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An Empirical Analysis of the Economic Effects of Sanctions

A Case Study of Iran and Russia

by

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Abstract: Sanctions, as a foreign policy tool, are increasing in popularity and frequency. This study empirically assesses how different types of sanctions imposed by the European Union, United Nations, and the United States affect the sanctioned states' GDP growth and degree of openness. Moreover, this study aims to address whether the economic costs of sanctions have undergone any notable changes in the context of contemporary geopolitical dynamics. The sample includes a total of 115 sanctioned countries over the period 1970-2021. I find that weakly significant results that suggest that arms and financial sanctions negatively affect GDP growth for the time period 1970-2000. No significant negative effect for any type of sanctions was found for the time period 2000-2021. Furthermore, this study delves into an in-depth analysis of the effect of sanctions in the contexts of Iran and Russia, two of the most heavily sanctioned countries at the present time. By applying the synthetic control method, I show that the sanctions imposed on Iran in 2011 led to a significant reduction in the country's real GDP by more than 15 percent between 2012 and 2013. In contrast, the sanctions imposed against Russia in 2014 do not display to have any significant effect on its real GDP.

Keywords: Sanction, GDP, Iran, Russia, Fixed Effects, Synthetic Control

Contents

List of Figures

List of Tables

1

Introduction

Sanctions have long been a prominent and widely utilized political instrument, standing the test of time and maintaining their relevance in not only the realm of international relations but also as a topic of discussion. In recent years, however, their popularity and frequency of use have witnessed a notable surge. As tools of economic coercion, sanctions have gained increasing traction as a means for countries and international bodies to exert pressure on targeted nations, seeking to bring about desired changes in their behavior. Furthermore, sanctions are frequently posited as a viable alternative to, or even a substitute for, the deployment of military force (Felbermayr et al., 2021). Even though sanctions are increasing in popularity, the research on the effectiveness of them remains inconclusive. The matter becomes of even greater importance since sanctions are found to inflict large humanitarian costs on sanctioned countries (Drezner, 2011). There are other unintended consequences that arise due to sanctions, such as trade deflection, economic disruption, and geopolitical shifts. They are not costless for the sanctioning economy either. Therefore, the research question addressed in this paper is: Do sanctions affect economic growth?

As mentioned, many economic and political researchers have devoted their time to investigating the efficacy of sanctions. However, a significant gap remains in understanding whether the impact of sanctions has evolved in modern times, especially in light of emerging economies gaining greater influence on the global economy and the formation of new trade alliances. This study aims to address this gap by investigating whether the economic costs of sanctions for the sanctioned country have undergone any notable changes in the context of contemporary geopolitical dynamics, to ultimately contribute to a more nuanced understanding of the policy's effectiveness in the present era.

To examine potential changes in the effectiveness of sanctions, this study focuses on analyzing the impact of sanctions on sanctioned countries' economic growth and trade openness. Specifically, the analysis spans the period from 1970 to 2021 and

investigates the effects of various types of sanctions imposed by the European Union, United Nations, and/or the United States. To conduct this analysis, a comprehensive dataset sourced from the Global Sanctions Data Base is utilized, encompassing a wide range of bilateral, multilateral, and plurilateral sanction episodes. Importantly, this dataset includes recent years, making this study stand out in its ability to provide contemporary insights. By examining the patterns and outcomes of these sanction episodes, this research aims to uncover any discernible shifts or developments in the economic costs of sanctions over time.

Moreover, this study examines the effects of sanctions within the specific contexts of Iran and Russia, two of the most heavily sanctioned countries at the present time. While several studies have investigated the effect of sanctions on Iran's economy, relatively few have analyzed the implications of sanctions on Russia's economy. None, to my knowledge, have analyzed the impact of sanctions on Russia's GDP using the Synthetic Control Method. Comparing these two cases becomes particularly intriguing as both Iran and Russia have faced similar types of restrictive measures. Exploring their respective experiences with sanctions can shed light on the varying outcomes and new insights into such measures' effectiveness.

This study has several delimitations that should be acknowledged. First, I do not examine the effectiveness of sanctions in terms of compliance with the demands made by the sanctioning country. Instead, the economic costs in terms of GDP are investigated. Second, this study does not examine the effect sanctions have on existing trade flows and in creating new trade flows - i.e., trade deflection and trade destruction. Third, although it is of great importance, this paper does not cover the adverse effects sanctions can have on the sanctioned country's humanitarian situation. It does not examine the unintended effects of sanctions on the sanctioning country either. Lastly, due to the relatively recent imposition of sanctions on Russia, in the wake of its aggressions against Ukraine, the available data cannot adequately capture the long-term effects and consequences of these sanctions. As a result, this study only focuses on the sanctions imposed against Russia in 2014.

The rest of the paper is organized as follows. The following sections will cover the background on the imposed sanctions on Iran and Russia. Chapter 2 covers the theoretical background that sets the foundation for analyzing the effectiveness of sanctions. The chapter begins with a description of the definition of sanction, which is thereafter followed by a presentation of the theoretical framework. Chapter 3 provides the prior research on sanctions' effect on economic performance. Additionally, the phenomenon of trade deflection and unintended geopolitical shifts, due to sanctions, are explored. Chapter 4 introduces the methods used to conduct the empirical analysis, namely the fixed effects method and the synthetic control method. Chapter 5 presents the data that has been used, and some descriptive statistics.

Chapter 6 presents the results and the sensitivity analysis. Additionally, the results are discussed and compared to the findings of previous research. Lastly, Chapter 7 summarizes and concludes the findings and contributions of the paper, together with suggestions for future research.

1.1 Background on the Sanctions Against Iran and Russia

This study chooses to take a closer look at Iran and Russia, due to their status as the two of the most heavily sanctioned countries. Before Russia's invasion of Ukraine in February 2022, Iran was the most sanctioned state. In Iran's case, UN and EU sanctions were first imposed in 2006 and reached a peak of stringency in 2012 (Felbermayr et al., 2020b). The US has imposed sanctions in different episodes since 1979 to influence Iran's policies. However, since February 2022, Russia has surpassed Iran by being the most sanctioned state in all categories - i.e., in terms of individual sanctions, economic sanctions, and travel bans (European Council, 2023a). The sanctions on both Iran and Russia's economies are extensive, they cover foreign trade and more specifically their top exports by introducing oil embargoes. Additionally, all Iranian and Russian banks that are identified as institutions in breach of US or EU sanctions are banned from SWIFT, the global payment system that connects banks.

1.1.1 A Summary of Sanctions Against Iran

As briefly mentioned, the United States has imposed sanctions in different episodes, with the first one being levied in 1979. This was the result of the hostage crisis in 1979-1981, which led the US to freeze Iranian assets, which later was accompanied by a trade embargo (Levs, 2012). While the trade embargo was eventually lifted in 1981, the following decade during Reagan's presidency several sanctions were imposed. Specifically, an arms and trade embargo. In 1995, Bill Clinton signed an executive order imposing comprehensive sanctions on Iran, including a ban on all US trade and investment with Iran, a freeze on Iranian government assets in the US, and a prohibition on US citizens from conducting any transactions with Iran. However, these sanctions will not be covered in the analysis, but the study will rather focus on the economic effect of the sanctions imposed after 2011, which were an expansion of existing sanctions that had been imposed since 2006.

Concerning Iran, there are two parallel systems of sanctions with different focuses, namely one that concerns nuclear technology and another one that concerns human rights. Specifically, the UN passed several resolutions imposing sanctions on

Iran between 2006 and 2015. The catalyst for the UN sanctions against Iran was the International Atomic Energy Agency's (IAEA) report on Iran's nuclear activities, specifically its uranium enrichment program (Felbermayr et al., 2020b). In response to Iran's refusal to comply with the Security Council's request to suspend the program, the first economic sanctions were introduced in July 2006 under UN Security Council Resolution 1696. These initial sanctions were subsequently expanded and intensified in the following years. 2011 was Iran's first full year under the heavy sanctions we know today. In addition to the UN resolutions, the EU and the US also imposed their own sanctions on Iran. The EU sanctions reached their peak at the beginning of 2012 when an oil embargo was introduced and Iran's central bank assets were frozen. A year prior to the oil embargo, the EU bought about 600,000 barrels per day of Iranian oil in 2011, which amounts to about a quarter of Iran's total oil exports (Van de Graaf, 2013).

When the Joint Comprehensive Plan of Action (JCPOA), also known as the nuclear deal, between the P5+1 countries was agreed upon in 2015, the UN, US, and EU lifted some of their sanctions (European Council, 2023b). While the EU lifted all of its financial and nuclear-related sanctions, the US and the UN maintained some. Note that some non-nuclear sanctions remained in place, particularly those related to Iran's human rights violations and support for terrorism. However, in May 2018, during Donald Trump's presidency, the US withdrew from the JCPOA and reimposed sanctions on Iran (Nephew, 2018). Once again, the economic sanctions were tightened, and even though the EU tried to maintain trade with Iran, SWIFT undermined their efforts by complying with US sanctions (Peel, 2018). The US has since imposed additional sanctions.

Since 2011, the UN, EU, and US have also implemented restrictive measures targeting human rights violations in Iran. These sanctions have included asset freezes, visa bans for individuals and entities responsible for serious human rights abuses, and bans on exports to Iran of equipment that might be used for internal repression and equipment for monitoring telecommunications (European Council, 2023b).

1.1.2 A Summary of Sanctions Against Russia

Since 2014, the US and EU have progressively imposed restrictive measures against Russia (European Council, 2023a). First, in response to the annexation of Crimea, where the sanctions began with asset freezes and travel bans on individuals found responsible. These sanctions expanded between 2014 to 2021 to include broader economic sanctions, such as restrictions on trade, finance, and the energy sector. Overall, the annexation of Crimea led to three categories of sanctions to be imposed against Russia: a prohibition on providing technology for oil and gas exploration,

a ban on providing credits to Russian oil companies and state banks, and travel bans on influential Russian individuals with close ties to President Putin who were involved in the annexation of Crimea (Overland and Kubayeva, 2018).

After Russia invaded Ukraine in 2022, unprecedented multilateral sanctions have been imposed against Russia. European Council (2023a) reports that €300 billion of foreign reserves (gold and foreign exchanges) are blocked in the EU and the G7 countries. This is estimated to be more than half of Russia's total reserves. Other financial sanctions include SWIFT bans on major Russian and Belarusian banks. Moreover, extensive trade sanctions are in place, among them an oil embargo imposed by the EU and a price cap imposed by the G7. Military sanctions, such as no-fly zones are also in place.

2

Theory

In this chapter, the theoretical background used for analyzing the effectiveness of sanctions, particularly on economic performance, is presented. First, I will begin by describing how to define sanctions, which is followed by a brief description of the different types. Second, the theoretical framework aimed at explaining how to define whether sanctions are successful, and what factors the success may depend on, is presented. Lastly, the "Sanctions Paradox" is briefly introduced, by focusing on its main argument. The shortcomings of both theoretical frameworks that are presented, and the theories of sanctions in general, is the inability to predict outcomes. This is a direct outcome of there being a wide range of factors affecting the effectiveness of sanctions. These factors are thoroughly explained in the sections below.

2.1 Anatomy of Sanctions

To be able to discuss and distinguish between different theoretical frameworks for analyzing the effectiveness of sanctions, one must first define what sanctions are. First and foremost, sanctions are coercive measures taken by one nation or a group of nations to exert pressure on another nation or group of nations, to achieve a specific objective - such as changing their behavior or policies. Sanctions can be imposed due to a range of different reasons, including human rights abuses, nuclear proliferation, terrorism, or aggression against other countries. Economic sanctions are a specific type of sanction that targets a country's economy and tries to inflict costs in three main ways: i) by limiting exports, ii) by restricting imports, iii) by impeding the flow of capital (Hufbauer et al., 2009). The latter can include freezing or seizing the sanctioned entity's assets within the sanctioning entity's control. Costs associated with trade sanctions for the sanctioned entity include lost export markets, refusal of necessary imports, lower prices obtained for sanctioned exports, and higher prices paid for alternative imports. In addition to economic sanctions, other forms

of sanctions can also be used, such as diplomatic sanctions that involve expelling ambassadors or withdrawing diplomatic recognition, and military sanctions that may include imposing a no-fly zone or deploying military force. To simplify matters, the sanctioning entity will from now on be called the sender, and the sanctioned entity will be called the target.

2.2 The Formula for Successful Sanctions

Hufbauer et al. (2009) propose a theoretical framework for analyzing the effectiveness of sanctions, and they are able to state it in one simple sentence: "The costs of defiance borne by the target must be greater than its perceived costs of compliance." In other words, in order for sanctions to be effective, the costs of complying with the sender's demands (such as changing their policies or behavior) must be perceived as greater than the costs of enduring the sanctions. However, accurately predicting the magnitude of these costs, as well as how the target country will perceive and weigh them, can be difficult.

According to Hufbauer et al. (2009), the success of a sanction depends on the sender's leverage over the target. The chances of a successful sanction are low if there are minimal trade and financial movements between the sender and the target. However, potential leverage alone is not sufficient for a successful sanction, as the sender's motivation and effective use of leverage also play a critical role. More specifically, if the sender is not strongly interested in achieving the target's compliance, then the potential leverage in question may not be fully deployed.

There are different types of leverage the sender can have over the target that can be crucial for the outcome. For example, if the target is larger and has more economic influence, e.g. in terms of trade and financial flow, then the chances of a sanction being successful are low (Hufbauer et al., 2009). That is unless the sender cares significantly more than the target about the issue. On the other hand, if the sender has more extensive leverage in terms of size and economic influence, the odds of success are higher but still not guaranteed if the target perceives the cost of compliance to be high. These costs may escalate if the sender is successful in gaining international support for its sanctioning initiatives, and the political costs may be further exacerbated if the sanctions are supported by recognized international organizations.

Furthermore, the effectiveness of sanctions depends on a variety of factors that in turn are related to the preconditions both within the countries and between. For instance, weak economic conditions in the target country can make sanctions more effective, while the ability of the target government to evade them or gain support from a rival of the sender can make them less effective (Hufbauer et al., 2009). Note

that the sender can increase the costs of defiance by threatening military force. Hufbauer et al. (2009) elaborate on the importance of a relationship, stating that the effectiveness of sanctions depends on the prior relations between the sender and target countries. A sender is likely to have more leverage over an ally, which can make even subtle or symbolic sanctions effective. This argument, that sanctions that impose less harm on the target are sometimes more effective than those that impose greater harm, is also stated in the theoretical framework built by Eaton and Engers (1992). Sometimes the mere threat of sanctions plays a greater role than one would expect. Finally, the impact of sanctions also depends on whether they produce a rally-round-the-flag effect[1] or political dissatisfaction in the target country (Hufbauer et al., 2009). In some cases, domestic politics may limit the effectiveness of sanctions, such as when a target government faces little domestic pressure to comply with the sender's demands. The authors, however, also emphasize that the nature of the sender's goals and the target regime affects the costs of compliance. Demands that threaten the internal regime stability are difficult to meet, and it may be impossible to impose sanctions severe enough to persuade the economy to comply. For instance, autocratic regimes with dictatorial leadership are unlikely to comply with demands that involve sacrificing the regime's primary source of wealth or the leader's physical safety.

2.3 The Sanctions Paradox

Drezner (1999) discusses many aspects and concepts that are outlined by Hufbauer et al. (2009), but the author offers his own analysis of the effectiveness and limitations of sanctions in his book "The Sanctions Paradox". The book distinguishes itself by using game theory to pursue its argument - which is that sanctions are paradoxical in nature as they can have unintended and counterproductive effects. The theoretical framework by Drezner argues that economic sanctions often fail to achieve their intended goals and, in some cases, can actually backfire and harm the sender's interests. One of the reasons is that sanctions are often undermined by the actions of third-party actors who continue to trade with the target country. Considering one of the eventual costs of sanctions is lower prices on sanctioned exports, a potential winner could be the third-party actors who benefit from reduced prices.

There are different ways in which target countries can respond to sanctions, such as i) evading them, ii) adapting their economies to reduce their dependence on the sender, or iii) retaliating with their own sanctions (Drezner, 1999). Conclusively,

[1]The "rally round the flag" effect is a phenomenon that describes how people, during times of crisis or war, tend to unify and support their country's leaders, regardless of their political affiliations or previous disagreements (Mueller, 1970).

the ability of target countries to respond to sanctions effectively undermines the effectiveness of economic statecraft. Furthermore, sanctions are not a cost-free option, and the sender may suffer consequences as a result of imposing sanctions. For example, sanctions may harm the sender's economy by reducing exports, hurting domestic firms that rely on trade with the target country, and disrupting global supply chains. In addition, Drezner mentions that sanctions may lead to a rise of anti-American or anti-Western sentiment (supposing that they are the senders) in the target country, which can make it more difficult to achieve the sender's foreign policy objectives in the future.

3

Previous Research

This chapter presents the previous research and their results regarding the effects of sanctions, and more specifically their effectiveness in reaching their intended goal. Not only are sanctions as a policy tool vigorously debated, but the literature investigating their efficacy is also not fully conclusive. The chapter begins by reviewing previous empirical studies on the effectiveness of sanctions as a policy tool and their ability to achieve their intended goal. Subsequently, in line with the research objectives, the chapter delves into an in-depth analysis of the effectiveness of sanctions specfically in the contexts of Iran and Russia. Moreover, this chapter goes beyond the intended effects of sanctions and delves into the examination of their unintended consequences. One such consequence is the phenomenon of trade deflection, where sanctioned countries seek alternative trading partners to mitigate the impact of sanctions. Additionally, other adverse effects, such as geopolitical shifts are explored to provide a comprehensive understanding of the complexities surrounding the efficacy of sanctions. The chapter concludes with a summary of the reviewed studies.

3.1 Empirical Evidence

Besides providing a theoretical framework, Hufbauer et al. (2009) also test the success rate of economic sanctions by using econometric methods such as regression analysis (the gravity model in this case), difference-in-differences analysis, and event studies to analyze the impact of economic sanctions on various economic and political outcomes. To do this, they use the updated version of the Hufbauer-Schott-Elliott-Oegg database that includes sanctions episodes from 1990 to 2000. They do recover some interesting findings. For example, they find sanctions to be partially successful in 34 percent of the cases that they documented. What they further uncovered is that the success rate is highly dependent on the type of policy or governmental change sought - where sanctions aiming at modest policy changes are the most successful. More interestingly, they argue that the likelihood of the sanction's success

decreases as time goes on, and they suggest that if sanctions have not achieved their intended goals within the first two years, they are unlikely to do so in the future. Dizaji and van Bergeijk (2013) confirm this statement by using their dataset. They explicitly find that 55 percent of the successes occur during the first two years, after this period the probability of success decreases significantly. This result is explained by Hufbauer et al. (2009), stating that sanctioned countries adapt to the sanctions and ultimately find ways to evade or circumvent them over time - which reduces their impact. The authors, therefore, argue that sanctions should be used as a short-term tool.

Another extensive study is conducted by Neuenkirch and Neumeier (2015), who investigates the impact of economic sanctions imposed by the UN and the US affect the target states' GDP growth. The study relies on regression analysis with a sample that includes 160 countries over the period of 1976 to 2012. They find significant results that imply that the imposition of UN sanctions has an average effect of decreasing the target state's annual GDP per capita growth rate by more than 2 percentage points and the negative effect diminishes over time and becomes insignificant after 10 years. On an aggregate level, the imposition of UN sanctions is associated with a drop in the target's GDP per capita of 25.5 percent. Comprehensive economic sanctions imposed by the UN, which they describe as embargoes on nearly all economic activity between the target and UN member states, lead to a decrease in GDP growth by more than 5 percentage points - which is the strongest effect they find. In contrast, US sanctions are found to have smaller effects on GDP growth and to be of less duration than that of UN sanctions. Specifically, the effect of US sanctions on the target's GDP growth is between 0.75-1 percentage point and accounts for a total decline in GDP per capita by 13.4 percent. Neuenkirch and Neumeier also find that US sanctions have a stronger negative effect on countries that are geographically close to the US.

Although there is no clear consensus on which type of sanction is the most effective, some argue that financial sanctions can be more effective than other types. Moreover, targeted financial sanctions have become more attractive due to the perception of them being "smart sanctions", meaning that they are more designed to target specific individuals or entities while minimizing the harm to innocent civilians. However, whether financial sanctions, or smart sanctions for that matter, actually spare a target country's population is another question. That discussion aside, Bapat et al. (2013) identify several factors that might contribute to sanctions success, by analyzing both threats of the imposition of sanctions and actual imposed sanctions - which includes 842 cases. They define 'success' if the target country partially or completely complied, or the case ended with a negotiated settlement. The authors find their variable covering financial sanctions to be systematically and pos-

itively related to the success of imposed sanctions - however, threats of financial sanctions are less likely to succeed. Gutmann et al. (2021) find similar results when analyzing the effects of sanctions on GDP growth and other transmission channels through which sanctions could affect economic activity - such as consumption, investment, and government expenditures. They find a significant negative effect of sanctions, with one of the main driver being financial sanctions. However, in contrast to Neuenkirch and Neumeier (2015), the authors discover that another main driver, besides financial sanctions, is US unilateral sanctions. Furthermore, Hufbauer et al. (2009) also find financial sanctions to have higher success rates compared to other types. The argument behind this is that modern market economies rely on access to finance for most economic activities, including trade. Thus, limitations on financial flows can in turn hinder trade flows. Also, it is easier to enforce financial sanctions than trade sanctions, as they are harder to evade, and may possibly have market-enforcing effects.

Lastly, there are some stylized facts about sanctions that Felbermayr et al. (2020a) bring forth in conjunction with their presentation of the Global Sanctions Data Base (see more on GSDB in section 4.1). This older version of the GSDB dataset covers all sanctions, bilateral, multilateral, and plurilateral, in the world from 1950 to 2015. What is made clear is that sanctions are over time being imposed more frequently, with European countries being the most frequent senders and African countries being the most frequent targets. Moreover, the share of trade sanctions is decreasing, while the share of financial and travel sanctions is increasing. The main objectives of sanctions have also shifted from being related to international diplomacy, to being more related to democracy and human rights. With this shift, the success rate of sanctions (i.e. partial to full compliance) has simultaneously also experienced a trend shift. More specifically, the success rate had been increasing up until 1995 but has since then fallen - landing on an average success rate of 30 percent.

3.2 The Effects of Sanctions on Iran's Economy

Several studies have analyzed the impact of sanctions on Iran's economy using various different econometric techniques. In this section, the findings of these studies will be examined and the effects of sanctions on Iran's economy will be explored.

One of the approaches used is the synthetic control method (SCM). Here the researcher attempts to closely mimic the economic development path in the target country up to the point of sanctions' implementation, using one or a weighted average of several other countries. Gharehgozli (2017) utilizes this method and uses eight OPEC countries to build a replica of Iran, in order to quantify the effect of the

implemented sanctions in 2011 through 2014. The author finds that the sanctions caused over a 17 percent drop in real GDP over the course of three years, with the largest drop of 12 percent taking place in 2012. Ghomi (2021) find an even bigger effect when applying the SCM. The modeling of these two studies differ in terms of control countries and covariates, but they both examine the effect of sanctions on GDP. Ghomi finds that the sanction caused a 12.5 percent drop in GDP in 2012, similar to the previous study. However, the author finds the overall effect to be more persistent - resulting in a total of 19.1 percent fall in real GDP four years after the imposition of the sanctions. The results imply that in the two years following the lifting of the sanctions in 2015, real GDP stayed 5 percent below its counterfactual level.

Other studies do not find such strong effects as those of Gharehgozli (2017) and Ghomi (2021), but they do find that Iran's economy has been impacted by the imposed sanctions. Felbermayr et al. (2020b) implement the structural gravity framework by using the PPML estimator and obtaining country-pair and directional estimates of trade sanctions. They find that the effects of sanctions on Iran are widely heterogeneous across countries, i.e., they vary across country-pairs. They also vary within country-pairs, depending on the direction of trade flow - for instance, it is found that Germany has suffered the biggest export losses to Iran since 2006. The authors also conduct a counterfactual analysis, examining what the economic performance of Iran would have been in the absence of the sanctions. They find that by terminating the sanctions, Iran's real income per capita is predicted to rise by about 4.2 percent. Additionally, Kwon et al. (2020) examine the short- and long-run effects of economic sanctions on growth through an instrumental variable strategy. They study the differential effects of the type of sanctions and find trade sanctions to have a significantly greater negative impact on growth compared to smart sanctions, in contrast to Torbat (2005) that finds financial sanctions to be the most effective. Specifically, they find trade sanctions to lead to a long-run decline in both the degree of openness and TFP. The results of Kwon et al. (2020) suggest that sanctions, in general, have a negative short-run effect on the target's GDP per capita. More specifically, they find an additional sanction to be associated with a 0.23 percent decrease in contemporaneous growth.

3.3 The Effects of Sanctions on Russia's Economy

In the wake of the annexation of Crimea in 2014, Russia was hit with a range of sanctions. This section will discuss the results of several studies that have sought to assess the impact of these measures on Russia's economy. Some of them aim to predict the outcome of the intensification of the sanctions, that are currently in

place, imposed after Russia's aggression against Ukraine. However, as Berlin (2022) underlines, the impact of the sanctions in 2014, the counter-sanctions imposed by Russia as retaliation, as well as exogenous shocks such as the COVID-19 pandemic and significant changes in oil prices in this period, will make it difficult to distinguish what the real effect of the imposed sanctions on Russia is.

Kholodilin and Netsunajev (2016) evaluate the consequences of the sanctions imposed in 2014 by setting up a structural vector autoregression (SVAR). Their results indicate that sanctions negatively affect Russia's GDP, and the sanctions are to blame for the much larger variation in the GDP growth compared to those of the selected countries in the euro area. However, the authors only report the immediate effects, which is a quarter-on-quarter loss of GDP of less than 2 percentage points measured over a period of six months. It is unclear from their study whether the effects of the sanctions persisted over the long term. Moreover, the Russian economy is highly affected by fluctuations in exchange rates due to its high reliance on foreign trade and investment, motivating Dreger et al. (2016) to examine the indirect effects of sanctions using the exchange rate as the channel. In fact, following the annexation of Crimea in early 2014, the Russian ruble experienced a 50 percent depreciation against the US dollar. The analysis is based on cointegrated VAR models and aims to investigate how much of the depreciation was caused by the sanctions. The results found imply that the depreciation is mainly related to the decline of oil prices, which further questions the effectiveness of sanctions.

Crozet and Hinz (2020) investigate changes in Russia's trade flows, specifically regarding export losses, using a general equilibrium counterfactual analysis. They find that between 2013 and 2015, Russia experienced a significant drop in exports. However, they also find that Western countries also bear a significant share of the global lost trade, which mainly stems from products that have not been directly targeted by Russian retaliation sanctions.

A couple of studies have attempted to investigate the possible impact of the economic sanctions imposed in response to Russia's invasion of Ukraine. Hosoe (2023) predicts, via a computable general equilibrium model, a decline of 3 to 7 percent in GDP due to Russia's reduction in exports. de Souza et al. (2022) also predict a decline in exports but argue that further sanctions by the EU can lead to larger real income losses in Russia, compared to other sanctioning allies due to their prior trade relationship.

3.4 The Sanction Strikes Back

Several studies have found that sanctions have limited effect on a long-term basis. Dizaji and van Bergeijk (2013), who looks at both economic and political variables,

find results that indicate that an oil boycott on the Iranian economy causes a significant cost that act as an incentive to move towards a more democratic setting. However, this effect only lasts two years and actually has an opposite effect after six to seven years when the economy has adjusted. Kwon et al. (2020) find evidence that further confirms this perspective. Specifically, they find sanctions to have an insignificant long-term effect on the target country's GDP per capita. Even trade sanctions, which they find to be the most effective type, are less effective over time. Smart sanctions are found to even promote long-run growth. Furthermore, there is no strong evidence indicating that sanctions against Russia have had any substantial effect on its economy. Instead, it is found that the sanctions imposed on Russia have substantial spillovers and that the retaliation sanctions can have an even greater effect than those imposed on Russia in the first case (de Souza et al., 2022). For example, Gullstrand (2020) investigates the effect of Russian counter-sanctions after the annexation of Crimea on the Swedish economy, and finds that the costs are highly heterogeneous. While the overall impact on the Swedish economy was found to be negligible, the costs on a firm level of directly facing the Russian counter-sanctions were found to be substantial. Others, such as Hosoe (2023) hypothesize that the effect of the sanctions against Russia would have been greater if China and/or India would participate in these restrictive measures.

This leads us to an important aspect, that is, the role of third parties in succeeding with sanctions. For instance, Haidar (2017) uses disaggregated customs data to study export deflection in Iran after sanctions were imposed in 2008. Haidar finds that two-thirds of non-oil exports that had been destroyed by sanctions were deflected to non-sanctioning countries. Although export deflection caused welfare costs due to reduced prices, exporting firms actually increased their quantities when exporting to a new destination. In fact, following the implementation of export sanctions in 2008, China replaced the EU as Iran's top importer - increasing its non-oil imports by nearly 35 percent. To further confirm the existence of trade deflection, Felbermayr et al. (2020b) find insignificant estimates between China and Iran when examining sanctions' effect on trade, and even positive estimates between United Arab Emirates - reflecting trade deflection effects. These patterns of trade deflection are apparent in Russia's case as well. Adolfsen et al. (2023) show that even prior to the EU oil embargo and the G7 price cap, Russia had already redirected a substantial portion of its oil supply mainly to Asian countries - resulting in the overall volume of Russian seaborne crude oil exports remaining relatively stable. In fact, there was a notable surge in the exports of crude oil to China and India during November 2022, prior to the enforcement of the new sanctions regime on December 2022. As a result, the collective share of Russian oil exports to these two countries climbed to approximately 70 percent a significant rise compared to the

pre-war period when it stood at just under 20 percent. Although Russia's seaborne exports of crude oil experienced a notable drop when sanctions came into place, export volumes quickly recovered. However, similar to Iran's case in terms of price drops, Russia is trading oil at a discount.

Furthermore, can it be so that sanctions lead to new cooperations and/or strengthen relationships between the target country and non-sanctioning countries? There is evidence that points to that. Overland and Kubayeva (2018) argue that Chinese engagement and funding of Russia experienced a surge following the annexation of Crimea. Subsequent to prolonged negotiations, there was a notable rise in the frequency of meetings aimed at discussing substantial energy initiatives such as Power of Siberia, which stands as one of the most substantial energy agreements in global history. In Iran's case, not only are they finalizing their membership in the Shanghai Cooperation (SCO) in 2023, but they also struck a 25-year deal with China in 2021 where China is to invest 400 billion dollars in exchange for a steady and heavily-discounted supply of oil (Shokri, 2022; Hincks, 2020). Moreover, Iran and Venezuela, with the latter also facing US sanctions, signed a 20-year deal in 2022 that includes cooperation in the fields of oil, petrochemicals, defense, agriculture, and tourism (Reuters, 2022). During the signing of the deal, the Iranian president Ebrahim Raisi stated "Venezuela has shown exemplary resistance against sanctions and threats from enemies and Imperialists", referring to the US.

There is an enormous challenge in quantifying the magnitude of trade deflection due to the lack of accurately reported data. For example, Bloomberg (2023) reported that the Chinese yuan has replaced the dollar as the most traded currency in Russia. Additionally, China is, as mentioned, lending and trading extensively to emerging and developing countries, where it is unclear whether the transactions are denominated in US dollars or yuan (Ilzetski et al., 2019). Taking this into account, it makes it nearly impossible to accurately estimate the real impact of sanctions, as the data, denominated in dollars, does not reflect the true trade and financial flows. On top of that, there are events that undermine the effectiveness of sanctions that are not properly reported by the sanctioning countries. A study conducted by the Centre for Research on Energy and Clean Air, shows that the EU and G7 countries are still importing Russian oil products, not directly but from third parties (CREA, 2023). The five "laundromat" countries that are found to be reselling Russian oil are China, India, Turkey, United Arab Emirates, and Singapore - who collectively are making up to 70 percent of Russia's crude oil exports.

3.5 Summary

Overall, sanctions have demonstrated limited effectiveness, with several studies indicating a success rate of approximately 30 percent. Also, the success rate is highly dependent on who the target country is. Moreover, the body of research is in consensus regarding the time limit of sanctions. In other words, numerous studies find that sanctions are less effective over time. Although researchers agree that the negative effects of sanctions tend to diminish over time, there remains a disagreement regarding the specific time frame within which this reduction occurs. Opinions on the impact of US sanctions vary as well, with some studies suggesting a lesser effect while others argue for a greater effect. Neuenkirch and Neumeier (2015) find this to depend on geographical closeness - which is in line with the theory presented in Chapter 2. Additionally, certain researchers assert that financial sanctions have been more effective in affecting the target's economic performance.

While the studies investigating Iran have found sanctions to affect the country's economy negatively, modest results are found in the case of Russia. The most dramatic findings are studies that find sanctions to blame for the larger variation in economic performance and disruption in trade flows. However, sanctioning countries have been found to be negatively affected, both by their own sanctions and Russian counter-sanctions.

Third-party involvement appears to play a crucial role in shaping the effectiveness of sanctions. It is observed that trade deflection occurs. While export prices may have experienced a decline, the volume of trade has shown an upward trend. This raises the question of whether third parties emerge as the beneficiaries of sanctions. Furthermore, sanctions may have the potential to foster the development of new relationships between target countries and non-sanctioning countries, paving the way for alternative trade alliances and partnerships. Also, there are clear signs that anti-American sentiments have risen, as the theory predicts. Whether it is a direct result of sanctions or other events is unclear.

4

Data

This chapter presents the data that has been used in the research. First, an overview is given of how the data has been collected and processed, and later the variables will be more specifically described. This is done by providing descriptive statistics of the variables used in the fixed effect regressions. Moreover, this section offers valuable insights into the trends and developments in imposed sanctions between 1970 to 2022.

4.1 Source Material

To conduct the empirical study, three datasets have been used, where one contains a total of 115 countries that have been subjected to sanctions imposed by either the UN, EU, and/or the US between the time period 1970 to 2021. To see more detailed information about which countries are included, see Table 9.1 in Appendix B. This dataset has been used for the fixed effects regression model and is unfortunately unbalanced due to the long time span. To put it simply, unbalanced data refers to a situation where there is incomplete data available for each country in each year, and some variables have more observations compared to others, both within countries and between variables. This dataset includes variables of different types of sanctions, that are obtained from the Global Sanction Database (GSDB). The database covers all bilateral, multilateral, and plurilateral sanctions in the world from 1950 to 2022 across three dimensions: type, political objective, and extent of success (see the following papers that have accompanied previous and current versions of the GSDB data: Felbermayr et al., 2020a; Felbermayr et al., 2020b; Kirilakha et al., 2021; Dai et al., 2021; Syropoulos et al., 2022).

The two other datasets have been pooled for the two SCM models aimed at estimating the effects of the imposed sanctions on Iran and Russia in 2011 and 2014 respectively. The sample for Iran has a time period of 1990-2021, while the sample for Russia covers 2000-2021. In the process of selecting the appropriate donor pool, I

follow Gharehgozli (2017) and Ghomi (2021) for Iran - which results in a donor pool of 22 control countries (see Table 9.2 in Appendix B). For Russia, I follow the choice of control countries of Alessandro Borin and Mancini (2022) to a limited extent - since I cannot include sanctioning countries in the donor pool. This limitation is the main weakness of the data for Russia since nearly all European countries must be excluded from the sample - which affects how representative the control group is of the treated country. Countries, such as Kazakhstan and Turkiye are also excluded as they are affected by the war as well, and are indicated as potential hubs for trade with Russia (Alessandro Borin and Mancini, 2022). Thus, the limitations of the data increase the potential for biased estimates in my SCM for Russia. In total, the donor pool for Russia includes 23 countries (see Table 9.3 in Appendix B).

4.1.1 Variables

The outcome variables are real GDP (constant 2015 US$), annual GDP growth, and the degree of openness [1]. The two former dependent variables are obtained from the World Bank's World Development Indicator database. The calculated degree of openness for each country is based on data from the Direction of Trade Statistics, which is obtained from the International Monetary Fund (IMF). The trade data from the Direction of Trade Statistics consists of the value of merchandise exports and imports, and the reported data is supplemented by estimates whenever such data is not available. Imports are reported on a cost, insurance, and freight basis (CIF) and exports are reported on a free-on-board (FOB) basis.

The control variables are obtained from the World Bank's World Development Indicator database. The choice of control variables for the fixed effects regressions, with annual GDP growth as the dependent variable, follows Neuenkirch and Neumeier (2015), with some small exceptions. When using the degree of openness as the outcome variable, no previous model specification is followed, instead variables that are likely to have an effect on the dependent variable are used. One example is telephone subscriptions per 100 people which aims to measure infrastructure development and in turn is used as a proxy for economic integration (Asiedu, 2002). Moreover, inflation, as measured by the consumer price index, is used as a control for macroeconomic stability. More detailed information about the variables and their sources can be found in Table 4.1.

An important notion is that using data from the World Bank or the IMF, which is often denoted in US dollars, may not fully capture the true level of economic activity in a country - especially for countries whose trade is conducted in other currencies. Furthermore, it is important to note that not all economic activity may

[1] The Degree of Openness, or so-called trade openness, is imports plus exports divided by GDP.

be accurately recorded, which exacerbates the issue of unreliable data.

Table 4.1: Variables: Description and Sources

Variable	Description	Abbreviation	Source
Real GDP	Gross Domestic Production, Constant 2015 US dollars	GDP	World Bank, WDI
GDP growth	Gross Domestic Production growth (annual %)	growth	World Bank, WDI
GDP per capita	GDP divided over population	GDP/cap	World Bank, WDI
Degree of openness	Calculated as exports plus imports over GDP	openness	IMF, Direction of Trade Statistics
Population growth	Total population growth	population	World Bank, WDI
Investment	Net investment in nonfinancial assets (% of GDP)	investment	World Bank, WDI
Inflation	Inflation, consumer prices (annual %)	inflation	World Bank, WDI
Trade	Trade (% of GDP)	trade/GDP	World Bank, WDI
Telephone subscriptions	Fixed telephone subscriptions per 100 people	telephone sub	World Bank, WDI
FDI	Foreign direct investment, net inflows (% of GDP)	fdi	World Bank, WDI
Natural resource rent	Total natural resources rents (% of GDP)	natural rent	World Bank, WDI
Services	Services, value added (% of GDP)	services	World Bank, WDI
Industry	Industry (including construction), value added (% of GDP)	industry	World Bank, WDI
Agriculture	Agriculture, forestry, and fishing, value added (% of GDP)	agriculture	World Bank, WDI
Sanctions	Dummy variable equal to 1 indicating the presence of sanctions, distinguished by type	trade, arms, mil, fin, trav	Global Sanctions Database

4.2 Descriptive Statistics

Table 4.2 shows the summary statistics on imposed sanctions from 1970 to 2022, including for all sanctioning countries but also distinctly for the EU, UN, and US. What can be deducted from the table is that sanctions continue to increase, i.e. they are being imposed more frequently. The most popular sanction continues to be financial sanctions, followed by trade sanctions. Interestingly, one can see that there has been a shift between the time periods 1970-2000 and 2000-2022, which is that travel sanctions and other types of sanctions (e.g. diplomatic ones, or sanctions targeting individuals) are becoming more popular. This is most likely reflecting the increasing popularity of smart sanctions, as indicated by the literature.

Furthermore, as previous research has reported, the EU, UN, and US are responsible for more than half of the imposed sanctions, which is further visualized in Figure 4.1. The most frequently imposed type of sanction is by far the financial sanction. In contrast to the findings by Felbermayr et al. (2020a) that indicated a decrease in the share of trade sanctions, data covering 2010-2022 shows that it has increased since its decline in 2000-2010.

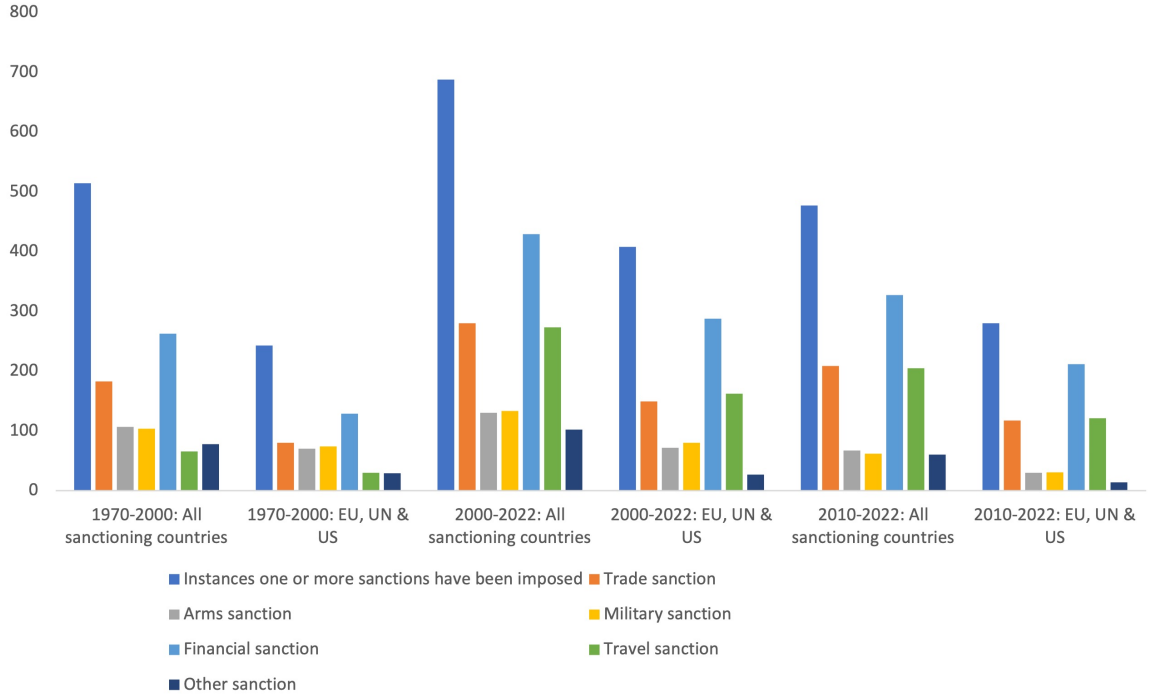
Table 4.2: Development of imposed sanctions, total and by the EU, UN, and US

	1970-2000		**2000-2022**		**2010-2022**		**1970-2022**	
Sanctions	**Total**	**West**	**Total**	**West**	**Total**	**West**	**Total**	**West**
Sanction package	514	243	688	408	477	280	1180	640
Trade sanction	183	80	280	149	209	117	455	226
Arms sanction	107	70	130	72	67	30	229	136
Military sanction	104	74	133	80	62	31	227	149
Financial sanction	263	129	429	288	327	212	681	411
Travel sanction	66	30	273	162	205	121	330	188
Other sanction	78	29	102	27	60	14	178	52
Total	801	412	1347	778	930	525	2100	1162

Note: Sanction package refers to instances where one type of sanction or more have been imposed. Also, "West" refers to sanctions imposed by the EU, UN, and US. Author's own calculation with data from GSDB.

Additionally, Table 4.3, presents the descriptive statistics for the variables employed in the fixed effects model. What can be deduced from the table, is that most of the variables take less extreme minimum and maximum values between the years of 2000-2021, compared to 1970-2000 - even though the mean value does not change substantially. One variable that stands out is the one for inflation. Between 1970 and 2000, the mean value of the inflation rate was more than 62 percent, with a maximum of 23773.13 - which belongs to the Democratic Republic of the Congo in 1994. Despite that, the mean values stay stable, although some of them such as telephone subscriptions per 100 people, increase - which is to be expected. Three

Figure 4.1: Frequency of imposed sanctions



Note: Author's own calculation with data from GSDB.

of these variables have a larger standard deviation compared to the rest, which are inflation, the degree of openness, and telephone subscriptions per 100 people. This is most likely due to the wide range of countries, and many of them being distinctly different from each other. Lastly, investment as a share of GDP is the variable with the least observations, and the observations surprisingly decrease substantially between 1970-2000 and 2000-2022.

Table 4.3: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
1970-2021					
growth	5203	3.726021	6.7222	-64.04711	149.973
openness	5258	53.61793	35.69704	2.722636	575.6146
$\log(\text{GDP/cap})_{t-1}$	5092	7.799209	1.29514	5.039882	11.39602
$\text{population growth}_{t-1}$	5750	1.840528	1.633443	-24.2114	20.98791
investment_{t-1}	1951	3.354753	3.641645	-7.977849	39.61709
inflation_{t-1}	4533	36.14435	443.7797	-17.64042	23773.13
$\text{telephone sub}_{t-1}$	5510	9.816108	14.09579	0	68.14231
fdi_{t-1}	5057	3.347303	14.25229	-104.059	449.0809
1970-2000					
growth	2839	3.759661	7.33468	-64.04711	149.973
openness	2909	48.36936	32.50778	2.722636	575.6146
$\log(\text{GDP/cap})_{t-1}$	2755	7.598417	1.239222	5.05689	10.64776
$\text{population growth}_{t-1}$	3335	2.02532	1.75033	-24.2114	20.98791
investment_{t-1}	1438	3.392704	3.736222	-4.275279	39.61709
inflation_{t-1}	2332	62.46165	617.115	-17.64042	23773.13
$\text{telephone sub}_{t-1}$	3169	6.894868	11.45807	.0124738	67.03996
fdi_{t-1}	2721	1.395533	4.85208	-55.23406	161.8237
2000-2021					
growth	2475	3.714732	5.838095	-50.33852	86.82675
openness	2461	59.97107	38.15708	7.805933	419.9623
$\log(\text{GDP/cap})_{t-1}$	2448	8.024746	1.319889	5.039882	11.39602
$\text{population growth}_{t-1}$	2530	1.591753	1.40973	-6.622632	10.48612
investment_{t-1}	552	3.226006	3.341924	-7.977849	29.51152
inflation_{t-1}	2301	8.569343	27.37244	-10.06749	557.2018
$\text{telephone sub}_{t-1}$	2455	13.73927	16.25246	0	68.14231
fdi_{t-1}	2445	5.530328	19.65822	-104.059	449.0809

Note: The descriptive statistics reflect those variables that are included in the fixed effects model.

5

Methods

The chapter presents the empirical approach taken in this study, with previous research used as a guideline. To investigate whether the imposition of sanctions leads to lower rates of economic growth and degrees of openness, two different approaches have been used. The first model assesses how different sanctions imposed by the United Nations, the European Union and/or the United States affect the target countries' GDP growth and their degree of openness, by using a fixed effects model. The second model looks more closely at two of the most sanctioned countries, namely Iran and Russia. More specifically, a comparative case study through a Synthetic Control Method (SCM) is done to examine the effects of the imposed sanctions.

While the fixed effects model helps provide a broader analysis of the overall effects of sanctions on multiple countries, it may not capture all the nuances and complexities of individual country contexts, potentially oversimplifying the analysis. The SCM allows for a detailed examination of the specific impacts of sanctions on Iran and Russia, and therefore enables a more precise estimation of the treatment effect. By utilizing both methodologies, this study aims to capture a more comprehensive understanding of the impact of sanctions on target countries' economy. The chapter contains different sections, which will thoroughly explain the models and discuss their weaknesses and limitations.

5.1 Fixed Effects Model

To assess the impact of the UN, EU, and US sanctions on the sanctioned countries' economic performance I follow the model specification of Neuenkirch and Neumeier (2015) closely - with some minor augmentations. Different versions of the following baseline model are estimated:

$$y_{i,t} = \beta_0 + \beta_1 sanctions_{i,t} + \beta_2 X_{i,t} + \epsilon_{i,t} \tag{5.1}$$

where i refers to a sanctioned country and t describes the time period. The dependent variable, $y_{i,t}$ represents the annual growth rate of country i's real GDP or degree of openness at time t. In my specification using economic growth as the outcome variable of interest, I employ three types of sanctions that can be considered having a direct effect on the economy, namely: trade sanctions, arms sanctions, and financial sanctions. When using the degree of openness as the outcome variable of interest, travel, military and other sanctions are also included. The sanctions are dummy variables that take the value of 1 during years in which UN, EU, or US sanctions were in place. The vector $X_{i,t}$ includes control variables that are commonly used in economic growth equations (see Sturm and de Haan, 2005). The controls are the log of real GDP per capita, population growth, the degree of openness, investments as a percentage of GDP, and inflation. The controls employed, with the degree of openness as the outcome variables of interest, are: telephone subscriptions per 100 people, annual growth rate, inflation, and foreign direct investment as a percentage of GDP. Lastly, $\epsilon_{i,t}$ is the error term. When conducting panel data regression, and making comparisons between countries, there most likely will be country- and time-specific effects. If these effects exist, the error term in the model takes the following form:

$$\epsilon_{i,t} = \alpha_i + u_{i,t} \tag{5.2}$$

This equation consists of two components: α_i, which represents the country-specific effect that remains constant over time but varies across countries, and the idiosyncratic error term, $u_{i,t}$. The time-invariant country-specific effect, α_i, captures the unobserved heterogeneity among the countries. The idiosyncratic error term, $u_{i,t}$, represents the unexplained variation in the dependent variable that is not accounted for by the independent variables or the fixed effects. The key assumption is that α_i is uncorrelated with the independent variables, in order to ensure that the estimated coefficients of the independent variables are unbiased and efficient. In other words, the fixed effect α_i accounts for the unobserved heterogeneity that may be correlated with the independent variables and the dependent variable. By including the fixed effect, the model is able to control for these unobserved factors and isolate the within-country variations, allowing for a more accurate estimation of the effects of the independent variables on the dependent variable (Wooldridge, 2012: pp. 484-497).

To test whether the assumption that the fixed effects are uncorrelated with the independent variables, I run a Hausman test which rejects the null hypothesis - suggesting that the random effects model is not appropriate and that a fixed effects model is preferred. In other words, it is recommended to use fixed effects to account for the unobserved heterogeneity - which in simpler terms means adding fixed effects

to the model. Conclusively, the model lands in a fixed effects model, which therefore transforms equation 5.1 as follows:

$$y_{i,t} = \beta_0 + \beta_1 sanctions_{i,t} + \beta_2 X_{i,t} + \alpha_i + u_{i,t} \tag{5.3}$$

All regressions include country- and time-fixed effects. The fixed effects model's main feature is that it uses a within-transformation by subtracting the mean value of each country from its observations. This transformation eliminates the time-invariant factors or country-specific effects from the model, allowing for the estimation of the relationship between the time-varying factors and the outcome variable. Ultimately, this leaves us with only the within-country variation to analyze.

However, it is important to address the limitations of the fixed effects model, and the weaknesses of my specification in terms of causality. Angrist and Pischke (2012: pp. 167-169) list some of the issues related to fixed effects estimates. They mention that even though the method is able to control for omitted variables to some extent, fixed-effects estimates are very susceptible to attenuation bias from measurement error. Attenuation bias, caused by measurement error or noise in the independent variables, leads to the estimated coefficients becoming biased towards zero. This in turn can lead to an underestimation of the true effect of the explanatory variable on the outcome variable. In this case, there may be a larger effect of sanctions on economic performance in reality, than what is shown by the regression estimates. Moreover, fixed effects estimates are not immune to endogeneity issues, such as reverse causality and simultaneity bias. There is likely a feedback loop between e.g. foreign direct investment and the degree of openness, as there often is between economic variables. Ultimately, the coefficient estimates of the control variables must be interpreted with caution. However, the variables of interest, i.e. the sanctions, are exogenously determined - since they are imposed by external entities. This means that endogeneity concerns related to reverse causality or simultaneity are less likely to arise. However, omitted variable bias or measurement error can still affect the estimates if there are unobserved factors that are correlated with both the sanctions and dependent variables.

5.1.1 Regression Diagnostics

This section discusses the series of tests that are performed to test and check the properties of the variables, and thus evaluate the quality of the model. The purpose of this is to investigate whether the assumptions made about the data and the model are consistent with the actual recorded data. All econometric analyses are performed in Stata. As previously mentioned in the preceding chapter, the data that is used is unbalanced. Regression analysis in Stata drops all observations that have a missing

value for any of the variables used in the model. The issue with the lack of data has, therefore, an impact on the regression results since it affects the reliability. However, due to the large number of included countries, this should not affect the estimates since the sample size is relatively large, despite the dropped observations.

First and foremost, all the variables used in the fixed effects model have been tested for stationarity through an augmented Dickey-Fuller test for unit roots. The null hypothesis, that all panels contain unit roots, is rejected. In short, the variables that are employed in the regressions are stationary. Moreover, the Breusch-Pagan test is performed to test for heteroskedasticity of the errors in the regressions. As expected, the null hypothesis that the error variances are all equal - i.e., constant variance in the errors - was rejected. The issue with heteroskedasticity is that it can lead to biased and inconsistent estimates of the standard errors of the regression coefficients, which in turn affects the confidence intervals of the produced estimates. Thus, this leads to incorrect conclusions about the statistical significance of the coefficients. To account for this, all regressions are run with HAC robust standard errors. The variables are also tested for autocorrelation by implementing the Wooldridge serial correlation test. While the variables used for the regressions where the dependent variable is growth fail to reject the null hypothesis of no first-order autocorrelation, the variables used in the other regressions with the degree of openness as the dependent variable do not. A solution is to use clustered standard errors, as they allow for both heteroskedasticity and autocorrelation - although only within countries and not between (Hanck et al., 2023).

Lastly, the issue of multicollinearity is addressed, since having highly correlated independent variables makes it challenging to separate their individual effects on economic growth and the degree of openness (Wooldridge, 2012: pp. 94-95, 530). It can also cause an overfitting problem, which in turn results in unreliable predictions and less accurate estimates. However, since multicollinearity is nearly always present in regressions, it is more of a question of how severe it is. A suggested rule of thumb for severe multicollinearity is when the correlation exceeds the threshold of 0.7. As can be seen in Table 8.1 and Table 8.2 in Appendix A, the variables do not exceed this threshold.

5.2 Synthetic Control Model

To gain a more detailed examination of the effects of sanctions on the target economy, the Synthetic Control Method (SCM) is implemented using Iran and Russia as treated units. These two countries were selected due to their current status as two of the most heavily sanctioned nations.

The motivation behind comparative case studies is to detect the effects of an

event or policy intervention on an outcome (in this case, the effect of sanctions on GDP), by concentrating on a specific instance where the magnitude of the event or intervention is large relative to other outcome determinants (Abadie et al., 2010). Comparative case studies can only be carried out when some units are exposed while others are not, or when the exposure levels of the various units are noticeably different. The SCM is a standard tool in the literature on comparative case studies, and I have adapted it from Abadie and Gardeazabal (2003), Abadie et al. (2010), and Abadie et al. (2015). It allows me to construct synthetic GDP figures for Iran and Russia under the scenario in which there had been no sanctions after 2011 and 2014 respectively. The difference between the synthetic real GDP and the actual real GDP is used to determine the quantitative effect of the imposed sanctions. Instead of using a single control unit, the SCM selects a set of weights that, when applied to a collection of related units, generate a counterfactual to the treated unit that is ideally approximated. This leads to the counterfactual, the so-called "synthetic control unit", resembling the treated unit more closely.

The SCM offers a number of methodological advantages over alternative estimation strategies (Cunningham, 2021). First, it allows for a more flexible treatment group selection which is done by generating a synthetic control group that matches the treated unit's pre-treatment features. As mentioned, this results in the control group being more closely matched to the treatment unit. Second, it does not rely on the parallel trends assumption. The assumption states that in the absence of treatment, the treated and control groups would have followed the same trend over time - which can be difficult to satisfy in practice. Third, SCM avoids extrapolation by using interpolation, which means that it compares outcomes in a given year with a counterfactual in the same year based on a convex hull of control group units. The use of interpolation helps to avoid unreliable estimates that can occur when extrapolating beyond the support of the data - which can happen with regressions.

There are some methodological challenges that are important to also take into account, selecting appropriate control units from the donor pool perhaps being the most important. Abadie et al. (2015) emphasize that when selecting control units, that are meant to approximate the counterfactual, it is crucial to choose units that are similar to the unit of interest in terms of the underlying process that drives the outcome of interest and have not experienced any significant structural changes in the outcome variable during the study period. In simpler terms, the donor pool must be similar to the treated unit (Iran and Russia) and must have economic similarities, since the outcome variable is GDP. This is to ensure that the selected control group is a good approximation of what the outcome would have been without the treatment. In this context, where the aim is to quantify the effect of sanctions on the economic performance of Iran and Russia, I cannot use countries that have imposed those

sanctions on them as potential control units, due to cross-contamination. This is because sanctioning countries are likely to be affected by the sanctions in question as well, thus making them unsuitable as control units.

Another challenge is that the method requires a relatively large pre-treatment period, as the more pre-treatment observations there are, the more accurate the weights are likely to be (Cunningham, 2021). This is challenging both in terms of data availability, but also because Russia, in particular, experienced significant economic and political transformation in the 1990s - including the collapse of the Soviet Union and the transition to a market-based economy. These events make it challenging to establish a stable pre-treatment period that accurately reflects the economic conditions and trends that are relevant for the analysis of the impact of sanctions on Russia's GDP. Therefore, I have chosen to limit the pre-treatment period for Russia, so it only spans between 2000 to 2014. For Iran, the pre-treatment period spans from 1990 to 2011, to avoid capturing any remnants from the Islamic Revolution.

5.2.1 Formalization of the Synthetic Control Method

The structure of the SCM developed by Abadie and Gardeazabal (2003), Abadie et al. (2010), and Abadie et al. (2015) can be explained in the following way. Assuming that $Y_{j,t}$ is the outcome of interest, real GDP, for country j of $J+1$ countries at time $t = 1, ..., T$, where $J + 1$ countries is the control group often referred to as the donor pool. The treatment group, Iran and Russia separately, are indicated as $j = 1$. By using a linear combination of optimally chosen countries as a synthetic control from the donor pool, the synthetic control estimator models the effect of the treatment at time T_0 on the treatment group. For the post-intervention period the estimator measures the causal effect as:

$$Y_{1,t} - \sum_{j=2}^{J+1} w_j^* Y_{j,t} \tag{5.4}$$

where w_j^* is a vector of optimally chosen weights (Cunningham, 2021). The matching variables, or the so-called covariates, X_1 and X_0, are chosen as predictors of post-treatment outcomes and must be unaffected by the treatment. Assume that X_1 is a vector containing pre-treatment characteristics for the treatment unit (in this case, Iran and Russia), while X_0 is a vector of the same variables but for the untreated unit (the donor pool). The choice of weights can be seen in Table 6.3 and Table 6.6. Moreover, the objective is to minimize the distance, $||X_1 - X_0 W||$, subject to weight constraints. There are two weight constraints, that is $W = (w_2, ..., w_{j+1})'$ with $\mathrm{w}_j \geq 0$ for $j = 2, ..., J + 1$ and $w_2 + ... + w_{J+1} = 1$. This implies that no

unit receives a negative weight, but can receive a zero weight, and that the sum of weights must equal one. Furthermore, as is standard in the SCM literature, I select the vector W^* that minimizes the norm:

$$||X_1 - X_0 W|| = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)} \tag{5.5}$$

where V is a diagonal and positive semidefinite matrix, and is chosen such as the mean squared prediction error (MSPE) of the outcome variable is minimized for the pre-treatment period.

Lastly, the average pre-treatment Root Mean Square Prediction Error (RMSPE) is used to measure the fit of the synthetic model over the period $t = 1, ..., T$ is defined as:

$$RMSPE = \left(\frac{1}{T - T_0} \sum_{t=T_0+t}^{T} \left(Y_{1,t} - \sum_{j=2}^{J+1} w_j^* Y_{j,t} \right)^2 \right)^{\frac{1}{2}} \tag{5.6}$$

A lower pre-treatment RMSPE indicates a better fit of the model and higher predictive accuracy. Moreover, the ratio of post-treatment RMSPE to pre-treatment RMSPE in SCM provides a measure of the extent to which the intervention has affected the outcome of interest. A higher ratio is indicative of a larger post-treatment effect. However, the value of RMSPE alone cannot be used to determine the size of the causal effect, as it depends on the quality of the pre-treatment fit of the synthetic control group (Abadie et al., 2015). If the pre-treatment fit is poor, a large post-intervention RMSPE does not necessarily indicate a large causal effect. This ratio will be further discussed when comparing my synthetic models and in the placebo studies in later chapters.

6

Empirical Analysis

This chapter presents the findings of the empirical analysis conducted, employing two distinct models: fixed effects and synthetic control method (SCM). By employing both the fixed effects model and the synthetic control model, a comprehensive understanding of the effects of sanctions is achieved. Additionally, the weights of the control groups of the SCM analysis are presented, as well as the covariates employed in the matching process to ensure a proper balance between the treatment and control groups. After the results, those obtained by the SCM, are presented, the SCM will be subjected to a number of standard sensitivity tests for robustness. Finally, the chapter concludes with a discussion of the results.

6.1 Results: Fixed Effects Model

To investigate the effect of sanctions, distinguished by type, over time I run the fixed effects regression over three time periods: i) 1970-2000, ii) 2000-2021, and iii) 1970-2021. However, it is important to note that regression analysis alone cannot establish a causal relationship between sanctions and economic performance.

Table 6.1 presents the regression results when using GDP growth as the outcome variable. As can be seen from the table, the variables arms sanction and financial sanction are weakly significant at the 10 percent level for the years 1970-2000, implying that a unit increase of each type of sanction leads to a decrease of nearly 1.3 and 1.74 percentage points in growth. All significance for the sanction variables disappears for the years 2000-2021. Interestingly, financial sanctions are significant when testing for the full period, implying that a unit increase negatively affects GDP growth by 1 percentage point. Trade sanctions remain insignificant for all regressions. Overall, the results are not overwhelming. What is interesting, however, is that the constant for 2000-2021 is strongly significant. The negative and significant constant term indicates that there is a systematic downward pressure on GDP growth in the absence of sanctions. Perhaps, it implies that the countries in the

Table 6.1: The effect of sanctions on GDP growth

	1970-2000	2000-2021	1970-2021
	(1)	(2)	(3)
$\log(\text{GDP/cap})_{t-1}$	0.124	7.942***	-0.238
	(1.557)	(2.069)	(1.354)
$\text{population growth}_{t-1}$	-0.285	-0.538	-0.338*
	(0.397)	(0.392)	(0.199)
$\text{degree of openness}_{t-1}$	-0.0145	0.0631*	-0.00815
	(0.0230)	(0.0328)	(0.0211)
investment_{t-1}	-0.152	-0.129**	-0.0691
	(0.160)	(0.0556)	(0.0710)
inflation_{t-1}	-0.00141**	-0.116***	-0.00149**
	(0.000660)	(0.0363)	(0.000697)
trade sanction	-0.0490	-1.212	-0.467
	(0.679)	(1.407)	(0.435)
arms sanction	-1.375*	0.294	-1.158*
	(0.722)	(1.006)	(0.639)
financial sanction	-1.740*	0.0855	-1.055**
	(0.878)	(0.951)	(0.464)
Constant	5.944	-80.22***	-1.257
	(13.02)	(19.14)	(12.01)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Observations	991	471	1499
R^2	0.138	0.476	0.196
Number of countries	72	41	73

Clustered robust standard errors are reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

sample may be facing broader economic challenges or unfavorable conditions that hinder their economic performance even before the introduction of sanctions.

Furthermore, to check the robustness, I run the sanction dummies separately to see whether the results are consistent. This can be seen in Table 10.1 in Appendix C. When running them separately, the coefficients of the sanction dummies become larger and more strongly significant for 1970-2000 and for the full sample - even trade is significant for the full sample. However, they remain insignificant for 2000-2021. Important to note is that the R^2 for all regressions is relatively low, which indicates that the independent variables have low explanatory power. Neuenkirch and Neumeier (2015), who run similar regressions to analyze the relationship between US and UN sanctions on GDP growth, also produce low R^2 values.

Table 6.2 presents the regression results when using the degree of openness as the outcome variable. The only significant sanction variable is found to be the

Table 6.2: The effect of sanctions on the degree of openness

	1970-2000	2000-2021	1970-2021
	(1)	(2)	(3)
telephone subscriptions$_{t-1}$	0.0307	-0.160	0.0950
	(0.190)	(0.176)	(0.157)
growth$_{t-1}$	0.261**	0.306*	0.329**
	(0.123)	(0.167)	(0.164)
inflation$_{t-1}$	0.000625***	0.0254	0.000632*
	(0.000236)	(0.0294)	(0.000332)
foreign direct investment$_{t-1}$	0.353	0.0597**	0.0307
	(0.309)	(0.0288)	(0.0732)
trade sanction	0.777	-0.231	-1.832
	(2.366)	(2.110)	(1.974)
arms sanction	-2.133	-2.585	-1.889
	(3.210)	(2.979)	(2.803)
military sanction	0.590	2.069	-0.672
	(2.714)	(2.033)	(1.796)
financial sanction	-5.148	-2.020	-1.293
	(3.382)	(1.605)	(1.984)
travel sanction	2.664	3.795**	1.476
	(6.264)	(1.769)	(2.358)
other sanction	4.927	1.320	4.185
	(4.584)	(2.255)	(3.159)
Constant	53.64***	65.00***	63.04***
	(3.404)	(2.638)	(2.653)
Time fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Observations	2044	2144	4188
R^2	0.100	0.111	0.117
Number of countries	99	110	110

Clustered robust standard errors are reported in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

travel sanction, indicating a rise in openness by nearly 3.8 percentage points. The robustness of this result can however be questioned, due to the coefficient turning insignificant when running the sanction separately (see Table 10.2 in Appendix C). Overall, based on the estimates, one cannot say that sanctions have a significant effect on the degree of openness.

6.2 Results: Synthetic Control Method

Figure 6.1 visualizes the paths of the real GDP of Iran and its synthetic Iran from 1990 to 2021. Synthetic Iran is represented by the dashed line, and the vertical line marks the time of the imposition (in Iran's case, the intensification) of sanctions -

namely, the year 2011. Table 6.3 compares the pre-sanction fit of synthetic Iran and an average of the countries in the donor pool. From looking at the table, one can observe that the control group (synthetic Iran) demonstrates similarities to Iran in terms of pre-sanction predictors, even though the donor pool does not.

The discrepancy between Iran and its synthetic counterfactual implies a remarkable negative effect of the sanctions on the country's GDP. The SCM actually quantifies the difference, which is that real Iran's GDP is over 15 percent lower than its synthetic counterpart, two years after the sanctions. There seems to be a lag in the effect of the treatment, since the first year under full heavy sanctions, i.e. 2011, Iran is only experiencing a nearly 2 percent decline in its GDP, compared to synthetic Iran. Furthermore, as reported in table 5.7, the negative effect continues and the gap between the two grows up until 2015 - when the JPOA is agreed upon. Interestingly, there seems to be a significant drop close to 2018, at the time when the US decides to withdraw from the nuclear deal. The robustness of the results will be further discussed in the following section, but what stands out (see table 6.9) is that while the p-values are significant for 2012 and 2013, they become weakly significant at the 10 percent level for 2015 and 2016, until turning insignificant the two following years. Additionally, they become weakly significant again in 2018 and 2019.

Figure 6.1: Real GDP: Iran vs synthetic Iran

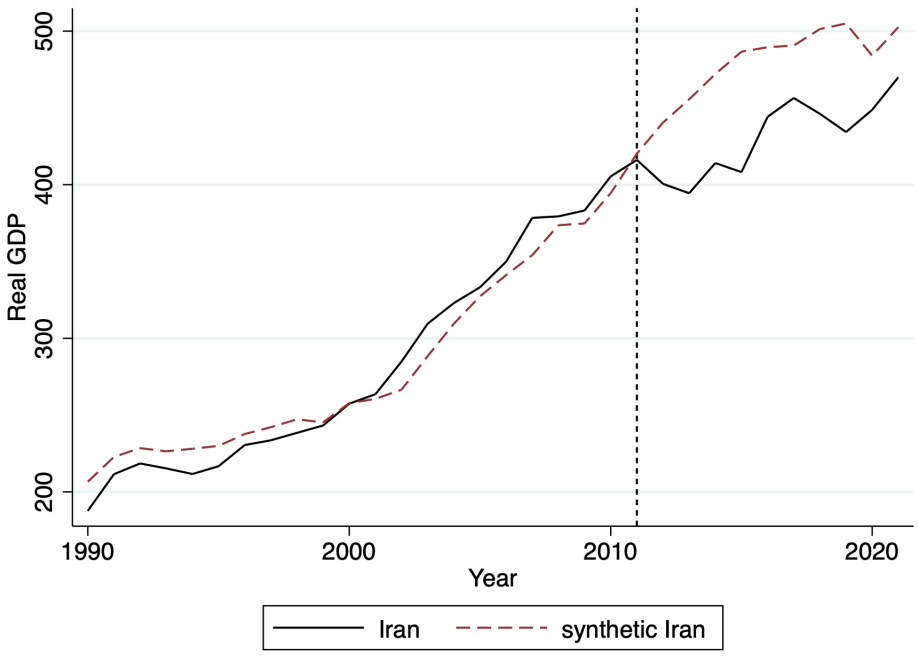


Figure 6.2 plots the results and shows the actual real GDP of Russia, compared to synthetic counterfactual Russia, represented by the dashed line, between 2000 and 2021. The vertical line marks the time of treatment, which is 2014 when the

Table 6.3: Weights of each country included in the construction of synthetic Iran

Country	Weights	Country	Weights
India	0.004	South Africa	0.202
Libya	0.023	Saudi Arabia	0.384
Nigeria	0.34	South Africa	0.047

Table 6.4: GDP predictor means before the sanctions, Iran

Predictor	Iran	Synthetic Iran	Pool
$GDP_{t-1}(b\$)$	273.4768	273.4244	542.8325
Total natural rent (%GDP)	24.64767	22.60848	15.08473
Agriculture (%GDP)	9.126006	9.325785	10.17941
Population (m)	65.66967	54.56114	152.6258
Industry (%GDP)	41.65218	41.30909	37.90789
Services (%GDP)	50.56751	47.10356	48.39394
Trade (%GDP)	42.93355	55.81017	72.51479

Note: All the variables are averaged over 2000–2011.

Table 6.5: Difference between synthetic and real Iran

		2011-2021		
	2000-2010	2011	2012-2013	2014-2021
Diff. actual vs synth (%)	-0,153	-1.887453	-15,283385	-22,14558875
Post-RMSPE/Pre-RMSPE		10.979		

sanctions were first introduced after Russia's annexation of Crimea. Overall, there is a good match between the synthetic and actual Russia, which is further confirmed by Table 6.7 which shows the predictor means before the sanction for synthetic and real Russia. Even the predictor means for the whole donor pool are closer to real Russia, than those for Iran. One can also deduce from Figure 6.2 that the match between synthetic and real Russia gets increasingly better the last few years before the sanctions are imposed.

A possible explanation for the higher growth rate prior to the sanctions may be due to the economic reforms and the opening up of Russia's economy after the fall of the Soviet Union. The drop is most likely due to the Financial Crisis in 2007-2008, which the control group might not have been as affected by. What stands out the most in Figure 6.2, however, is that not only does Russia seem completely unaffected by the treatment, but it also performs better than its synthetic counterfactual two years after. Actually, real Russia, before the treatment, already has a lower GDP in comparison to its counterfactual. After the treatment, the average effect is that Russia's GDP goes from being 0.827 percent lower from synthetic Russia to only 1.425 percent lower, in the two upcoming years after the sanctions. From 2016 to 2021, Russia's GDP is higher than its synthetic counterfactual by an average

of 3.718 percent. Additionally, as can be seen in Table 6.8, the post-RMSPE and pre-RMSPE ratio is below 1, suggesting that the treatment led to a reduction in variability.

Table 6.6: Weights of each country included in the construction of synthetic Russia

Country	Weights	Country	Weights
Bosnia and Herzegovina	0.032	India	0.004
Brazil	0.655	Saudi Arabia	0.273
Hong Kong	0.036		

Table 6.7: GDP predictor means before the sanctions, Russia

Predictor	Russia	Synthetic Russia	Pool
$GDP_{t-1}(b\$)$	1092.14	1092.514	532.453
Total natural rent (%GDP)	17.4021	14.35746	9.176824
Agriculture (%GDP)	4.267765	4.34426	8.864981
Population (m)	143.8583	136.3112	131.7242
Industry (%GDP)	30.54434	32.19087	32.14844
Services (%GDP)	52.19393	53.24802	53.21945
Trade (%GDP)	54.38286	54.07777	75.63796

Note: All the variables are averaged over 2000–2014.

Figure 6.2: Real GDP: Russia vs synthetic Russia

Table 6.8: Difference between synthetic and real Russia

		2014-2021	
	2000-2013	2014-2015	2016-2021
Diff. actual vs synth (%)	-0,827	-1,425	3,718
Post-RMSPE/Pre-RMSPE		.859	

6.3 Sensitivity Analysis

In this section, the SCM models will be subjected to a number of standard sensitivity tests for robustness to evaluate the reliability of the results obtained. To do this, two types of placebo studies are run for the cases of Iran and Russia. First, an "in-time placebo" study is conducted, where the SCM is repeated with the whole donor pool but instead of using the year when the sanctions were in reality imposed, the study uses a "fake" treatment year. The confidence about the validity of the results would disappear if the SCM also estimated a large effect when applied to years when the intervention did not occur (Abadie et al., 2015). Second, an "in-space placebo" study is employed. The SCM is applied again, but this time another country is used as the treated unit. One should expect the real treated unit to be an outlier in the distribution of the placebo effects, which would strengthen the validity of the results. Moreover, the significance of the results is discussed. The p-values are reported in Table 6.9 and Table 6.10, which represents the percentage of control units with estimated placebo effects greater than the estimated effect received by the treated unit.

6.3.1 Sensitivity Analysis for Iran

As already mentioned, the p-values indicate that the sanctions imposed in 2011 had a significant effect on Iran's GDP, but that the significance diminishes as Iran gets further away from the treatment date (see Table 6.9). Moreover, the post-RMSPE and pre-RMSPE ratio is well above 1, indicating an increase in variability after the treatment, which in turn is a sign that the sanctions have affected Iran's GDP.

To give confidence about the validity of the results, I conduct both in-time and in-space placebo studies. From the in-time placebo study, as visualized in Figure 6.3, one can observe that there is no significant difference when the treatment is assigned to 2006, instead of 2011, between Iran and synthetic Iran. There is no divergence between the actual GDP of Iran and synthetic Iran, which strengthens the predictive power of the synthetic counterfactual and the estimated effect of the actual sanctions of 2011. However, when conducting the in-space placebo, where the SCM is iteratively applied to all the countries in the donor pool, with the actual

treatment year of 2011, Iran is not an outlier. Figure 6.4 displays a set of gap plots generated from using the placebo method with the SCM. This questions the validity of the results that imply that Iran's underperformance is due to the sanctions imposed.

Table 6.9: Statistical significance for the SCM results for Iran

Years after sanction	Estimates	p-values
2011	-95.55735	0.3
2012	-145.1769	0.05
2013	-180.0117	0.05
2014	-187.6272	0.1
2015	-223.2776	0.1
2016	-213.5568	0.15
2017	-236.7822	0.15
2018	-279.959	0.1
2019	-316.1752	0.1
2020	-292.2343	0.15
2021	-327.4111	0.15

Figure 6.3: Placebo in-time study, Iran

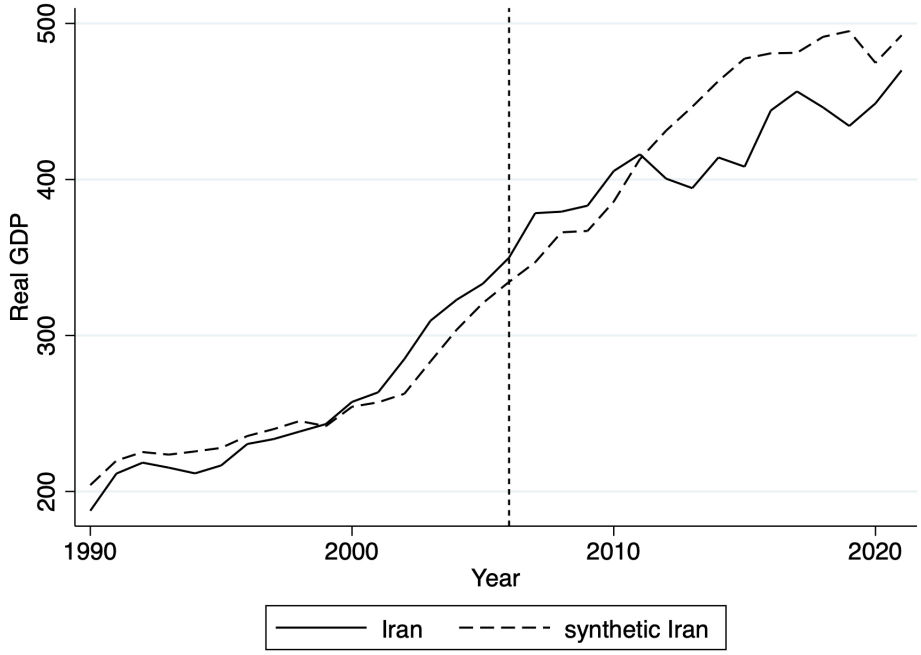
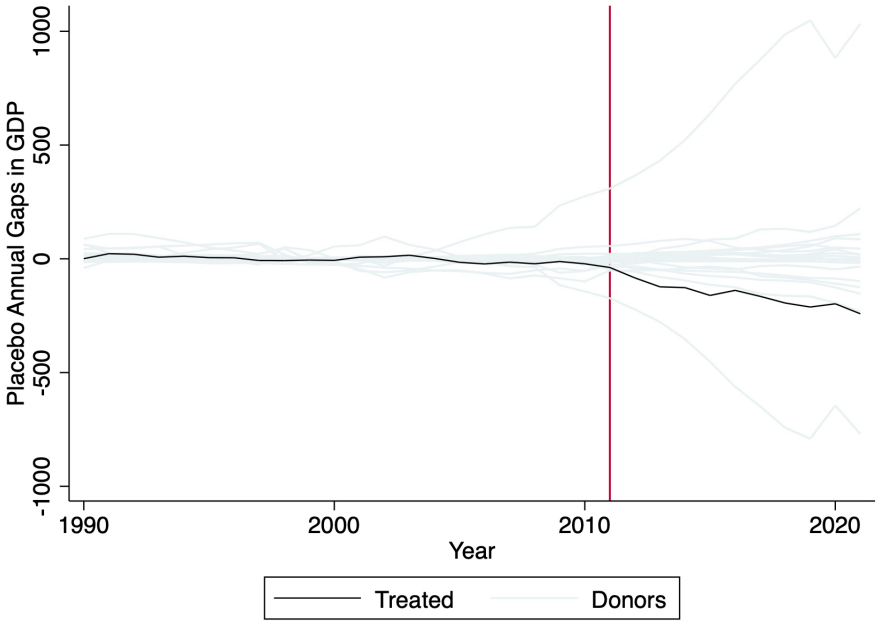


Figure 6.4: Placebo in-space study, Iran



6.3.2 Sensitivity Analysis for Russia

First and foremost, as can be seen in Table 6.8, the post-RMSPE and pre-RMSPE ratio is below 1, suggesting that the treatment lead to a reduction in variability in the outcome variable - further suggesting that the imposed sanctions in 2014 did not affect Russia's GDP. On the contrary, other countries displayed much larger ratios. Moreover, as shown in Table 6.10, the p-values for the SCM are not significant, meaning that the observed differences between Russia and the control unit are not statistically significant. In other words, the observed differences could have occurred by chance and we cannot conclude that the sanctions had any significant effect on real GDP.

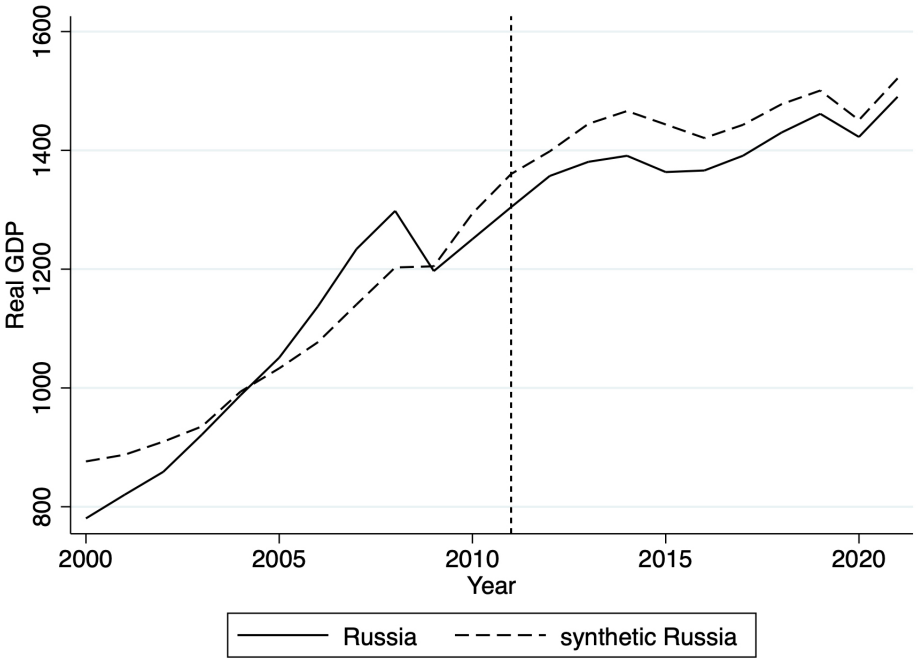
Even though the p-values indicate that there is no treatment effect, both placebo studies are conducted. First, the in-time placebo study was performed, where the sanctions against Russia were reassigned to 2011 instead of 2014 - three years before the actual sanctions were imposed. Figure 6.5 displays the results of the in-time placebo study, and one can deduce that Russia and its synthetic counterfactual are parallel but not as close as in Figure 6.2. However, the in-time placebo produced insignificant results as well.

Moving on to the in-space placebo study, the SCM used to estimate the effect of sanctions in Russia is iteratively applied to all the countries in the donor pool, with the actual treatment year of 2014. Figure 6.6 display the results of the in-space placebo study. Each graph in the figure represents a gap plot resulting from a placebo analysis using the SCM. As can be seen, Russia does not distinguish itself from the donor pool, i.e. the treated unit is not an outlier.

Table 6.10: Statistical significance for the SCM results for Russia

Years after sanction	Estimates	p-values
2014	-9.720168	1
2015	-1.921264	1
2016	35.28528	.9130435
2017	45.69757	.826087
2018	58.96273	.826087
2019	75.42719	.8695652
2020	91.25943	.8695652
2021	99.25372	.6956522

Figure 6.5: Placebo in-time study, Russia

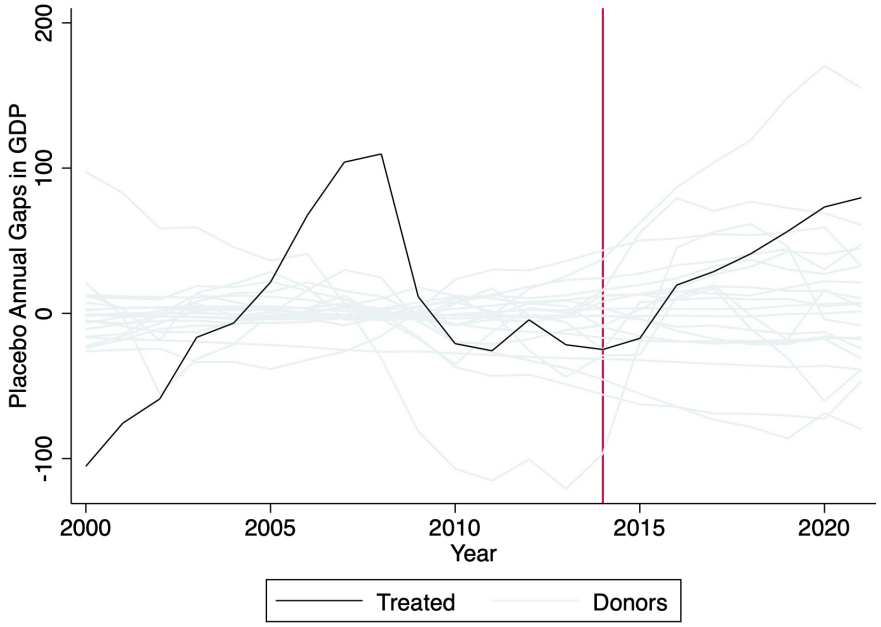


6.4 Discussion

There are a couple of statements that can be made with certainty. First, sanctions continue to be more frequently imposed, and the EU, UN, and US are responsible for more than half of them. Second, financial sanctions are the most popular, followed by trade sanctions. Third, there has been a significant shift between 1970-2000 and 2000-2021 regarding travel and other sanctions. They have increased significantly, most likely reflecting the rising popularity of "smart sanctions".

Although sanctions as a policy tool are becoming increasingly popular, this study does not find any evidence suggesting that their effect has become larger on the target economy's GDP growth. In contrast, between 2000-2021, I do not find any significant estimates indicating that sanctions have had any effect on growth, which

Figure 6.6: Placebo in-space study, Russia



contrasts the results of Neuenkirch and Neumeier (2015). I do, however, find weakly significant results for 1970-2000 suggesting that arms financial sanctions may be the only types that negatively affects economic growth. Financial sanctions were also significant when testing for the full period, which is in line with several studies arguing that financial sanctions have stronger negative effects on targets' economies (e.g. Hufbauer et al., 2009 and Gutmann et al., 2021).

Remarkably, my analysis yields intriguing results as it indicates that none of the sanction types examined have a detrimental impact on the trade openness of the sanctioned countries. This finding suggests the possibility of trade deflection, whereby the targeted economies manage to establish alternative trading partnerships with other countries, thereby compensating for any potential decline in trade with the sanctioning countries. Despite facing economic restrictions, these countries appear to actively seek out new trade opportunities and maintain their overall level of trade flows.

Further analyzing the case studies of Iran and Russia, two contrasting results are found. Iran's GDP was negatively affected by the imposed sanctions in 2011, with a significant decline, in the two upcoming years of more than 15 percent relative to synthetic Iran. These findings are in line with previous research. Additionally, similar to Dizaji and van Bergeijk (2013) and Kwon et al. (2020), I do not find a significant long-term effect on Iran's GDP - although Iran is visually performing worse than its synthetic counterfactual. Russia, on the other hand, seems to be unaffected by the imposed sanctions in 2014.

This raises the question of what may differ between the cases of Iran and Russia.

The theoretical framework implies that the larger the target and the more economic influence it has, the less the chances of a successful outcome (Hufbauer et al., 2009). Perhaps this is the main reason behind the difference in economic performance between these two countries. This argument is further strengthened by the found negative effects the sanctions against Russia have had on sender countries. However, there might be other factors in play. For instance, the theory also states that the ability of the target government to evade sanctions or gain support from a rival of the sender can make them less effective. It is plausible that Russia was sufficiently prepared to deal with the imposed sanctions, as it already was engaged in other economic organizations (such as being a member of the SCO) and as Overland and Kubayeva (2018) report, was receiving funding from China. Trade deflection may further explain why the sanctions imposed on Russia were found to be insignificant, and also why the effect on Iran's GDP turned completely insignificant after 2015. Studies and reports show that the sanctions on Iran and Russia have given rise to new trade patterns. Their exports may have experienced a decline in prices, but they are exporting larger quantities.

The emergence of new trade patterns and economic partnerships, due to prior imposed sanctions, could potentially have significant implications for the effectiveness of future sanctions. As both the theory and prior research state, the chances of a successful sanction become lower if the trade and financial movements between the sender and the target decrease. Therefore, instead of isolating the target economy, the imposition of sanctions may in the long-run lead to the isolation of the sanctioning entity. This shift can already be observed through new partnerships, anti-American sentiment, and a more specific event - the Chinese yuan replacing the dollar as the most traded currency in Russia. Furthermore, it is worth noting that China, as a third party, has been actively engaged in extensive lending and trading activities with emerging and developing countries. The currency denomination of these transactions, whether in US dollars or yuan, remains uncertain (Ilzetski et al., 2019). Whether sanctions from the West promote these events or accelerate these relationships, I leave it to future research to find out - as well as the implications it has on the US dollar as the global currency.

Lastly, it may be time to question sanctions as a policy tool that is increasingly used in a "one size fits all" manner. Sanctions operate by altering the cost-benefit analysis of the target entity, influencing their decision-making process rather than directly impeding their capacity to undertake specific actions. In general, the success of sanctions is therefore dependent on the cost of defiance. But what happens when the cost of compliance is infinitely large? The findings of Felbermayr et al. (2020a) suggest that the falling success rates of sanctions since 1995 are due to the main objectives of sanctions shifting. Before, imposed sanctions were more related

to international diplomacy, but have now become more related to democracy and human rights. This is also directly applicable to the cases of Iran and Russia, where the sanctions imposed are due to demands that threaten the internal regime stability. As the theoretical framework predicts, these sanctions are very unlikely to succeed.

7

Conclusion

Sanctions are increasingly becoming a more popular policy tool, however, their potential variations in their effectiveness over time remain an area of investigation. The purpose of this study was to examine whether sanctions affect economic growth, and if the impact of sanctions has changed over time.

The effect of different types of sanctions on economic performance across different periods is examined by using a fixed effects method that in total covers the years between 1970 and 2021 for countries sanctioned by the EU, UN, and/or the US. I only find weakly significant results for the time period of 1970-2000 suggesting that arms and financial sanctions negatively affects GDP growth. I do find significant results when running for the whole time period, 1970-2021, that implies that the imposition of a financial sanction is associated with a 1 pp drop in GDP growth. I do not find any significant impact of sanctions on the degree of openness - which might reflect the phenomenon of trade deflection.

Furthermore, this study delves into the economic costs of sanctions within the specific contexts of Iran and Russia, two of the most heavily sanctioned countries at the present time. Using a synthetic control method, I show that the sanctions imposed on Iran in 2011 caused a significant fall in real GDP by more than 15 percent in 2012 and 2013. In contrast, the sanctions imposed on Russia in 2014 do not display to have any significant effect on its real GDP. The discrepancy between these two countries is argued to be attributed to their different preconditions.

7.1 Future Research

The phenomenon of trade deflection, geopolitical shifts, and third parties potentially benefitting from sanctions are sweepingly mentioned and discussed in this paper. These areas warrant further in-depth investigation, and future research should aim to delve deeper into this. As mentioned, the emergence of new trade patterns and economic partnerships, as a consequence of prior imposed sanctions, could poten-

tially have significant implications not only for the effectiveness of future sanctions but also for the status of the EU, UN, and US in the global economy - as them being the largest sanctioning entity. In light of existing theories and previous studies, it is crucial to further explore the potential long-term consequences of imposing sanctions. Studies have already found unintended adverse effects on the sender's economy. Traditional thinking suggests that isolating the target through sanctions would lead to desired outcomes, emerging evidence points to a different narrative. Future research should investigate the possibility that imposing sanctions may inadvertently lead to the isolation of the sanctioning entity itself.

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8

Appendix A: Correlation Matrices

Table 8.1: Correlation matrix (variable of interest: GDP growth).

	$\log(\text{GDP}_{t-1})$	pop_{t-1}	inv_{t-1}	open_{t-1}	inf_{t-1}	trade	arms	fin
$\log(\text{GDP}_{t-1})$	1.000							
pop_{t-1}	-0.407	1.000						
inv_{t-1}	-0.241	0.124	1.000					
open_{t-1}	0.291	-0.161	0.177	1.000				
inf_{t-1}	-0.028	0.024	-0.043	-0.023	1.000			
trade	0.054	-0.040	0.003	-0.065	-0.001	1.000		
arms	-0.042	-0.002	0.022	-0.108	0.050	0.482	1.000	
fin	-0.099	-0.006	0.055	-0.072	0.035	0.594	0.465	1.000

Table 8.2: Correlation matrix (variable of interest: degree of openness).

	telsub_{t-1}	growth_{t-1}	inf_{t-1}	fdi_{t-1}	trade	arms	mil	fin	trav
telsub_{t-1}	1.000								
growth_{t-1}	-0.056	1.000							
inf_{t-1}	-0.028	-0.061	1.000						
fdi_{t-1}	0.193	0.056	-0.012	1.000					
trade	0.019	-0.048	-0.001	0.002	1.000				
arms	-0.069	-0.026	0.050	0.047	0.482	1.000			
mil	-0.123	-0.015	0.051	-0.02	0.389	0.625	1.000		
fin	-0.118	-0.048	0.035	-0.001	0.594	0.465	0.526	1.000	
trav	-0.051	-0.046	0.052	0.006	0.476	0.543	0.442	0.52	1.000

9

Appendix B: List of Countries

Table 9.1: Sanctioned countries included in regression analysis

Afghanistan	Cote d'Ivoire	Ireland	Poland
Albania	Croatia	Jamaica	Portugal
Algeria	Cuba	Kenya	Romania
Angola	Cyprus	Korea, Rep.	Russian Federation
Antigua and Barbuda	Dominica	Kuwait	Rwanda
Argentina	Dominican Republic	Kyrgyz Republic	Saudi Arabia
Austria	Ecuador	Lao PDR	Sierra Leone
Azerbaijan	Egypt, Arab Rep.	Latvia	Somalia
Bangladesh	El Salvador	Lebanon	South Africa
Belarus	Equatorial Guinea	Lesotho	South Sudan
Belize	Eritrea	Liberia	Sri Lanka
Benin	Ethiopia	Libya	Sudan
Bolivia	Fiji	Madagascar	Suriname
Bosnia and Herzegovina	France	Malawi	Syrian Arab Republic
Brazil	Gambia, The	Mali	Tanzania
Bulgaria	Germany	Malta	Thailand
Burkina Faso	Ghana	Mauritania	Togo
Burundi	Greece	Moldova	Tunisia
Cambodia	Guatemala	Mozambique	Turkiye
Cameroon	Guinea	Myanmar	Uganda
Canada	Guinea-Bissau	Nepal	Ukraine
Central African Republic	Haiti	Nicaragua	Uruguay
Chad	Honduras	Niger	Uzbekistan
Chile	Hong Kong SAR, China	Nigeria	Venezuela, RB
China	Hungary	Pakistan	Vietnam
Colombia	India	Panama	Yemen, Rep.
Congo, Dem. Rep.	Indonesia	Paraguay	Zambia
Congo, Rep.	Iran, Islamic Rep.	Peru	Zimbabwe
Costa Rica	Iraq	Philippines	

Note: All included countries have been sanctioned by the EU, UN, and/or the US during the period of 1970-2021

Table 9.2: Donor pool for Iran

Algeria	Libya
Bahrain	Malaysia
Bangladesh	Nigeria
China	Oman
Ecuador	Qatar
Egypt	Saudi Arabia
India	South Africa
Indonesia	Sudan
Jordan	Thailand
Korea, Rep.	Turkiye
Kuwait	United Arab Emirates

Table 9.3: Donor pool for Russia

Argentina	Mexico
Bosnia and Herzegovina	Morocco
Brazil	Pakistan
China	Peru
Ecuador	Qatar
Hong Kong	Saudi Arabia
India	Serbia
Indonesia	South Africa
Iran	Sri Lanka
Kenya	Thailand
Kuwait	United Arab Emirates
Malaysia	

10

Appendix C: Further Empirical Results

Table 10.1: The effect of sanctions on the GDP growth

	1970-2000			2000-2021			1970-2021		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\log(\text{GDP/cap})_{t-1}$	0.0255	0.125	0.0334	7.897***	8.294***	8.153***	-0.153	-0.143	-0.326
	(1.542)	(1.487)	(1.579)	(2.021)	(2.139)	(2.179)	(1.351)	(1.324)	(1.345)
$\text{population growth}_{t-1}$	-0.132	-0.184	-0.300	-0.539	-0.564	-0.585	-0.23 5	-0.268	-0.424**
	(0.437)	(0.399)	(0.409)	(0.414)	(0.424)	(0.415)	(0.213)	(0.189)	(0.209)
$\text{degree of openness}_{t-1}$	-0.0132	-0.0147	-0.0135	0.0630*	0.0654**	0.0615*	-0.00665	-0.00718	-0.00693
	(0.0238)	(0.0227)	(0.0237)	(0.0322)	(0.0309)	(0.0328)	(0.0221)	(0.0213)	(0.0218)
investment_{t-1}	-0.162	-0.157	-0.155	-0.127**	-0.132**	-0.129**	-0.0774	-0.0824	-0.0655
	(0.163)	(0.159)	(0.162)	(0.0541)	(0.0586)	(0.0533)	(0.0708)	(0.0698)	(0.0711)
inflation_{t-1}	-0.00138**	-0.00140**	-0.00140**	-0.115***	0.107***	-0.112***	-0.00148**	-0.00149**	-0.00148**
	(0.000641)	(0.000658)	(0.000650)	(0.0385)	(0.0367)	(0.0365)	(0.000689)	(0.000700)	(0.000688)
trade sanction	-0.667			-1.140			-1.163**		
	(0.804)			(1.063)			(0.443)		
arms sanction		-2.088***			0.165			-1.670***	
		(0.757)			(0.493)			(0.586)	
financial sanction			-2.291***			-0.699			-1.523***
			(0.858)			(0.686)			(0.432)
Constant	6.198	5.793	6.478	-79.74***	-83.88***	-81.95***	-2.655	-2.770	-0.439
	(13.03)	(12.49)	(13.25)	(18.68)	(19.54)	(19.85)	(12.03)	(11.85)	(11.96)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	991	991	991	471	471	471	1499	1499	1499
R^2	0.125	0.133	0.135	0.476	0.469	0.472	0.187	0.190	0.192
Number of countries	0.125	0.133	0.135	0.476	0.469	0.472	0.187	0.190	0.192

Clustered robust standard errors are reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

Table 10.2: The effect of sanctions on the Degree of Openness

	1970-2000					
	(1)	(2)	(3)	(4)	(5)	(6)
telephone subscriptions$_{t-1}$	0.0665	0.0547	0.0424	0.0203	0.0741	0.0795
	(0.194)	(0.194)	(0.194)	(0.192)	(0.195)	(0.194)
growth$_{t-1}$	0.272**	0.270**	0.273**	0.267**	0.272**	0.270**
	(0.118)	(0.118)	(0.118)	(0.120)	(0.119)	(0.121)
inflation$_{t-1}$	0.000536***	0.000612***	0.000601***	0.000641***	0.000487**	0.000551***
	(0.000173)	(0.000181)	(0.000185)	(0.000185)	(0.000209)	(0.000169)
foreign direct investment$_{t-1}$	0.336	0.333	0.331	0.351	0.335	0.337
	(0.316)	(0.317)	(0.318)	(0.311)	(0.317)	(0.317)
trade sanction	-1.200					
	(1.865)					
arms sanction		-2.935				
		(2.637)				
military sanction			-2.459			
			(2.173)			
financial sanction				-4.533*		
				(2.545)		
travel sanction					1.594	
					(4.067)	
other sanction						4.296*
						(2.511)
Constant	52.50***	53.14***	53.23***	53.86***	52.19***	51.94***
	(3.164)	(3.503)	(3.146)	(3.180)	(3.212)	(3.158)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2044	2044	2044	2044	2044	2044
R^2	0.089	0.091	0.091	0.096	0.089	0.091
Number of countries	99	99	99	99	99	99

Clustered robust standard errors are reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

	2000-2021					
	(7)	(8)	(9)	(10)	(11)	(12)
telephone subscriptions$_{t-1}$	-0.128	-0.130	-0.134	-0.131	-0.146	-0.126
	(0.178)	(0.178)	(0.177)	(0.177)	(0.177)	(0.178)
growth$_{t-1}$	0.292*	0.291*	0.299*	0.291*	0.303*	0.299*
	(0.166)	(0.167)	(0.165)	(0.167)	(0.165)	(0.166)
inflation$_{t-1}$	0.0253	0.0258	0.0257	0.0249	0.0258	0.0247
	(0.0305)	(0.0304)	(0.0297)	(0.0306)	(0.0292)	(0.0297)
foreign direct investment$_{t-1}$	0.0592**	0.0594**	0.0592**	0.0594**	0.0591**	0.0592**
	(0.0289)	(0.0289)	(0.0288)	(0.0290)	(0.0288)	(0.0288)
trade sanction	-0.667					
	(1.730)					
arms sanction		-0.541				
		(2.766)				
military sanction			1.668			
			(1.993)			
financial sanction				-0.944		
				(1.331)		
travel sanction					2.754	
					(1.739)	
other sanction						2.326
						(2.310)
Constant	64.86***	64.69***	64.48***	65.14***	63.91***	64.50***
	(2.695)	(2.536)	(2.509)	(2.557)	(2.552)	(2.527)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2144	2144	2144	2144	2144	2144
R^2	0.104	0.104	0.105	0.105	0.107	0.105
Number of countries	110	110	110	110	110	110

Clustered robust standard errors are reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$

	1970-2021					
	(13)	(14)	(15)	(16)	(17)	(18)
telephone subscriptions$_{t-1}$	0.106	0.0969	0.0966	0.0911	0.104	0.108
	(0.155)	(0.155)	(0.155)	(0.154)	(0.155)	(0.155)
growth$_{t-1}$	0.331**	0.329**	0.331**	0.330**	0.332**	0.333**
	(0.161)	(0.161)	(0.161)	(0.165)	(0.161)	(0.162)
inflation$_{t-1}$	0.000581*	0.000665**	0.000650**	0.000646**	0.000603*	0.000593*
	(0.000333)	(0.000319)	(0.000315)	(0.000324)	(0.000314)	(0.000301)
foreign direct investment$_{t-1}$	0.0292	0.0308	0.0296	0.0302	0.0293	0.0290
	(0.0739)	(0.0733)	(0.0735)	(0.0740)	(0.0735)	(0.0734)
trade sanction	-2.675					
	(1.727)					
arms sanction		-2.730				
		(2.126)				
military sanction			-1.841			
			(1.398)			
financial sanction				-1.993		
				(1.504)		
travel sanction					-0.105	
					(1.879)	
other sanction						3.085
						(2.912)
Constant	62.77***	62.20***	62.02***	62.97***	61.76***	61.60***
	(2.658)	(2.642)	(2.535)	(2.549)	(2.644)	(2.545)
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4188	4188	4188	4188	4188	4188
R^2	0.114	0.114	0.114	0.114	0.113	0.113
Number of countries	110	110	110	110	110	110

Clustered robust standard errors are reported in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.001$