of materials and technology needed for nuclear development. The latter incorporated an arms embargo. In 2008, the UNSC adopted Resolution 1803 that extended the asset-freezing sanctions, proposed the monitoring of the Iranian banks, and the inspection of the operations of Iran Air Cargo and Islamic Republic of Iran Shipping Line. The Resolution 1835, adopted in the same year, confirmed the four previous resolutions. (Seeberg, 2016)

### **3.1.3 Obama's presidency and the unprecedented international sanctions**

Alcaro and Tabrizi (2014) argue that it was only when President Obama took office that the EU had finally a partner that was willing to negotiate with the Islamic republic and thus choose mutually beneficial approach just like the one the Europeans had been following for years. Nevertheless, it was precisely during Obama's presidency when the toughest sanctions were imposed and consequently Iran came to the negotiating table. In 2009, president Ahmadinejad was reelected provoking waves of protests which were known as the Green Movement. The reason for the protests was the elections which were said to be rigged. Nonetheless, the result was several imprisonments of prominent Iranian politicians. Moreover, under president Ahmadinejad, Iran continued its nuclear activities.

According to Maloney (2015), Obama's administration also succeeded in drawing Russia and eventually China into the collaboration on Iran. Indeed, Security Council Resolution 1929,

adopted in 2010, enabled other countries to take even more punitive measures. These were then gradually intensified by the U.S. and particularly by the EU which after the Lisbon Treaty seemed ready to effectively deal with the Iranian issue.

In July 2010, the U.S. Congress passed the Comprehensive Iran Sanctions and Divestment Act (CISADA). As Maloney (2015) and Kozhanov (2011) note, CISADA represented an improved and stricter version of ILSA. It prohibited the imports of caviar, carpets and pistachios as well as sanctioned the third parties involved in the oil and gas sector in Iran. Namely, the former rule of \$20 million as the highest value of the possible investment was further elaborated, specifying that within a twelve months period, the investment in a single project must not be more than \$5 million and, eventually, the sum of all investments must not exceed \$20 million. Moreover, the U.S. and foreign firms were obliged not to supply any materials or technologies for the building and maintenance of oil refineries in the Islamic republic when these shipments were worth more than \$1 million each or more than \$5 million in total within a 12-month period. Although the Russians expressed some discontent with according to them exaggerated American reaction, the EU stopped any new energy investments. In 2011, the UK prohibited all financial transactions with any Iranian entity, including the Iranian Central Bank, which was also targeted by newly adopted American measures.

In March 2012, the Islamic republic experienced the most severe restrictions ever imposed on it. One of these constituted Iran's exclusion from the SWIFT worldwide messaging system, that serves international money transfers. Dreyer et al. (2015) notes that this measure represented a new and innovative approach in sanctioning. Nonetheless, it was the European oil embargo which had an absolutely devastating effect on Iran.

According to Maloney (2015), not only all import, purchase, and transportation of crude oil were banned, but it was also prohibited to insure Iranian oil shipments, several Iranian assets were frozen and later in 2012, the other members of the EU followed the UK prohibition of financial transactions with an exception of the licensed ones. Furthermore, the EU prohibited any trade in natural gas. In early 2013, the U.S. prevented remaining Iran's customers from providing any direct form of payment, thus making the trade with Iran a barter exchange. Generally speaking, it was difficult for Iran's major crude purchasers such as Japan, India, South Korea, China, and Turkey to avoid the sanctions and at the same time not to increase their domestic price of gasoline. E.g. the U.S. State Department designated some Chinese firms among which the state-run commercial company Zhuhai Zhenrong for not stopping the

sale of refined petroleum to Iran. However, all of the major purchasers of Iran's crude quickly met the U.S. criteria by reducing petroleum purchases. Namely, Japanese imports of Iranian crude fell by approximately 50 percent and that of China by 18 percent. Also, the United Arab Emirates (UAE), a key trade partner for Iran, followed the international sanctions almost immediately, freezing Iranian assets, prohibiting the new Iranian firms operations in the Ras al-Khaimah emirate, which is a free trade zone, and closing ports for gasoline cargoes to Iran. Still, the trade between Iran and UAE remains significant since the Emirates National Oil Company has to supply by law subsidized gasoline to the domestic market, and Iran is a cheap option.

Similarly, as noted in Maloney (2015) these measures negatively affected the business environment. Shell and Repsol canceled signed deals for South Pars, the world's largest gas field. The other oil giants such as Total, Statoil, and ENI started closing their offices and abandoned their future plans. Foreign banks providing the indispensable capital to Iran left as well.

Summing up, the economic situation, particularly after 2012, was severe. Iran was losing \$133 million per day in revenues, the rial virtually lost half of its value, as already noted, Iran was using barter exchange, also smuggling and other desperate methods for compensation (Maloney, 2015). The international trade experienced a massive shift especially to the Asian country, however, the oil production, as stated in Dreyer et al. (2015) decreased significantly resulting in Iran's loss of its position as second-largest oil producer within the Organization of the Petroleum Exporting Countries (OPEC) and its fall to the fourth position, behind Saudi Arabia, Iraq, and the UAE. The effects are more thoroughly discussed in the following chapters.

#### **3.1.4 The Iran Nuclear Deal**

In 2013, the Iranians elected Hassan Rouhani, a moderate who promised to improve the relations with the West, as a president. Seeberg (2016) states that there was also a change in the UNSC where the U.S., Russia, and China agreed on the mutual representation by the EU High Representative Catherine Ashton. Nevertheless, on 14th July 2015 after long negotiations, the U.S., U.K., France, Germany, Russia, China, the EU, and Iran successfully reached an agreement known as the Joint Comprehensive Plan of Action (JCPOA). Consequently, the UNSC unanimously adopted Resolution 2231 which enshrined the JCPOA.

The purpose of JCPOA is to stop Iran from developing nuclear weapons by preventing it from producing fissile material at its declared nuclear power plant for at least 10 to 15 years. Furthermore, thanks to the Resolution 2231, any participant of the JCPOA can start the process of re-imposing UN sanctions by alerting the President of the UNSC whenever there is a reasonable doubt that Iran does not adhere to the accord. Similarly, the U.S. Congress passed in reaction to the JCPOA the Iran Nuclear Agreement Review Act under which the President has to certify to Congress every 90 days that Iran is adhering to the rules and that the elimination of some sanctions is justified by the Iranian steps. Indeed, the indispensable condition for eliminating the sanctions associated with the nuclear programme was Iran's implementation of its nuclear commitments which were verified by the IAEA. Eventually, Iran could access more than \$100 billion of frozen assets, resume exporting oil to the world and use the global financial system for trade ("Iran Nuclear Deal," 2019) and (*The Iran Nuclear Deal*, n.d.).

### **3.2 Literature on Iran**

As already described in this chapter, Iran has been one of the most sanctioned countries in the world, and therefore there are several studies that examine the various measures taken against the Islamic republic.

In her weighty tome, Maloney (2015) dedicates one chapter to the sanctions on Iran. The analysis is rather qualitative. Similarly, the authors examine the single instances of Iranian sanctions (Kozhanov, 2011, Takeyh & Maloney, 2011, Alcaro & Tabrizi, 2014, Seeberg, 2016).

Torbat (2005) studies the effectiveness of the U.S. trade and financial restrictions on Iran by implementing the concept of welfare loss. The results show that financial sanctions are a more powerful weapon than trade sanctions. It is also stated that the economic impact of the U.S. sanctions was significant while the political minimal.

Another study by Popova & Rasoulinezhad (2016) looks at the modification of the Iranian trade between 2006 to 2013 period by using a panel-gravity trade model. The results show a significant negative impact of sanctions on Iranian trade with the EU, whereas there is a significant positive effect on trade with Asia.

An interesting theme is examined by Farzanegan & Hayo (2019). The authors focus on the shadow economy using data from 2001 to 2013. They state that 2012 and 2013 sanctions had

a significantly greater negative effect on the growth rate of the shadow economy than they did on the officially reported GDP growth rate.

Moreover, there are works that already focus on the lifting of the 2010 to 2013 sanctions such as Elena Ianchovichina Shantayanan Devarajan Csilla Lakatos (2016). In their paper, they use a global general equilibrium simulation model to measure the impact of lifting the sanctions. More specifically, Pratt & Alizadeh (2018) using the same model, study the economic impact of the lifting of sanctions on tourism in the Islamic republic.

A closely linked topic to this work is examined by Farzanegan (2019). In his paper, he is using the synthetic control method to evaluate the effect of the 2012 oil embargo on Iranian military spending. The synthetic Iran is then a combination of Algeria, Angola, Nigeria, and Saudi Arabia. The results show that over the period 2013-2015 per capita military spending decreased by about 119\$ per year on average.

Similarly, Gharehgozli (2017) and later in her dissertation work Gharehgozli (2018) is using the synthetic control method to estimate the effect of the nuclear sanctions on Iran during the period 2011 to 2014. The results show a decline of more than 17 percent over the studied period. Moreover, these results are compared to those obtained by Difference-in-Difference model and a dynamic panel data model.



## 4 Iranian economy and trade

### 4.1 Iranian economy

Throughout modern history, the Iranian economy has experienced several structural shocks. Esfahani & Pesaran (2009) calculates that in 1976, per capita GDP was about 64 percent of the average for Western European countries. Nevertheless, the Revolution and the following war with Iraq crippled Iranian GDP per capita (2010 US\$) from \$10,266 in 1976 to \$3,640 in 1988. Consequently, as described in the previous chapter, Iran has been a target of various sanctions that hindered economic development. Gheissari (2011) notes that the government hugely increased its role in the economy during this period. Various industries, as well as the credit market, were brought under full control of the state. However, many of these were privatized during the 2000s.

During Ahmadinejad's presidency, Iran's oil revenues rose sharply. Some 40 percent of more than \$700 billion that Iran had earned through crude exports in the previous thirty years was earned during Ahmadinejad's second presidency. Ahmadinejad election's slogan was to take oil revenue to people's dinner tables, nonetheless, during that period the transparency worsened and corruption increased (Maloney, 2015). After the 2010 sanctions the economy slowed down and when the European oil embargo was introduced, GDP started to decline. This is due to the fact that around 80 percent of exports are crude oil, whereas the total GDP depends on oil to some 22 percent according to the average oil rents which, however, fluctuate a lot.

Table 4.1 shows the countries with the largest oil reserves. All values are from 2017 and we use data from OPEC; for the monetary values we use OEC. With its second-largest reserves of natural gas and third-largest oil reserves, Iran's hydrocarbon wealth is second only to Saudi Arabia's. The last column of the table shows the number of years for which the country would be able to drill at the 2017 pace. Contrary to popular belief, tremendous mineral wealth may pose several problems.

**Table 4.1 Countries with the largest oil reserves (2017)**

Country	Crude oil reserves (million barrels)	Oil demand (million barrels)	Crude oil exports (million barrels)	Exported value of crude petroleum (billion \$)	Remaining years under 2017 production
United States	39,160	7284.6	422.8	19.4	11.5
Brazil	12,634	1132.8	411.5	17.4	13.2
Ecuador	8,273	87.9	140.7	5.63	42.7
Venezuela	302,809	183.4	582.7	22.2	407.7
Kazakhstan	30,000	107.2	500.3	19.9	56
Russia	80,000	1269.2	1847.5	96.6	21.2
IR Iran	155,600	663.9	775.6	38.5	110.2
Iraq	147,223	263.7	1387.7	57.5	90.3
Kuwait	101,500	135.5	733.7	31.3	102.8
Qatar	25,244	123.7	170.1	13.4	115.3
Saudi Arabia	266,260	1194.4	2543.4	110	73.3
United Arab Emirates	97,800	299	868.2	39.9	90.3
Algeria	12,200	153.9	230.9	12.8	31.6
Angola	8,384	42.1	575.5	26.8	14.1
Nigeria	37,453	155.5	661.1	35.6	66.8
China	25,627	4497.1	35.6	1.36	18.4

Firstly, Gheissari (2011) shows by very simple and not very precise calculations that if the government invested the whole hydrocarbon wealth, i.e. some one trillion dollars depending on the current market price, in a trust fund yielding 3 percent per year in real terms, the annual per capita earnings would be about \$430. If this money were to be distributed in 2005, the Gini coefficient of inequality would fall from 0.44 to 0.40, thus the poverty and inequality would not be wiped out.

Secondly, countries that are rich in natural resources may experience the notorious Dutch disease. Generally speaking, there are three sectors in the economy, i.e. the natural resource sector, the non-resource tradable sector constituted of agriculture and manufacturing and the non-resource non-tradable sector constituted of services. Solely the prices of the first two

sectors are determined on international markets and the non-tradable sector is determined on the domestic market. The real exchange rate is then the ratio of the price of the non-tradable sector to the price of the tradable. The Dutch disease happens when the public and private demand for all products is increased by a positive oil revenue shock. The demand for tradable goods can be met by increasing imports at international prices. On the other hand, the supply of non-tradable goods is less flexible and thus it pushes up their prices resulting in an increase of wages in the economy. Consequently, the profit margin in the tradable sector is reduced. Similarly, the Dutch disease can happen when a huge oil and gas sector attracts labour and capital from the other sectors of the economy leading to lower production in the rest of the economy. The relative prices, particularly in the non-tradable sector, are increased by lower supply. In the long run, this leads to the de-industrialization of the economy and to an increase in the prices of non-tradable goods. The tradable ones remain the same resulting in the appreciation of real exchange rates. As a consequence, domestic goods become more expensive in international markets, making local producers less competitive in the foreign market (M. R. Farzanegan, 2013).

In his analysis, Farzanegan (2013) shows that there is a statistically significant positive correlation between the logarithm of real effective exchange rates and the logarithm of oil prices after the Revolution. Moreover, there is evidence for the positive association between oil prices and real estate services as well as a negative correlation between oil prices and value-added of agriculture. This suggests that Iran has experienced the Dutch disease.

Summing up, although the whole economy has a huge potential, the recurrent sanctions, lack of transparency, poor rule of law, and omnipresent corruption hindered any stable improvement. Iran is in desperate need of investment, technology, and assistance from abroad. Its vast natural resources, such as for instance the South Pars gas field, need massive financial help from foreign oil giants. Sadly, the business environment is greatly affected by the above mention factors, thus making it difficult for foreign companies to enter.

## **4.2 *International trade***

### **4.2.1 Iranian trading partners**

On the eve of the European oil embargo in 2011, Iran exported value was \$180 billion. The crude oil accounted for some 81 percent of the total exported value. Apart from crude petroleum, Iran exported mainly other oil by-products. The main destinations were Asia, particularly China with 14 percent followed by Japan, India, and South Korea, and the EU

where the main importers were Italy with 3.7 percent followed by Spain and Greece (*OECD*, n.d.).

Nevertheless, as Popova & Rasoulinezhad (2016) show, Iran was forced to change the direction of its foreign trade toward Asian countries. Thus, in 2015, the last year of the nuclear sanctions, the exported value was only \$31.8 billion of which almost half went to China (*OECD*, n.d.)

#### **4.2.2 Iran and the EU**

Generally speaking, the EU and its member states have always had a more moderate approach to Iran than the American allies. Nonetheless, as Parvin (2012) states, even among the member states, there were considerable differences in how to deal with Iran. It is, therefore, not surprising that these differences also affected trade. States like Germany or Italy have a significant trade relation with Iran in comparison with the UK since Iran still perceives the UK as an ex-colonial power. Mousavian (2016) even mentions a possible positive effect of the Brexit on the EU-Iran relation. On the other hand, Iran's repeated violation of human rights and its anti-semitic rhetoric poses many problems for further cooperation particularly with the moderate EU members (Parvin, 2012).

As already mentioned, the EU was before the oil embargo along with China Iran's largest trading partner. The trade consisted mainly of Iran exporting oil to Europe and importing machinery, chemicals, and other industrial products. The dependence on oil varied among the member states. Giumelli (2013) points out that particularly the southern states of the EU relied on Iranian oil. In fact, Greece, Italy, and Spain imported in 2011 30, 14, and 12 percent respectively. After the financial crisis, Greece found itself in difficult conditions in the oil market where banks were not willing to provide credit as they feared Greece defaulting on its debt. Since very good credit conditions were offered by the Islamic republic, Greece almost doubled its Iranian oil imports in 2011. Nonetheless, after the embargo, Greece managed to replace the oil from Iran with the Russian, Iraqi, and Saudi ones.

As already stated in the previous chapter, after the American companies were prohibited from operating within Iran, the European firms tried to fill the void. Eventually, these had to leave as well. Nevertheless, after the JCPOA and prior to Trump's sanctions, the Europeans seemed to return to Iran. Indeed, Adebahr (2018) notes that French carmakers Peugeot and Renault started to invest more money in order to establish production lines in Iran and German

Volkswagen returned to Iran after 17 years. Similarly, Total signed a large deal to develop together with CNPC and Iran's Petropars the South Pars gas field.

### **4.2.3 Sino-Iranian relation**

As (LIU & WU, 2010) point out, throughout history, China has been always an important trading partner for Iran. After the establishment of diplomatic relations in 1971, the trading ties strengthened. Similarly, Conduit & Akbarzadeh (2019) state that although there has not been any written military agreement nor formal alliance, by the 1980s, China tried to offset the negative impacts of the U.S. and Soviet pressure. It also, for instance, apologized for Chairman Hua's visit to the Shah before the Revolution, thus demonstrating the willingness to cooperate with the newly born Islamic republic. Indeed, China has supplied military equipment to Iran, thus becoming its largest supplier. Nevertheless, Chinese main goal has been always accessing Iran's vast oil reserves.

Contrary to popular belief, not anyone who has money can buy oil. In the early 1990s, China's domestic energy supplies were not sufficient in order to satisfy the rising domestic demand. Consequently, China became a net oil importer searching for possible new oil resources around the world. It is blatantly obvious that China was not able to pursue the oil in the Mexican Gulf where the European and especially the American companies ruled, on the other hand, to gain the entrance to the Middle East and Africa was also difficult. China is a latecomer to the international energy market, thus it is for China virtually impossible to find any free oil or gas deposits in stable and credible countries. In these, the energy operations are executed by national companies or by huge Western oil companies. When the Americans forbade their firms from doing business in hostile countries, China used these unique opportunities. Due to the almost perpetual and increasing sanctions, China has gradually increased its presence in Iran (Hong, 2014).

Maloney (2015) notes that in 2004, already after the Discovery of the Iranian nuclear programme, China began to invest massively in the Iranian energy sector. Zhuhai Zhenrong signed a \$20 billion contract with Iran to produce 2.5 million metric tons of LNG per year for twenty-five years. To that date, it was the world's largest natural gas purchase. In the same year, Sinopec, another Chinese state energy giant, bought a 51 percent stake in the Yadavaran field. In December 2007, Sinopec was awarded a \$2 billion deal for the first stage of the Yadavaran's development. Later, the firm was reported to increase its imports of Iranian oil from 60 thousand barrels per day in 2007 to 160 thousand in 2008, increasing thus China's

crude imports from Iran by one-third. Already as a result of departures of some foreign oil companies, China National Petroleum Corporation (CNPC) signed in January 2009 a \$2 billion contract to develop the North Azadegan onshore oil field. After the 2010 sanctions mainly imposed by the U.S. and the EU, the major Western oil companies were prohibited from new investments in Iran and finally also from selling any refined petroleum. Therefore, China became the most important foreign entity in Iran. For its financial and political might, China ignored the possible danger of the U.S. sanctions, nevertheless, by 2010, Sinopec and CNPC slowed down their investments due to the CISADA.

As Hong (2014) points out, at the time of the nuclear sanctions, Iran was China's third-largest importer of crude oil, only after Saudi Arabia and Angola, supplying over 10 per cent of China's total oil imports. Not only does China want to buy Iranian oil, but it also wants to develop projects in order to lock in Iranian oil sales and expand its capital goods exports. From 2003 to 2011, the FDI from China increased from \$7.8 million to \$615.6 million, with an accumulated value of \$1,351.6 million. For comparison, the second-highest accumulated value of Chinese FDI in the Middle East was that of UAE with a value of \$1,174.5 million. Moreover, the China-Iran bilateral trade increased from \$5.6 billion in 2003 to \$45 billion in 2011. LIU & WU (2010) and Kozhanov (2011) note that although the official figures showed that the EU was Iranian biggest trading partner till 2011 when China took over, the reality might be different since much of Iran's trade with another important partner the UAE constitutes of goods that are coming to or from China. The Deputy Head of the Iran-China Chamber of commerce, Majid-Reza Hariri reported that more than half of the \$15 billion trade with the UAE in 2010 consisted of such goods. These include for instance gasoline that is purchased by Chinese companies in Singapore and then sold to Iran via Dubai.

As already mentioned, China remained a trading partner for Iran also after the sanctions. By 2012, it was buying 54 percent of Iran's oil exports and when sanctions hindered Iran's oil exports, China was ready to trade with Iran through barter exchange and also imported products that were not targeted by the sanctions such as iron ore. Indeed, in 2014, Iran became China's fifth-largest provider of iron ore. In January 2016, the chairman Xi was the first world leader to visit Iran after the sanctions were lifted. Several new deals were signed and the Chinese President promised that by 2026 the China-Iran bilateral trade would increase to \$600 billion (Conduit & Akbarzadeh, 2019).

Following the definition of Hufbauer et al. (2009), China has become clearly a black knight for Iran. As Hong (2014) notes, Iran wants to do business with China since the Chinese are

willing to accept Iranian requirements and methods how to do business. Contrary to Western countries, China does not require any special post-sale inspections of sold technologies which are commonly exchanged for oil imports. Nevertheless, at the time of the sanctions, China was perfectly aware that any escalation of the situation in the Middle East could pose a serious threat to the Chinese economy. Needless to say, the majority of China's imported crude comes from the Middle East and Africa. China had also poor oil reserve system in comparison to the Western countries.

To sum up, Iran found in China a very strong partner who is indifferent to the Iranian domestic political scene. As stated in *Muslim countries' silence on China's repression of Uyghurs* (2019), China does not care too much about the Iranian government and its violation of human rights as long as Iran turns blind eye to the Chinese treatment of Uyghurs in Xinjiang province. Similarly, China cannot leave one of its major oil importers without a significant cost. At the same time, it is in Chinese interests to pursue peace and stability in the Middle East.

## 5 Data and Methodology

### 5.1 Synthetic control method

Since its first introduction by Abadie & Gardeazabal (2003) the synthetic control method has become a very popular tool for evaluating impact of some specific intervention. Moreover, it is described by Athey & Imbens (2016) as arguably the most important innovation in the evaluation literature in the last fifteen years. The purpose of this method is to estimate the potential outcome of a unit, that is affected by some kind of intervention, had it not been for the intervention. This unit is then the synthetic control one and it is the weighted average of other units that are unaffected by the intervention.

Not only is the method used to analyze different policy interventions, but it is also widely used to evaluate the effects of wars, natural disasters, immigration, and terrorism. Indeed, in its first introduction, *The Economic Costs of Conflict: A Case Study of the Basque Country* Abadie & Gardeazabal (2003) assess the impact of the Basque terrorist organization ETA, that was responsible for many attacks particularly during the 80s and the 90s, on the economy of the Basque Country. They construct a synthetic Basque Country as a weighted average of all Spanish regions. The synthetic unit was constructed based on many different variables such as GDP per capita, the sectoral share of agriculture, industry, and many others. The results show a 10% gap between the real Basque Country and its synthetic counterfactual.

Later, Abadie et al. (2010) published a more formalized paper using the synthetic control method in order to estimate the effect of Proposition 99 in California. Proposition 99 was a large-scale tobacco control program that California implemented in 1988. Generally speaking, they use the same method as previously, i.e. creating a synthetic unit by weighting all of the US states, only this time they focus on the per-capita cigarette sales. They estimate that by 2000 the annual per-capita cigarette sales were about 26 packs lower than what they would have been in the absence of the intervention.

In 2015, again Abadie et al. (2015) estimate the economic impact of the 1990 reunification of Germany on West Germany. They build the synthetic West Germany based on the GDP per capita, inflation rate, investment ratio, schooling, and trade openness. The comparison of the synthetic unit with the real West Germany shows a reduction in per capita GDP by about 1600 USD per year during the period 1993-2003.



## 5.2 Methodology

### 5.2.1 The synthetic control estimator

Suppose that we observe  $J + 1$  regions. Without loss of generality, suppose that solely the first region is uninterruptedly exposed to the intervention. The remaining  $J$  regions are those not affected by the intervention, i.e. the so-called “donor pool” (Abadie et al. 2010, 2015). Not only do we consider regions that are not exposed to the intervention or any other structural shock, but we also try to find regions that are similar to the treated one.

Let  $Y_{it}^N$  be the potential outcome of the region  $i$  at time  $t$ , for units  $i = 1, \dots, J + 1$ , and time periods  $t = 1, \dots, T$  in the absence of the intervention and let  $Y_{it}^I$  be the outcome of the region  $i$  at time  $t$  in the presence of the intervention. Further, we observe these outcomes for some positive number of preintervention periods  $T_0$ , and some positive number of postintervention periods  $T_1$ , with  $T_0 + T_1 = T$ . Assuming that the intervention has no impact on the outcomes during the preintervention period, we have  $Y_{it}^N = Y_{it}^I$  for  $t \in \{1, \dots, T_0\}$  and  $i \in \{1, \dots, N\}$ . However, there might be some cases where interventions have anticipation effects and therefore  $T_0$  should be redefined (Abadie et al. 2010, 2015).

Let  $\alpha_{it} = Y_{it}^I - Y_{it}^N$  be the effect of the intervention for region  $i$  at time  $t$ , where  $t > T_0$ . Since solely the first region is exposed to the intervention we have  $\alpha_{1t} = Y_{1t}^I - Y_{1t}^N$ .  $Y_{1t}^I$  is observed so we only need to estimate  $Y_{1t}^N$ . Needless to say, the preintervention characteristics of the treated unit are often more precisely approximated by weighting several untreated units rather than looking at only a single one. The synthetic control is thus defined as a weighted average of  $J$  units from the donor pool. Let  $\mathbf{W}$  be a  $(J \times 1)$  vector of positive weights which sum to one, i. e.,  $\mathbf{W} = (w_2, \dots, w_{J+1})'$  with  $w_j \geq 0$  for  $j = 2, \dots, J + 1$  and  $w_2 + \dots + w_{J+1} = 1$ . Moreover, we define a  $(k \times 1)$  vector  $\mathbf{X}_1$  representing  $k$  preintervention characteristics of the treated unit and a  $(k \times J)$  matrix  $\mathbf{X}_0$  representing the same  $k$  preintervention characteristics of  $J$  untreated units. The characteristics in  $\mathbf{X}_1$  and  $\mathbf{X}_0$  may contain preintervention values of the outcome variable (Abadie et al. 2010, 2015).

We need to choose the vector  $\mathbf{W}^*$  such as to minimize the distance  $\|\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}\|$ . Abadie and Gardeazabal (2003) and Abadie et al. (2010) select  $\mathbf{W}^*$  as the value of  $\mathbf{W}$  that minimizes:

$$\|\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}\|_V = \sqrt{(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})' \mathbf{V} (\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})}$$

Where  $\mathbf{V}$  is some  $(k \times k)$  symmetric and positive semidefinite matrix. In other words,  $\mathbf{V}$  reflects the relative importance that we assign to each characteristic. We could potentially

choose  $\mathbf{V}$  subjectively based on previous knowledge of the relative importance of the given characteristics. Nonetheless, Abadie and Gardeazabal (2003) and Abadie et al. (2011) propose a data-driven procedure to select  $\mathbf{V}$ , which is at the same time implemented by default in the `synth` function in R. The idea is to solve a nested optimization problem, where  $\mathbf{V}$  is chosen among all positive semidefinite matrices such that the mean squared prediction error (MSPE) produced by the weights  $\mathbf{W}^*(\mathbf{V})$  is minimized over some set of pretreatment periods (Abadie et al. 2010, 2011, 2015).

The synthetic control estimator of  $Y_{1t}^N$  is therefore

$$\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

And the synthetic control estimator of  $\alpha_{1t}$  is

$$\hat{\alpha}_{1t} = Y_{1t}^I - \hat{Y}_{1t}^N$$

## 5.2.2 Inference with the synthetic control method

Generally speaking, the synthetic control method poses several obstacles that complicate the use of traditional approaches to statistical inference. E.g. usually we have only a small sample and the units are not chosen randomly. Therefore, Abadie and Gardeazabal (2003) propose using Placebo test that is later more formally developed by Abadie et al. (2010, 2015).

In fact, two Placebo tests are proposed. The first one is the so-called “in-time placebo” (Abadie et al. 2015) and its idea is to artificially change the date of the intervention. If then, large effects similar to the actual date of the intervention are observed, the credibility of our analysis diminishes. On the other hand, we need a sufficiently large number of time periods when no structural shock to the treated unit happened. Similarly, the second falsification test, the “in-space placebo” (Abadie et al. 2015), is based on the reassigning of the intervention, just this once not in time, but to the members of the donor pool. The test results in the distribution of estimated gaps of the  $J$  units artificially affected by the intervention.

Consequently, these are plotted together with the treated unit on a graph. The falsification lies in showing that the gaps of the control units from the donor pool are similar or larger than the gap of the treated unit. Perhaps more visible is to plot on a graph and compare the ratios of the postintervention and preintervention MSPEs that are calculated after having run the Placebo test. The following is the ratio formula

$$\frac{\frac{1}{T - T_0} \sum_{t=T_0+1}^T (Y_{1t}^I - \hat{Y}_{1t}^N)^2}{\frac{1}{T_0} \sum_{t=1}^{T_0} (Y_{1t}^I - \hat{Y}_{1t}^N)^2}$$

The “in-space placebo” test also allows us to construct a p-value that is defined as follows

*“In the absence of randomization, the p-value still has an interpretation as the probability of obtaining an estimate at least as large as the one obtained for the unit representing the case of interest when the intervention is reassigned at random in the data set”* – Abadie et al. (2015)

### 5.3 Data

For the implementation of the synthetic control method, we use data from the World Bank. Unfortunately, there is no strict rule which variables for the estimation should be used, thus we mainly follow Abadie and Gardeazabal (2003) and Abadie et al. (2015) choice of variables. The dependent outcome variable  $Y_{it}$  is GDP per capita (constant 2010 U.S. \$) and the  $k$  characteristics are value added by sectors agriculture, industry, manufacture and service, employment in agriculture, industry, and service, gross capital formation, exports and imports as a percentage of total GDP, oil rents, fertility rate, population density, dependency ratio, inflation rate, labor force participation, unemployment and rule of law. More information about the variables is provided in Appendix A.

Similarly, there is no definite methodology on how to select the units to the donor pool. Although they ought to be similar to the treated unit, the choice remains subjective. In our case, the following countries were selected: Algeria, Angola, Azerbaijan, Bahrain, Brazil, China, Ecuador, Equatorial Guinea, India, Indonesia, Kazakhstan, South Korea, Malaysia, Mexico, Myanmar, Nigeria, Oman, Pakistan, Saudi Arabia, Thailand, Turkey, Turkmenistan and the UAE. We primarily chose members of OPEC, even though many of them were not considered since they suffered a considerable structural shock during the studied period, i.e. Libya during the Arab Spring or Iraq during the whole studied period. Moreover, several oil-rich countries were added as well as the Iranian major trading partners such as China and India.

The data are annual starting in 1990, which is the date shortly after the Iran-Iraq war and at the same time the date after the fall of the USSR when we may observe more oil-producing countries such as Azerbaijan, Kazakhstan, and Turkmenistan. The data end in 2017. Nevertheless, the year 2015 is sufficient as the multilateral nuclear deal was signed.

# 6 Results

## 6.1 Iranian GDP per capita

Figure 6.1 presents the GDP per capita of the actual and the synthetic Iran. As we can see, the GDP per capita fell considerably after the 2012 oil embargo, however, we may also observe a slowdown after the first 2010 international sanctions. The difference between the actual Iran and its synthetic counterfactual is relatively small until 2010, but after 2010 the gap increases considerably. In 2015 the last year of sanctions when the nuclear accord was signed, we estimate the value of GDP per capita for the synthetic Iran to be \$7,984 which is \$1,911 or 31.45 percent more than the actual GDP per capita of Iran.

**Figure 6.1 Synthetic and actual GDP per capita of Iran**

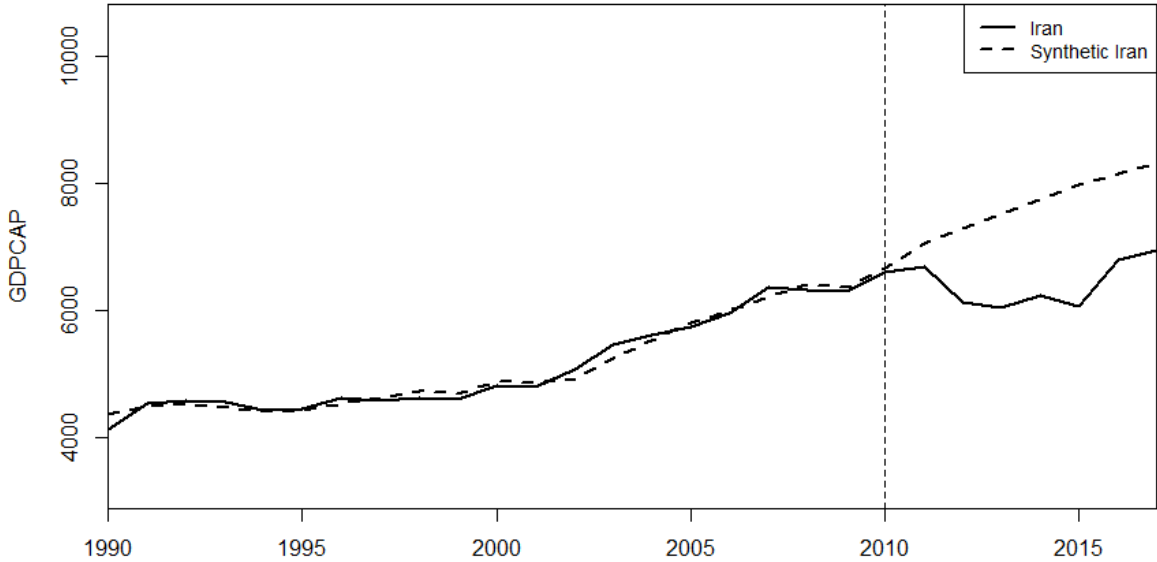


Table 6.1 shows the variables of the actual (treated) and synthetic Iran as well as the mean of the 24 units before 2010. The reported numbers are means of various selected periods depending on the availability of the data. For instance, the reported GDP per capita is the mean of 2008 and 2009 GDPs. Further information on the selected periods is reported in Appendix A. Inflation, for instance, was assigned weight 0 which explains the poor match.

**Table 6.1 Values of pre-treatment variables**

Variable	Treated	Synthetic	Sample mean
GDP per capita	\$6,316	\$6,395	\$9,852
Inflation	19 %	7.45 %	13.7 %
Oil rents	26.2 %	14.6 %	14.4 %
Fertility rate	1.88	2.25	2.97
Share of industry	45 %	47 %	41.3 %
Share of agriculture	7.3 %	9 %	11 %

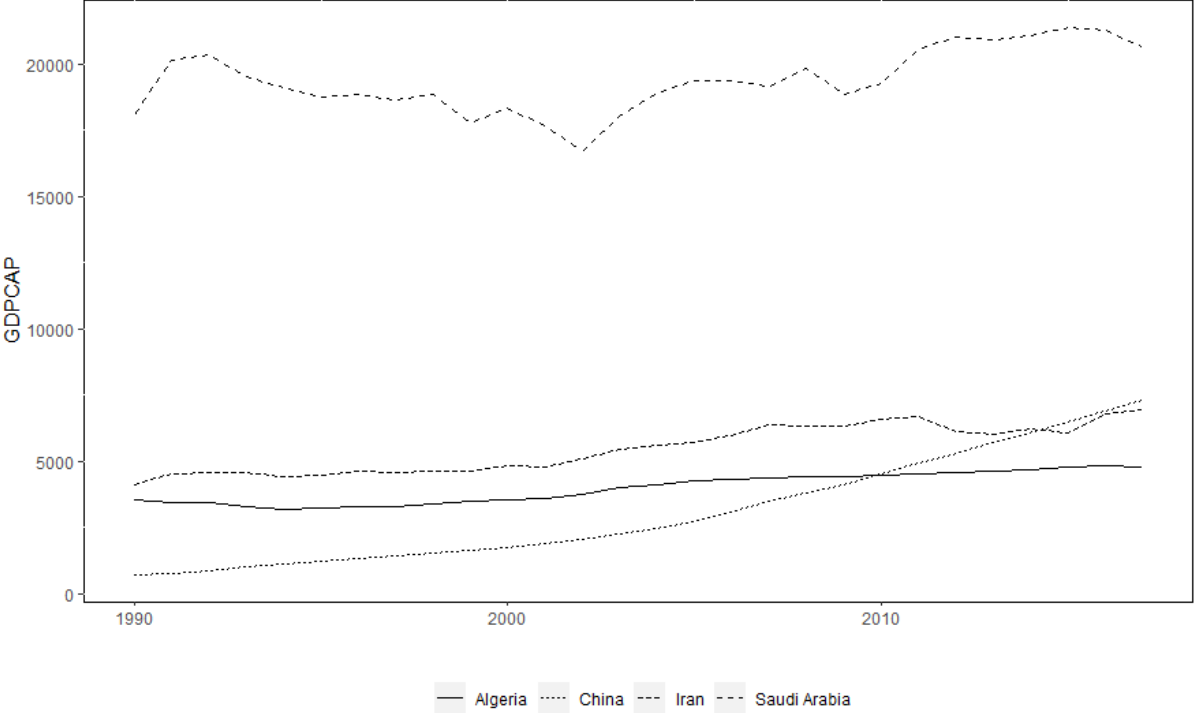
Table 6.2 shows the weights assigned to the countries in the donor pool. Our synthetic Iran is a weighted average of Algeria, Brazil, China, Kazakhstan, Mexico, Saudi Arabia, and Turkey. The biggest weight is assigned to Algeria, heavily oil-dependent country, which, nonetheless, was not so severely hit by the Arab Spring (Hamouchene & Rouabah, 2016). China has the second biggest weight which makes perfect sense since Iran as an isolated economy by the West was not so severely hit by the 2008 financial crisis and, therefore, for our synthetic estimation, we needed to find some other country that had experienced similarly mild effect of the Great Recession. Moreover, the Synth function assigned also relatively significant weight to Saudi Arabia, Iranian regional rival which is undoubtedly a large oil producer and at the same time the biggest Chinese importer of crude.

**Table 6.2 Synthetic control weights**

Country	Weight	Country	Weight
Algeria	0.388	Malaysia	0
Angola	0	Mexico	0.052
Azerbaijan	0	Myanmar	0
Bahrain	0	Nigeria	0
Brazil	0.006	Oman	0
China	0.364	Pakistan	0
Ecuador	0	Saudi Arabia	0.088
Equatorial Guinea	0	Thailand	0
India	0	Turkey	0.066
Indonesia	0	Turkmenistan	0
Kazakhstan	0.036	UAE	0
South Korea	0		

Moreover, since the synthetic Iran is primarily constructed from countries heavily dependent on oil such as Algeria and Saudi Arabia, our final estimate seems credible in the context of the 2014 huge oil price collapse, which affected the oil producers. On the other hand, China as a net importer of crude was better off, and thus any large weight may overestimate the final result. Figure 6.2 shows GDP per capita of the countries from donor pool that have received the greatest weight. We may observe a steady GDP per capita growth of China as well as a huge difference between the kingdom of Saudi Arabia and the rest of the countries.

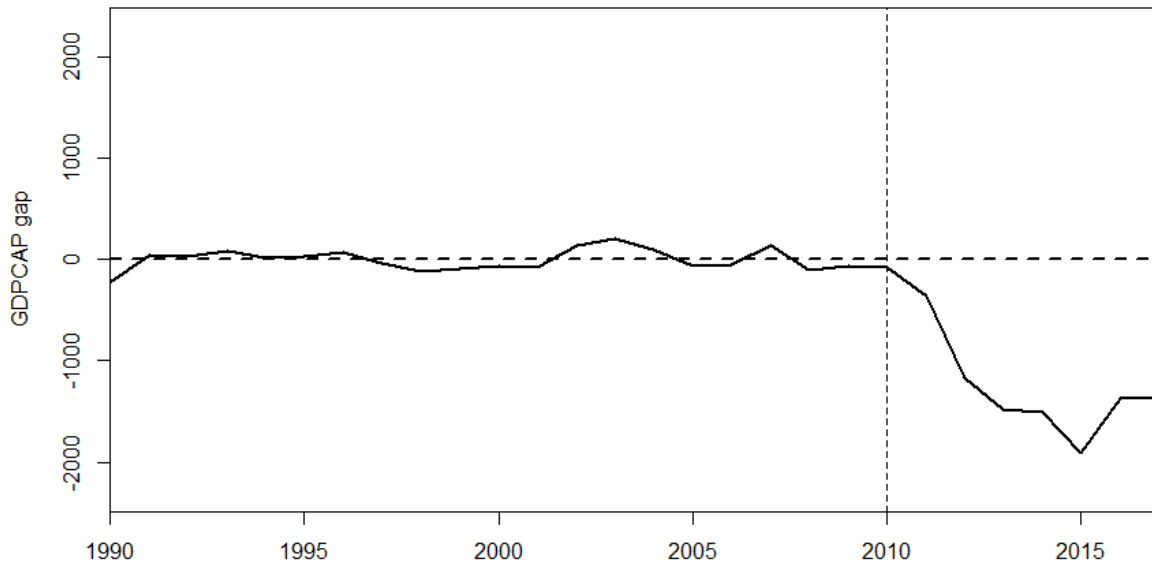
**Figure 6.2 GDP per capita comparison**



## 6.2 Placebo tests

Figure 6.2 presents the GDP per capita gap between the actual Iran and its synthetic counterfactual. For our purpose, we need the preintervention gap as small as possible in order to later good approximate the future development. As we may see, there is little difference prior to the intervention, but after 2010 the gap increases until 2015 as we would expect.

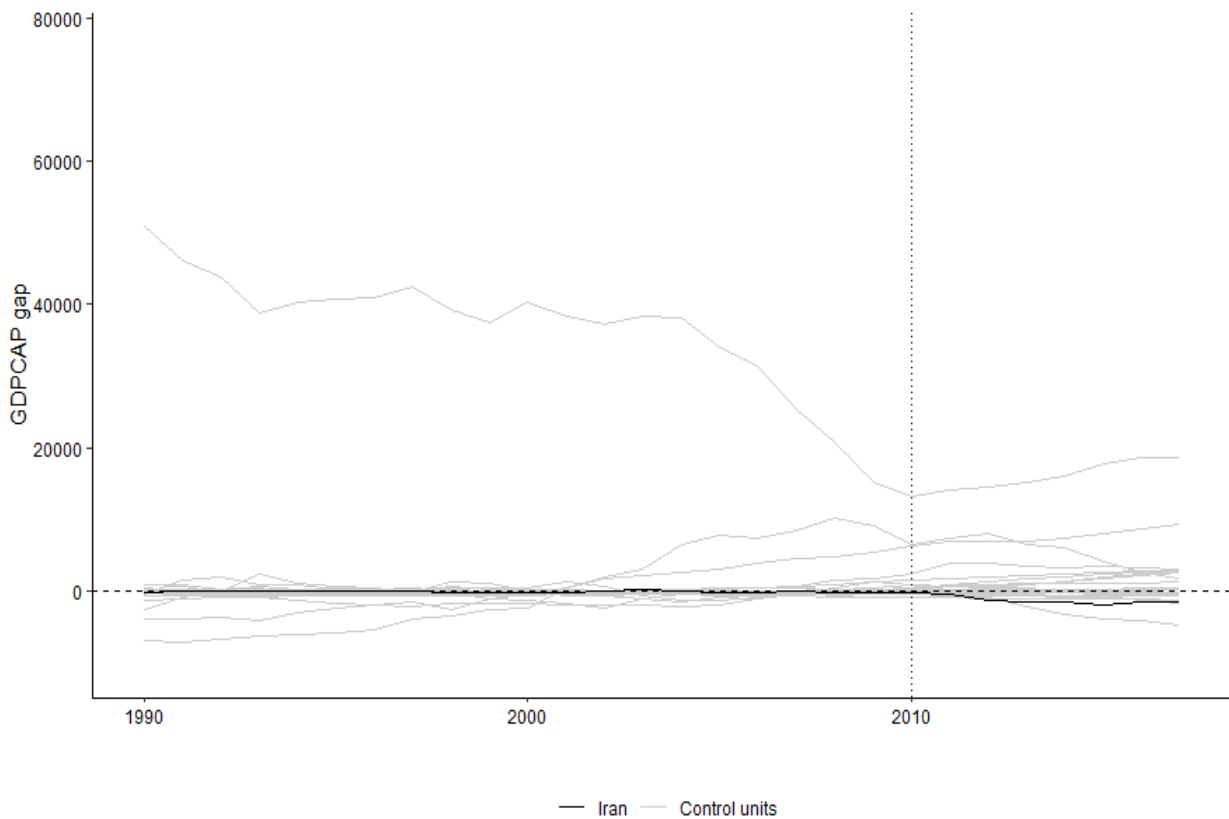
**Figure 6.3 Gaps between the actual and the synthetic Iran**



In order to perform Placebo tests, we construct the synthetic counterfactuals for all units from the donor pool, and consequently, we plot the difference between them and the actual units. We will consider the effect of the international sanctions on Iran significant if the estimated effect for Iran is considerably larger than the distribution of placebo effects (Abadie et al., 2015). If, however, the Iranian gap does not seem unusual, i.e. there are even countries with a larger postintervention gap, our prediction will be falsified. Figure 6.3 shows all the gaps plotted at the same time. Iran has the second-largest postintervention gap on average, therefore the test has not falsified our prediction. On the other hand, we can further increase our confidence in the results.

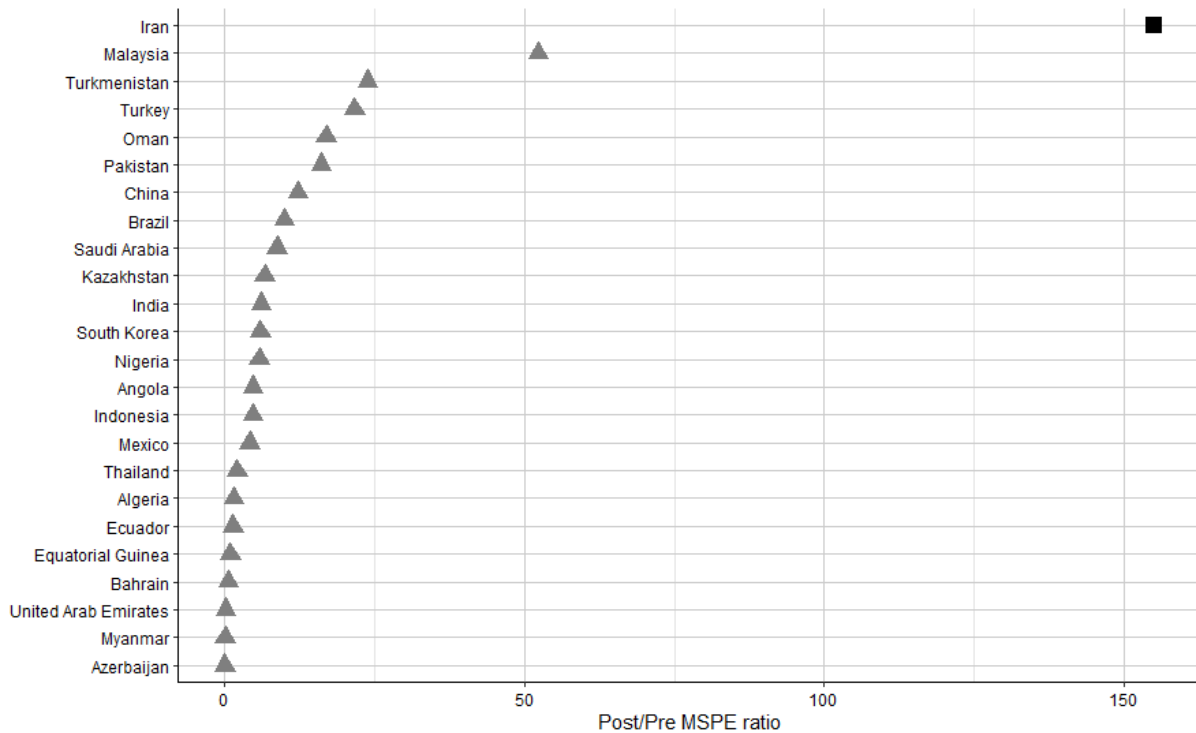


**Figure 6.4 Gaps of the 24 units**



In Abadie et al. (2010), the authors propose to eliminate the units that have huge preintervention MSPE. Indeed, a huge postintervention gap says little when at the same time there is no match during the preintervention period. A somewhat better way to assess the credibility is to compare the postintervention and preintervention MPSEs by constructing their ratios. Similarly, we expect the ratio to be highest for Iran, and at the same time, there should not be any other considerably high ratio, particularly for the units from which the synthetic Iran is constructed. Figure 6.4 shows the ratios of the postintervention and preintervention MSPEs. The Iranian post/preintervention ratio is by far the highest one amounting to 155. In other words, Iran's has the biggest difference between the postintervention and preintervention gaps which we attribute precisely to the sanctions. Furthermore, the p-value which here represents “*the probability of obtaining an estimate at least as large as the one obtained for the unit representing the case of interest when the intervention is reassigned at random in the data set*” (Abadie et al., 2015), is 0.041 which increases the credibility of our results.

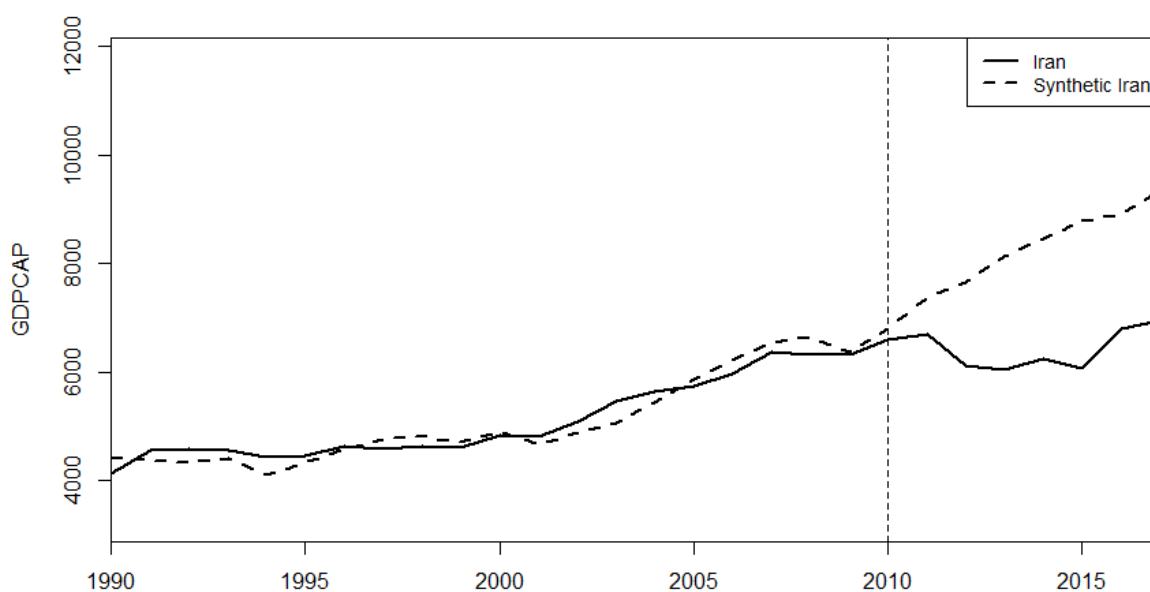
**Figure 6.5 Post/preintervention ratios**



### 6.3 Robustness test

In addition, we rerun the model excluding China and Algeria to test the sensitivity of our previous results to changes in the unit weight,  $W^*$  (Abadie et al., 2015). Figure 6.5 presents the new estimation. This time, the synthetic Iran is a weighted combination of Turkey, India, Angola, and Turkmenistan. With 0.466, the weight of Turkey dominates. The results seem also viable, although the synthetic counterfactual does not match the actual Iran as well as our previous estimate. The estimated value of GDP per capita in 2015 is this time \$8,560 which might be an overestimation due to the 2014 oil price fall, i.e. India and Turkey are oil importers, thus the fall in the price of oil affected them rather positively. Overall, this additional analysis shows that our previous results are pretty robust to the exclusion of the main weights.

**Figure 6.6 Synthetic and actual GDP per capita of Iran (robustness test)**



#### **6.4 Other effects of the sanctions**

As already noted in chapter 4, the sanctions had a dramatic effect on Iranian trade. On the eve of the oil embargo in 2011, Iran's total exported value was \$180 billion which was some \$40 billion more than the previous year (*OECD*, n.d.). This might well correspond to the observation made by Afesorgbor (2019) who finds that countries tend to stockpile if there exists a potential danger of sanctions. However, after the oil embargo by the EU, Iranian trade changed considerably. The exports fell to \$63.6 billion in 2012 and they shifted towards the Asian countries. Indeed, China, India, Japan, and South Korea formed on average 83.2 percent of Iran's exports during the 2012-2015 period. Moreover, in 2015, the Iranian exported value was solely \$31.8 billion. After the lifting of the sanctions, the trade started to slowly take off as well as the oil exports to the EU (*OECD*, n.d.). Table 6.3 compares Iran with the oil exporting countries from the donor pool which have received positive weight.

**Table 6.3 Exported value of crude petroleum (billion \$)**

Country	2010	2011	2012	2013	2014	2015	2016	2017
Iran	103	145	45.8	33.1	37.2	18.3	25.7	38.5
Algeria	24.5	32	32	29.5	22.8	12.4	10.3	12.8
Saudi Arabia	334	497	544	526	232	101	96.1	110

Generally speaking, it is difficult to assess the overall effect of the sanctions since we cannot, for instance, precisely measure the missed opportunities of foreign investment. Nevertheless, the Iranian economy was not in good condition during the sanction period, and after the imposition of the EU oil embargo, it experienced an unprecedented decline. Although the unemployment remained stable, the relatively high Iranian inflation exceeded 40 percent in 2013 (*Iran Inflation Rate | 1957-2020 Data | 2021-2022 Forecast | Calendar | Historical*, n.d.). These factors could contribute to Iran's decision to eventually sign the famous nuclear deal.

## **6.5 Comparison with existing works**

Gharehgozli (2018) on the other hand, chooses a bit different approach. She divides the pre-sanction period into a training period from 1980 to 1994 and a validation period from 1995 to 2011. Her donor pool is constructed from OPEC members including Libya, other similar countries such as Bahrain, Oman, and Turkey, and she also includes China and Canada. She estimates both the total GDP and GDP per capita. The main difference is, however, the dependent variable  $Y$ , which is the total GDP and GDP per capita, Purchasing Power Parity (PPP)- adjusted and measured in constant 2011 international dollars, whereas we are using GDP per capita constant 2010 U.S. dollars.

The results of Gharehgozli (2018) show the 2014 GDP per capita difference of 19.6 percent between the actual Iran and its synthetic counterfactual which is constructed from 67 percent from China. This fact might overestimate the final result. Nevertheless, our estimation for 2014 GDP per capita loss is 24.1 percent, thus it seems that any particular comparison between the weight assigned by both works is impossible due to the PPP exchange rates.

Eventually, Gharehgozli (2018) points out that the results may be also overestimated by the population growth. Namely, the Iranian population rose from 73.76 in 2010 to 78.49 in 2015.

## 7 Conclusion

The relationship between Iran and the rest of the World has always been very tense. The pursue of Iran's regional ambitions since the very existence of the Islamic republic has commonly collided with the interests of other regional players such as Saudi Arabia or Israel supported by the U.S. Consequently, Iran has been often a target of various U.S. sanctions. In spite of these punitive measures, Iran successfully managed to find countries that were willing to trade and to some extent offset the American sanctions.

Later, after the continuing Iranian reluctance to abide by the international rules concerning its nuclear programme, the EU joined the U.S. in sanctioning Iran. In 2012, the oil embargo was imposed which dramatically reduced the value of Iranian exports. Generally speaking, even China, the Iranian biggest trading partner at that time, was not able to continue with its increasing trade with Iran due to the threat of sanctions from the West, thus forcing Iran to come to the negotiation table.

In our thesis, we applied the synthetic control method introduced by Abadie & Gardeazabal (2003) and further improved in the more recent works (Abadie et al. 2010, 2011, 2015). We tried to estimate the possible development of Iranian GDP per capita during the 2010-2015 period had it not been for the international sanctions.

Our results show a steady growth of the GDP per capita in the absence of the sanctions. In 2015, the last year of the sanctions, the difference between our estimated GDP per capita and the actual one is \$1,910.7. When it comes to the assessment of these sanctions, it is important to note the relatively short duration of them, the elimination of the offsetting factors, and the relatively modest goal, namely to force Iran to abide by the international rules. Overall, they seem highly successful.

Eventually, the story of sanctions on Iran does not end in 2015. After the U.S. withdrawal from the JCPOA, new American sanction has been imposed. Therefore, there is plenty of room for further studies.

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## **List of appendices**

### **Appendix A: Additional results**

# Appendices

## Appendix A: Additional results

**Table A.1 Description of the variables**

<b>Variable</b>	<b>Data Source</b>
GDP per capita (constant 2010 US\$)	World development indicators (World Bank)
Agriculture, forestry, and fishing, value added (% of GDP)	World development indicators (World Bank)
Industry (including construction), value added (% of GDP)	World development indicators (World Bank)
Manufacturing, value added (% of GDP)	World development indicators (World Bank)
Services, value added (% of GDP)	World development indicators (World Bank)
Gross capital formation (% of GDP)	World development indicators (World Bank)
Exports of goods and services (% of GDP)	World development indicators (World Bank)
Imports of goods and services (% of GDP)	World development indicators (World Bank)
Employment in agriculture (% of total employment)	World development indicators (World Bank)
Employment in industry (% of total employment)	World development indicators (World Bank)
Employment in services (% of total employment)	World development indicators (World Bank)
Oil rents (% of GDP)	World development indicators (World Bank)
Fertility rate, total (births per woman)	World development indicators (World Bank)
Population density (people per sq. km of land area)	World development indicators (World Bank)
Age dependency ratio (% of working-age population)	World development indicators (World Bank)
Inflation, GDP deflator (annual %)	World development indicators (World Bank)
Labor force participation rate, total (% of total population ages 15 and over)	World development indicators (World Bank)
Unemployment, total (% of total labor force)	World development indicators (World Bank)
Rule of Law: Estimate	Worldwide Governance Indicators (World Bank)

**Table A.2 Weights of the variables**

<b>Variable</b>	<b>Weight</b>
GDP per capita (constant 2010 US\$) mean of 1990-1996	0.041
GDP per capita (constant 2010 US\$) mean of 1997-2001	0.056
GDP per capita (constant 2010 US\$) mean of 2002-2007	0.066
GDP per capita (constant 2010 US\$) mean of 2008-2009	0.046
Agriculture, forestry, and fishing, value added (% of GDP) mean of 2000-2009	0.019
Industry (including construction), value added (% of GDP) mean of 2000-2009	0.002
Manufacturing, value added (% of GDP) mean of 2004-2009	0.025
Services, value added (% of GDP) mean of 2008-2009	0.05
Gross capital formation (% of GDP) mean of 2008-2009	0.141
Exports of goods and services (% of GDP) mean of 2001-2009	0.029
Imports of goods and services (% of GDP) mean of 2001-2009	0.122
Employment in agriculture (% of total employment) mean of 2000-2009	0.015
Employment in industry (% of total employment) mean of 2000-2009	0.021
Employment in services (% of total employment) mean of 2000-2009	0.03
Oil rents (% of GDP) mean of 2000-2009	0.055
Fertility rate, total (births per woman) mean of 2000-2009	0.131
Population density (people per sq. km of land area) mean of 2000-2009	0.057
Age dependency ratio (% of working-age population) mean of 2000-2009	0.041
Inflation, GDP deflator (annual %) mean of 2000-2009	0
Labor force participation rate, total (% of total population ages 15+) mean of 2000-2009	0.004
Unemployment, total (% of total labor force) mean of 2000-2009	0.033
Rule of Law: Estimate mean of 2002-2009	0.015