UNIVERSITA' DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI "M.FANNO"

CORSO DI LAUREA MAGISTRALE / SPECIALISTICA IN ECONOMICS AND FINANCE

TESI DI LAUREA

INTERNATIONAL ECONOMIC SANCTIONS: AN ASSESSMENT OF ECONOMIC EFFECTS

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ANNO ACCADEMICO 2021 – 2022

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Introduction

Sanctions are one of the most important topics nowadays. Their aim is to reach a goal (political, human right, end of civil war, etc.) without going through an armed or direct intervention. During the past years sanctions have been used as a symbol more than a real policy instrument, but recently in this increasingly developed framework in which making a war has become very expensive not only in economic terms for both but even in life terms and given and the fact that an armed conflict could bring severe consequences not only for the target country, but also for the country(s) that decide to intervene (one of which is for example is the spread of terrorism), they have become an important tool able to reach a specific goal while avoiding heavy consequences. Among these sanctions we find a variety of them:

- Economic sanctions that hit: export, import, foreign direct investment inflow, financial sector, aid from UN, IMF and etc.
- Military sanctions: arms embargo to cut off supplies of arms or dual-use items.
- Travel sanctions: ban on certain categories of people from entering the sanctioning state
- Others: sports, environment, etc.

There have been many studies about the effect that sanctions have in reaching specifics goals, but few that evaluate the effects that this latter has on the economy of the target. For these reasons is interesting analyze what effect they have sorted on GDP per Capita and Export: both are interesting to understand if the government has shifted the weight of sanctions on people's shoulders.

Among countries that has been subject to sanctions, I have selected four countries: Iran, Kenya, Nicaragua, and Russia. For three of them we have a joint effect: internal crisis in the country and sanctions: in particular for Iran, Kenya and Nicaragua. For the Russian case we do not have particular situation inside the country that leads us to think that Russia has been subject to internal crisis that had caused a drop in its GDP per Capita and its Export, other than sanctions.

In this analysis I focused on the sanctions issued by the U.S. and the U.N. The reason is simple, they are the most important players that are able to inflict a non-indifferent effect when decide to issue sanctions, thanks to the fact that both are two very big economic players.

In the first chapter we review the the existing literature, the history of sanctions and discuss the method used to conduct the analysis, that is the Synthetic Control Method. In the following

chapters we analyse the four cases mentioned before: Iran, Kenya, Nicaragua and Russia to see the effect sorted in their economies and then we draw the conclusion about what has been discovered.

To address this analysis I have used the Global Sanctions Database (GSDB) that provides useful information on the sanctioned state, sanctioning state; the begin and the end of sanctions; specifications about the type of sanctions: trade (export, import or both), arms, military, financial, travel and others; the objective of these sanctions: terrorism, human rights, end of civil war, democracy, policy change and etc; finally, if they have achieved their objective or not. I have also built my own database using the data bank available at the site of the World Bank, in particular I have used the World Development Indicators' Data Bank. This dataset is a panel dataset that include data from 1990 to 2019 for 207 countries around the world, among them we have also non recognized countries like Taiwan.

Chapter 1

1.1 Literature review

As it has been said in the introduction, sanctions are an important tool to achieve a specific goal. During these years many researchers have focused on the importance that sanctions has on achieving a change in the behavior of the targeted country, on the effectiveness that those constraints have on them. For example, one of the most prominent research in this field have been conducted by Hufbaauer et al. (1990a), on a broad number of sanctioned countries using a bivariate model, then criticized by Cooper (1998) for the impossibility of ruling out spurious relationships due to lack of control variables. In any case, different studies have argued that many times sanctions have failed into their job. Hufbaauer et al. (2008) have shown in their work that only 34 percent of all sanctions episodes successfully achieve their political goal. This has to do with different explanations: who is the sender, what type of relationship is there between the sender and the target, what could be the counter effect on the sender economy, can the target bypass sanctions relying on a black night (Hufbaauer et al. 1990), what is the effect that sanctions have on the shadow economy, what type of sanctions can be the most effective against the target. After asking ourselves all these questions, others interesting points of views are those of Kaempfer and Lowenberg (1992: 21): “as long as both the demand for and the supply of internationally traded goods is sufficiently elastic, little economic hardship will be induced in the target country by sanctions”; and that of Gardner and Kimbrough (1990): “in a world of homogeneous goods and commodities with high substitution elasticity, only a sender with more than half the productive capability of a certain good has the ability to influence the terms of trade”.

The explanations mentioned above, not only has an impact on the success probability of sanctions but even give us a hint on how big the effect could be, that is what we are looking for. The sender country/ies is/are important because determine what has been said before. There is an important difference whether the sender is U.S or whether is Serbia, for instance. A very big, developed economy like U.S could cause a bigger shock in the economy of the target respect to the case in which is Serbia the sender, that is a small economy.
Another point to ponder, is the relationship among sender and the target. Prior strong relationship between the two has a non-indifferent effect. The block of export on a country that

exports 30% of its GDP to the sender could have disastrous effects on the whole target economy, but not only on it but also to the living quality of people.

Talking about the cost for the sender, it is very noticeable that in imposing sanctions the imposer has to consider what could be the cost in its economy if a particular sanction is applied: if country A decide to impose a trade sanction on country B that include export and import, and a big chunk of A's GDP is composed by the production of electronic equipment and A is a big importer of semiconductor, having imposed sanction will create ground for a big collapse, if A is not able to differentiate in the short and long term.

There are different ways to bypass sanctions, but the one argued by Hufbaauer et al. (1990) is very interesting, that is the presence of a black night. This individual helps the target to circumvent the sanctions, making them less effective and for this reason the sender must make sure to make the imposition of sanctions disadvantageous even for who wants to be the Black Knight. Another important thing to think about is the informal economy, that has a fundamental role in adapting the economy to sanctions, but also as a method of circumvent the latter, (e.g., Early and Dursun, 2019; Andreas, 2005; Heine-Ellison, 2001; Crawford and Klotz, 1999). Informal economies comprise "those economic activities that circumvent or other - wise elude government regulation, taxation, or observation" (Feige 1989, 1). Early and Dursun, (2019) argue that what comes with the disruption of the target economy due to sanctions "create incentives for both firms and individuals to shift their activities to the shadow sector", in this way growing this sector and enhancing losses to the target state, for example due to non-payment of taxes due. At the same time, the government leaders could in an act to avoid losing power and creating the basis for further chaos could become more tolerant in front of this shadow economy in order to assist as the electorate to circumvent and mitigate some of their economic distress. On the other hand, companies that are headquartered in the sender country and have been dealing and are dealing with companies whose headquarters are in the territory of the target, in order to avoid incurring the cost of penalties, might consider continuing to have relationships if the cost due to the non-relationship is greater than the cost they would incur if they were found to still have a stable relationship. By turning to third parties, i.e., intermediaries, they could continue to operate while reducing the risk. For example, Iranian companies have relied on intermediaries to conceal transactions with counterparties by exploiting the territory of Dubai to evade sanctions (Early, 2015). Sometimes, as we have said above, is difficult imposing sanctions in a manner to hit in a proper way the target, so when you want to impose sanctions that work, you have to think about the ones that might be the most effective. Most effective sanctions, also called smart sanctions like financial, travel ban, asset freezes and arms embargoes are believed to be a means of persuasion rather than a punishment

in the strict sense (Drezner, 2011; Tostensen and Bull, 2002), so that you get what you want without hitting the country hard, because in the end those who pay the consequences are very often the people. Sanctions can have devastating consequence for the civilian population as they can negatively affect the availability of food and clean water (Cortright and Lopez, 2000; Weiss et al., 1997) and access to medicine and health-care services (Garfield, 2002; Gibbons and Garfield, 1999), as well as have a detrimental impact on life expectancy and infant mortality (Ali Mohamed and Shah, 2000; Daponte and Garfield, 2000). Another possible drawback of sanctions is the worsen of human right in the target's countries, Pekesen (2009). Peksen and Drury (2010), find argue that sanctions can have detrimental impact on the level of democracy, which is sometimes what sanctions attempt to restore. The limited empirical evidence suggests that sanctions trigger financial crises (Hatipoglu and Peksen 2018; Peksen and Son 2015) and reduce income per capita (Neuenkirch and Neumeier 2015). Reductions in trade (Afesorgbor 2019; Crozet and Hinz 2020; Felbermayr et al. 2020b) and foreign direct investment (Biglaiser and Lektzian 2011; Mirkina 2018) are likely transmission channels.

Coming back to smart sanctions the most dangerous ones are financial and asset freezes. The assets freezing can easily destabilize the exchange rate of a country, we saw this situation with the freezing of Russian reserves by several states after the 2022 invasion of Ukraine. Initially, Russia, unable to access its own funds at central banks, was unable to adequately stabilize the ruble. A stable exchange rate ensures adequate foreign trade and provides an optimal environment for economic development, while on the contrary, an unstable exchange rate will increase financial uncertainty, domestic and foreign investment risk, and consequently reduce social welfare (Devereux, 2004; Byrne and Davis, 2005). A high exchange volatility has been shown to lead greater risk of domestic and foreign investments, in particular for developing countries (Urata and Kawai, 2000; Serven, 2003; Byrne and Davis, 2005). In Russia, after the imposition of sanction from EU in 2014, the exchange rate of Russia’s ruble collapsed, and this led to serious inflation.

Political risk theory, following the works of Haendel (1979) and Simon (1974), tells us that instability in foreign systems influences investment opportunities. In this theory, investors are described as moral, risk-averse, and cautious. They try to minimize political, financial, and operational risks. They choose host countries with better protection of property rights and investment support. On the other hand, different other studies support the theory based on the *Economic Opportunism*, in which companies are described as rational and opportunist (Rugman, 1986; Williamson, 1981). Some companies ignore what is happening inside the

country, such as human rights violations, as long as their profits are stable or otherwise continue to grow (Peksen and Drury, 2010; Oechslin, 2014).

1.2 History of sanctions

Sanctions has originated as a policy instrument in the international system at the beginning of the 20th century, particularly in the period during and after the WWI, when the use of economy blockade was repurposed and reframed as a peacetime instrument. The first organization to have this power was the one created by the winners of the first WWI: The League of Nations. It had the power to impose economic and financial sanctions on countries that were deemed by its council to have committed an act of aggression, so to have violated the territorial integrity of a member state or to have infringed on national sovereignty. This was the negative side the article 16. Article 16, in its final paragraph, also spoke of other economic instruments that were to be put in place, particularly financial and logistical aid to the victims of an invasion, a relatively undeveloped point, but an important one because it stemmed from inter-allied logistical cooperation. During the first world war the sharing of resources among allies and not only the depriving of opponents of resources, became a major policy challenge in the 1920s and 30s. the League of Nations to impose these sanctions required large degrees of coordination between national policy makers and international institutions particularly the permanent organs of the league which were based in Geneva and Switzerland. An example of how sanctions were used as a means of threat were actually used as a threat rather than being actually applied and led to some successes was in the 1920s, in particular against smaller economies the first time sanctions were successfully used as a deterrent was in late 1921 when Yugoslavia was engaged in a covert military incursion into northern Albania the League of Nations council convened began to discuss sanction procedures and there was a very overt threat of using this kind of procedure against Yugoslavia. Very quickly the value of the Yugoslav dinar fell on financial markets in the city of London and soon the government in Belgrade yielded and withdrew its troops and an international commission fixed the border, and this conflict was resolved relatively quickly within a matter of weeks.

In the fall of 1935, The League of Nations (52 countries altogether) imposed economic sanctions triggering for the first time a full article 16 procedure against Italy, which under Mussolini had invaded another league member state: Ethiopia. These sanctions included an arms embargo, a ban on financial transactions, restrictions on a number of commodities being sent to Italy and crucially an embargo on buying any kind of Italian export. This led to a decrease in export revenue, but this reduction wasn't quickly enough to stop the Italian war

machine and within the space of about eight months the Italian army conquered Ethiopia and fairly shortly sanctions were lifted due to the failure of them.

From 1939 onward western states began to impose sanctions against Japan that was already engaged in a war with China. At that time (1940/41), Japan saw itself increasingly pushed out of the trading relations with a number of countries, particularly the British empire and its dominions and colonies (India, Australia, New Zeeland, Canada) which had been important trading partners around the specific pacific, no longer traded with Japan and it became almost entirely reliant on their last remaining neutral economy in the world: United States. By the summer of 1941, Japan was almost entirely reliant on the United States for oil imports but also iron and scrap metal and other various essential raw materials such as nickel and copper. When then the U.S moved on to an asset freeze and an oil embargo, this prompted Japan to attack several months later across the pacific including Pearl Harbor and conquer large parts of southeast Asia to secure these resources that it could no longer obtain through trade. This was the final episode that showed dramatically the potential of sanctions.

The concept of positive economic weapon had been born by the experience of policymakers in the first world war, in which was passible to use instrument such as loans but also aid and logistical supplies. For example, shipping all sort of raw materials and commodities from grain to metals, in order to balance out the effects of negative sanctions weapon on the world economy. Interestingly John Maynard Keynes was also involved in providing feedback and debating with the League of Nations officials in the EFO (Officials in League of Nations Economic & Financial Organization) how such instrument should be designed and already in 1924 we find him writing: “I believe that such positive measure would be much more impressive when the time came than negative acts which would always run the risk of not being efficacious and of not being easily distinguished from an acts of war”. However, this positive tool was never entered into force because at that time that it came up for a ratification, the great repression had taken place. It did make a comeback few years later during the second world war when there was again economic warfare and blockades but crucially a much more ambitious economic assistance program to not only countries under attack but any country willing to fight on the side of allies. The lend-lease program, about 50 billion dollars in 1940s, the equivalent of today’s three trillion dollars, provided a massive stimulus in terms of goods but also raw materials and services provision from the United States to the rest of the world economy.

Doing few comparisons and contrasts between this history of the 1920/30/40s and the today's situation, clearly the current large-scale economic sanctions not just in the scale of the sanctions but in the size of the target against Russia are really unseen in scale and in severity since 1930s, so we are in many ways in a new situation that since the creation of the IMF and the Bretton Woods System we haven't really seen. There are some important differences of in this situation, both politically and strategically: one important aspect of the current sanctions is that Russia is a major commodity exporter, and this means that it is self-sufficient in food and crucial energy forms of energy which makes it quite different from those economies like Japan and Italy that were targeted by sanctions in the 30s. Then, talking about the risk of military escalation, it is probably somewhat lower because of sanctions, and this simply because these sanctions while very damaging to Russia are not in the same way an existential danger to Russian society, but there is a serious economic escalation risk, that is spillover effect today are larger than before because of the increased interdependence and the higher Trade/GDP ratios. Finally, it is important to consider the *When* sanctions are disposed; the timing is very important: can enhance the effects or weaken them. In this moment, we are in a particular situation because of pre-existing problems and legacies of previous shocks: pandemic-caused disruptions, supply-chain fragilities caused by underinvestment in AE (Advanced Economies), a global tightening cycle monetarily and financially which has led the global financial cycle to revert out of emerging markets and back into advanced economies and this has created serious problems in the realms of balance of payments and debts for emerging markets in developing economies. All of this this pre-existing situation makes sanctions on the 11th largest economy in the world tantamount to a major economic shock: commodity price shock because Russia is a large commodity exporter but there are also additional effects such as private sector response to sanctions, a sort of self-sanctioning caused by withdrawal from Russia and the refusal to engage in certain transactions and trades that are even remotely tied to Russia by many firms banks exporters merchants around the world and is aggravating and amplifying the sanctions shock this is going over and above what the law of many sanctions regulations requires and it means therefore that the maker economic effect of the sanctions cannot be deduced from the formal restrictions that governments have imposed it's creating ripple effects throughout the private sector through fears of future sanctions and compliance risks. On top of that there are several effects that we might call sanctions hysteresis in this private sector, in a sense over-reaction to sanctions were unlikely to see a big economic recovery, even if the sanctions were lifted, because the private sector will continue to have doubts, fears and uncertainties about the future global economic environment. Speaking in Keynesian terms, also of a negative multiplier effect caused by the corporate withdrawal and the private sector disengagement from Russia and from

more broadly speaking the commodity trade tied to Russia this means that in the short term the global GDP and trade effects of the sanctions are likely overshooting the scope of official government restrictions, while in the median term we will probably see adjustment both in the sanctions imposing economies as they find alternate sources of energy that they're now reliant on Russia, but also in Russia itself as some measure of trade diversion sets in. In the long run these sanctions will damage the world economy not just in terms of missed growth for Russia economies tied to it and more broadly the diversion and the opportunity and time spent finding other trade partners but also the living standard in several emerging markets developing economies that are now hit by much higher import bills for food and energy prices and then hysteresis effect of foreign investors fearing reinvestment.

Positive economic weapon

Looking at what a positive economic weapon will look like today and what kind of constructive policies can be effective to offset the damage that sanctions are doing to the world now, we can think at advanced economies doing more on the supply side in terms of investing in infrastructure that will ease some of the supply chain bottlenecks and inflationary pressures. For emerging markets and developing economies the question is different, particularly for the demand-side support because incomes are much more squeezed, there is less physical space, and the situation in many aspects is much more dire. One concrete thing that can be done is the expansion of the SRD (Special Drawing Right) to avert EMDE (Emerging Markets and Developing Economies) balance-of-payments and debt crisis. Another important thing on which Europe, UN and US are working is the food and energy demand management: an international coordination through diplomacy; humanitarian aid channels for food and medicine.

Post war

These large-scale sanctions are a form of economic war, so post-sanctions world economy require support in terms of aid and finance not only for the reconstruction of Ukraine but also support Russia after sanctions lifting, avoiding doing the same errors as we have seen in the past.

1.3 Synthetic Control Method

The Synthetic Control Method is a statistic tool developed by Abadie and Gardeazabal (2003) and further developed in Abadie et al. (2010), Abadie et al. (2015) and Abadie (2021). It is used by researchers in comparative case studies, in which they estimate the evolution of aggregate outcomes (such as income per capita, GDP, FDI, mortality rate, crime rate, etc.) for a unit affected by a particular event or intervention and compare it to the evolution of the same aggregates estimated for some control group of unaffected units. In comparing the evolution of an aggregate outcome between a unit affected by an event of interest and a set of unaffected units we need only aggregate data. When these data are not available at the same level of aggregation as the outcome of interest, information on a sample of disaggregated units can sometimes be used to estimate the aggregate outcome of interest. In any case, comparative case study research is limited in the social science by two problems that affect its empirical implementation. First, in comparative case studies there is typically some degree of ambiguity about how comparison units are chosen, because usually researchers select comparison groups based on subjective measures of affinity between affected and unaffected units. Second, comparative case studies often employ data on a sample of disaggregated units and inferential techniques that measures only uncertainty about the aggregate values of the data in the population. Uncertainty about the values of aggregate variables can be eliminated completely if aggregate data are available, but the availability of aggregate data does not guarantee that the effect of the event of interest is estimated without any error. In fact, in the case we have these aggregate data, remains the uncertainty about the ability of the control group to reproduce the counterfactual outcome trajectory that the affected units would have experienced in the absence of the event. This error is not reflected by the standard errors constructed with traditional inferential techniques. The use of a data driven approach can reduce the discretion in the choice of the comparison control units (the first problem mentioned above). This method force researchers in demonstrating the affinities between the affected and unaffected units using observable quantifiable characteristics, but we need to highlight that in practice, it is often difficult to find a single unexposed unit that approximates the most relevant characteristic of the unit(s) exposed to the event. The idea behind the SCM is that a combination of units can offer a better comparison for the unit exposed to the intervention than any single unit. For instance, Abadie, Diamond and Hainmueller (2010) in their study about what would be the evolution of East Germany if nothings had changed, used a combination of 16 states to estimate the possible evolution of the GDP per Capita.

The SCM with respect to traditional regression methods offer more transparency and safeguards against extrapolation. The synthetic control method is a weighted average of the available control units, the SCM makes explicit: the relative contribution of each control unit to the counterfactual of interest and the similarities (or lack of it) between the unit affected by the event and the synthetic control, in terms of preintervention outcomes and other predictors of postintervention outcomes, in this way making transparency a first attractive feature. In addition, to avoid extrapolation, in this method weights are restricted to be nonnegative and to sum to one. Basically, using the same concept that we use in machine learning and combining the concept of the SCM with the lasso regression and allowing non-restriction to weights we are able to build something that has a high degree of precision but a low degree of accuracy. The SCM extends the traditional linear panel data (difference-in-difference), allowing the effects of unobserved variables on the outcome vary with time, so this model can account for the effects of confounders changing over time, by weighting the control group so that it has similar pre-intervention characteristics to the threated unit. "The synthetic control method combines elements from matching and difference-in-differences techniques"[1]

1.3.1 Synthetic Control Method in math

Suppose that we have J+1 regions and that only one is the threated one and the remaining J regions are the potential controls (donor pool). Suppose also that the threated region is uninterruptedly exposed to the intervention of interest. Let Y_{it}^N be the outcome that would be observed for region i at time t in absence of intervention, for units $i = 1, \dots, J+1$, and time periods $t = 1, \dots, T$. Let T_0 be the number of preintervention periods, with $1 \leq T_0 \leq T$. Let Y_{it}^I be the outcome that would be observed for unit i at time t if unit i is exposed to the intervention in periods $T_0 + 1$ to T. If we assume that the intervention has no effect on the outcome before the implementation period, so for $t \in \{1, \dots, T_0\}$ and all $i \in \{1, \dots, N\}$, we have that $Y_{it}^I = Y_{it}^N$. Basically, interventions may have an impact prior to their implementation (for instance, through anticipation effect) if $Y_{it}^I \neq Y_{it}^N$ before the implementation period. In those cases, T_0 could be redefined to be the first period in which the outcome may possibly react to the intervention. In addition, this model assumes the *no interference between units*, that is the outcome of the untreated units are not affected by the intervention that we have for the treated unit.

Let $\alpha_{it} = Y_{it}^I - Y_{it}^N$ be the effect of the intervention for unit i at the time t, and let D_{it} be an indicator variable that takes value one if unit i is exposed to the intervention at time t, and value zero otherwise.

[1] https://en.wikipedia.org/wiki/Synthetic_control_method#cite_note-ajps-3

The observed outcome for unit i at time t is:

$$Y_{it} = Y_{it}^{N} + \alpha_{it} D_{it}$$

Given that only the first region is hit by the event and only after period T_0 (with $1 \leq T_0 \leq T$), we have that:

$$D_{it} = \begin{cases} 1 & if\ i = 1\ and\ t > T_0 \\ 0 & otherwise \end{cases}$$

What we want to estimate is: $(\alpha_{1T_0+1}, \ldots, \alpha_{1T})$. For $t > T_0$,

$$\alpha_{1t} = Y_{1t}^{I} - Y_{1t}^{N} = Y_{1t} - Y_{1t}^{N}$$

Given that Y_{1t}^{I} it is observed, to estimate α_{1t} we just need to estimate Y_{1t}^{N}. So, supposing that Y_{1t}^{N} is given by a factor model:

$$Y_{1t}^{N} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it}, \quad (1)$$

where δ_t is an unknown common factor with constant factor loading across units; Z_i is a $(r \times 1)$ vector of observed covariates (not affected by the intervention), θ_t is a $(1 \times r)$ vector of unknown parameters, λ_t is a $(1 \times F)$ vector of unobserved common factors, μ_i $(F \times 1)$ vector of unknown factor loadings, and the error terms ε_{it} are unobserved transitory shocks at the region level with zero mean.

Consider a $(J \times 1)$ vector of weights $W = (w_{2,\ldots\ldots,} w_{J+1})'$ such that $w_j \geq 0$ for $j = 2, \ldots\ldots, J+1$ and $w_{2,\ldots\ldots,} w_{J+1} = 1$. Each particular value of vector W represents a potential synthetic control, that is, a particular weighted average of control regions.

The value of the outcome variable for each synthetic control indexed by W is:

$$\sum_{j=2}^{J+1} w_j\, Y_{jt}^{N} = \delta_t + \theta_t \sum_{j=2}^{J+1} w_j\, Z_j + \lambda_t \sum_{j=2}^{J+1} w_j\, \mu_j + \sum_{j=2}^{J+1} w_j\, \varepsilon_{jt} \quad (2)$$

Now, suppose that there are $(w_2^*, \ldots, w_{J+1}^*)$ such that:

$$\sum_{j=2}^{J+1} w_j^* Y_{j1}^N = Y_{11}^N, \qquad \sum_{j=2}^{J+1} w_j^* Y_{j2}^N = Y_{12}^N,$$

$$\sum_{j=2}^{J+1} w_j^* Y_{jT_0}^N = Y_{1T_0}^N, \qquad and \sum_{j=2}^{J+1} w_j^* Z_j = Z_1.$$

then, if $\sum_{t=1}^{T_0} \lambda_t{}' \lambda_t$ is nonsingular, we have:

$$Y_{1t}^N - \sum_{j=2}^{J+1} w_j^* Y_{jt}^N = \sum_{j=2}^{J+1} w_j^* \sum_{s=1}^{T_0} \lambda_t \left(\sum_{n=1}^{T_0} \lambda_n{}' \lambda_n \right)^{-1} \lambda_s' \left(\varepsilon_{js} - \varepsilon_{1s} \right) - \sum_{j=2}^{J+1} w_j^* \left(\varepsilon_{js} - \varepsilon_{1s} \right) \quad (3)$$

The mean of the right-hand side of this equation will be close to zero if the number of preintervention periods is large with respect to the scale of the transitory shocks. So, we should use:

$$\widehat{\alpha_{1t}} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}^N$$

with $t \in \{T_0 + 1, \ldots, T\}$ as an estimator of α_{1t}

Equation (2) works only if $\left(Y_{11}^N, \ldots, Y_{1T_0}^N, Z_1{}'\right)$ belongs to the convex hull of $\left\{\left(Y_{21}^N, \ldots, Y_{2T_0}^N, Z_2{}'\right), \ldots, \left(Y_{J+11}^N, \ldots, Y_{J+1T_0}^N, Z_{J+1}{}'\right)\right\}$. Basically, sometimes no set of weights exists such that Equation (2) holds exactly in the data, in this way synthetic control region is selected so that Equation (2) holds approximately. Sometimes, we are not even able to obtain a weighted combination of untreated units such that Equation (3) holds approximately, that is the case when $\left(Y_{11}^N, \ldots, Y_{1T_0}^N, Z_1{}'\right)$ falls from the convex hull of $\left\{\left(Y_{21}^N, \ldots, Y_{2T_0}^N, Z_2{}'\right), \ldots, \left(Y_{J+11}^N, \ldots, Y_{J+1T_0}^N, Z_{J+1}{}'\right)\right\}$. Beware that the magnitude of such discrepancy can be calculated for each application, so the analyst can decide if the characteristics of the treated unit are sufficiently matched by the synthetic control and when the fit would result be poor is not recommended using a synthetic control. In addition, even when the synthetic control provides a good fit, the interpolation biases may be large if the simple linear model ($Y_{1t}^N = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it}$) does not hold over the entire set of regions in any

particular sample. We can try to minimize these biases, interpolation across regions with very different characteristics, by restricting the donor pool holding regions with similar characteristics to the region exposed to the event or intervention of interest.

From Equation (1) we can obtain the traditional difference-in-difference (fixed-effects) model, by imposing λ_t constant for all t. In practice, DiD model allows for the presence of unobserved confounders but they have to be constant over time, in this way they are eliminated by taking time differences. Instead, the factor model from Equation (1) allows the effects of confounding unobserved characteristics to vary with time and in this way even when we take time differences, this does not eliminate the unobserved confounders, μ_j. Then, a synthetic control such that:

$$\sum_{j=2}^{J+1} w_j^* Z_j = Z_1 \; and \; \sum_{j=2}^{J+1} w_j^* \mu_j = \mu_1 \quad (4)$$

would provide an unbiased estimator for Y_{1t}^N. However, having a synthetic control in this way is not possible, because $\mu_1, \dots \dots, \mu_{J+1}$ are not observed. Under reasonably standard conditions, the factor model shown in Equation (1) implies that a synthetic control can fit Z_1 and a long set of preintervention outcomes, $Y_{11,\dots\dots,}Y_{1T_0}$, only if it fits $Z_1$and μ_1, that is Equation (4) holds approximately.

1.3.2. Implementation

Consider W be a $(J \times 1)$ vector of positive weights that sum to one: $W = (w_2, \dots., w_{J+1})'$ with $w_j \geq 0$ for $j = 2, \dots, J+1$ and $w_2 + \cdots + w_{J+1} = 1$. Each value of W is a weighted average of the available control regions and so, a synthetic control. This latter one is the results of a convex combination of unexposed units. Notice that we could also use negative or positive weights that exceed 1, but the cost for this operation is allowing extrapolation.

The outcome variable of interest is observed for T periods, $t = 1, \dots, T$, for the region affected by the intervention, Y_{1t}, and the unaffected regions, Y_{jt}, where $j = 2, \dots., T$. Let the $(T_0 \times 1)$ vector $K = \left(k_1, \dots., k_{T_0}\right)'$ define a linear combination of preintervention outcomes:

$$\overline{Y_i^K} = \sum_{s=1}^{T_0} k_s Y_{is}$$

In the case $k_1 = k_2 = \cdots = k_{T_0-1} = 0 \; and \; k_{T_0} = 1$, then $\bar{Y}^K = Y_{iT_0}$, the value of the outcome variable in the period before the intervention; instead if $k_1 = k_2 = \cdots = k_{T_0-1} = 1/T_0$, then $\bar{Y}_i^K = {T_0}^{-1} \sum_{s=1}^{T_0} Y_{is}$, we obtain the simple average of the outcome variable in the preintervention periods. Consider now, M of such linear combinations defined by the vectors $K_1, \ldots, K_M$ and letting $X_1 = (Z_1', \bar{Y}_1^{K_1}, \ldots, \bar{Y}_1^{K_M})'$ be a $(k \times 1)$ vector of preintervention characteristics for the exposed region, with $k = r + M$. Instead, X_0 is a $(k \times J)$ matrix that contains the same variables for the unaffected regions, with the jth column of X_0 being equal to $(Z_j', \bar{Y}_j^{K_1}, \ldots, \bar{Y}_j^{K_M})'$. To find the vector W^*, we need to minimize this distance:

$$\|X_1 - X_0 W\|$$

with, $w_2 \geq 0, \ldots, w_{J+1} \geq 0 \; and \; w_2 + \cdots + w_{J+1} = 1$. An obvious choice for $\bar{Y}_i^{K_1}, \ldots, \bar{Y}_i^{K_M}$ is $\bar{Y}_i^{K_1} = \bar{Y}_{i1}^{K_1}, \ldots, \bar{Y}_i^{KT_0} = Y_{iT_0}$ (because Y_{iT_0} is observed for all, treated and untreated), the value of the outcome variable for all the preintervention periods.

By the way, the computation of the weights $w_2^*, \ldots, w_{J+1}^*$ could be simplified considering only few linear combinations of preintervention outcomes and checking if Equation (2) holds approximately for the resulting weights.

To quantify the discrepancy between X_1 and $X_0 W$, we will use:

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

with V that is a $(k \times k)$ symmetric and positive semidefinite matrix, (other choice are also possible). Notice that if the relationship between the outcome variable and the explanatory variables in X_1, X_0 is highly nonlinear and the support of the explanatory variables is large, interpolation biases may be severe. However, it is possible to deal with this situation choosing a W^* that minimize $\|X_1 - X_0 W\|$ plus a set of penalty terms specified as an increasing function of the distance between X_1 and the corresponding values for the control units with positive weights in W. Otherwise, as mentioned before, it is possible to reduce the control units, leaving only the regions that are similar to the with the exposed region in terms of X_1.

There is to point out that even if our inferential procedures are valid for any value choice of V, the choice of this latter one influences the MSE (mean square error) of the estimator. It is

possible to choose V in way that the synthetic control approximates the trajectory of the treated unit.

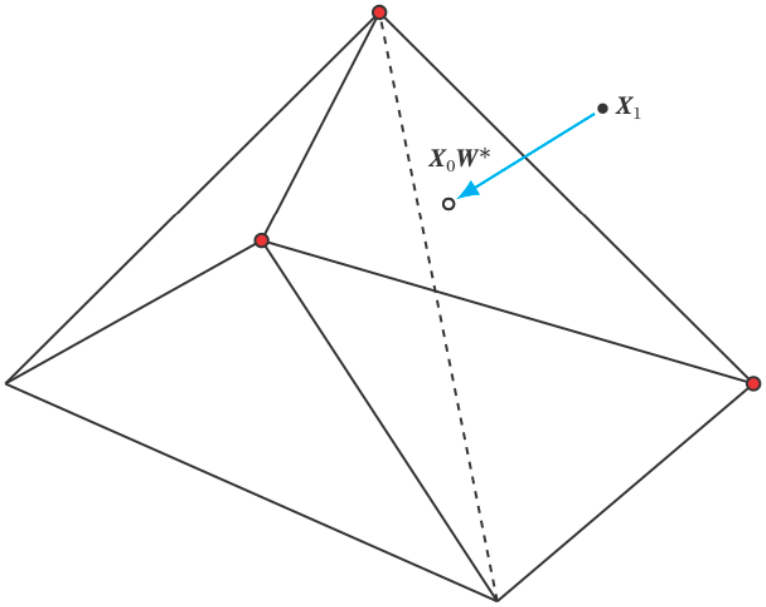

Figure 1.1. *Projecting X_1 on the Convex Hull of X_0*[2]

Figure 1.1 "provides a visual representation of the geometric interpretation of the sparsity property of synthetic control estimators. Only the control observations marked in red contribute to the synthetic control."[3]

[2] Abadie, A. (2021)
[3] Abadie, A. (2021)

Chapter 2 – Iran

2.1 Iran’s history and causes that led to sanctions

To study the motivations that led Iran to be subjected to sanctions we need to start from the Iranian Revolution and what has caused it.

During the 70’s, in an attempt to make Iran the main power of the Middle East, the Scià Mohammad Reza Pahlavi attempted to accentuate the nationalist and autocratic character of his reign committing the vast majority of Iranian economic resources in the construction of a powerful and modern army and in the self-celebration of his monarchy. His political modernization of the Iranian society, in particular the White Revolution, increased the Shiite clergy's impatience with him, who had also supported him in the 1953 during the crisis with nationalist prime minister Mohammad Mossadeq. The Shah alternated between modernizing policies and ruthless repression. Among these modernizing policies we find: ban on women wearing headscarves; admission of these latter ones to Tehran University without abolishing what are male privileges in marriage and family law; support for modern secular schools without forcing the closure of the country's madrasas. This ambivalent policy, resulted in a partial and superficial modernization, with the addition that the army increased its power to give more support to the Shah’s policy. During these years, Iran had been given the green light by the United States to purchase every type of armament except atomic armaments. Among the reasons for this green light was Britain's withdrawal from the Persian Gulf. The expenses for these armaments, including the lavish celebrations for the 2,500th anniversary of the Persian monarchy, cost the state $250 million in 1971, which further aggravated the less than rosy situation of the poorer sections of the population. To the growing discontent within the country, the shah responded with force. During these years thousands of citizens were tortured and killed by the secret police (SAVAK). In 1975, the shah decided to make all political parties illegal, thereby destroying all forms of legal opposition and encouraging the emergence of illegal resistance movements. Opposition forces - religiously inspired, national-liberal, and Marxist - rallied around the figure of Ayatollah Ruhollah Khomeyni, who was exiled first to Najaf and then to Paris for criticizing the shah since 63. Mass protests began in 1978 following an article in the regime press mocking the Ayatollah himself, initiating a series of protests that led to the blockade of the country. Leading the uprisings at first were the Marxist-inspired Fedayyin-e khalq ("people's volunteers"), who soon decided to join with the Islamic mujahideen in order to involve wider and wider layers of the population in the struggle and thus broaden the base of

the protest. Khomeiny directly from Paris, incited the revolution through messages in audiotapes that were broadcast throughout the country. The situation became so difficult that the United States suggested that the shah leave the country, so on January 16, 1979, Reza Pahlavi left the country to take refuge in Morocco. Khomeyni, aware of the situation, decided to return home on Jan. 31, 1979. On March 30, a referendum sanctioned the establishment of the Islamic Republic of Iran with 98 percent of the vote. Along with the birth of the new republic, there were profound changes: alcoholic beverages, gambling and prostitution were made illegal; persecution of homosexuals began; death penalty for rape and adultery and for anyone who engaged in behavior not in accordance with the Shari'a; women were required to cover their arms and legs with non-skimpy clothing, and to cover their heads with a veil, hiding their hair as well. Meanwhile, the shah had managed to reach and take refuge in the United States, but Iran claimed him and demanded his extradition for fear that a coup like the 1953 CIA-backed coup against Mohammad Mossadeq could be repeated and Reza Pahlavi regain power. The U.S. refusal brought a series of anti-U.S. protests culminating in the taking hostage of 52 American diplomats from the U.S. Embassy in Tehran, subsequently released only in 1981. Sanctions were imposed the same year of the diplomatic incident, 1979, and were about finance and import. Sanctions were lifted in 1981, when the hostages were released.

2.2 GDP per capita's analysis

In analyzing the GDP per capita, as explanatory variable we have chosen the trade openness, the sum of exports and imports of goods and services measured as a share of gross domestic product, the foreign direct investment inflows as a share of gross domestic product, the logarithm of population, the logarithm of the military expenditure and three lagged periods of the dependent variable, that is 1963, 1967 and 1977. We have had these three lagged periods in order to help the model to find the best match.

Table 2.1. RMSE and R-squred

Treated Unit:	**92**	***Treatment Time:***	**1979**
Mean Absolute Error	0.07712	Number of Control Units	27
Mean Squared Error	0.00974	Number of Covariates	7
Root Mean Squared Error	0.09871	R-squared	0.92853

As we can see from table 1.1, the RMSE is low and the R-squared is pretty good, telling us that the model fit well the data, but not perfectly.

Table 2.2. Predictor balance in the pre-treatment periods:

Covariate	*V.weight*	*Treated*	*Synthetic Control*		*Average Control*	
			Value	Bias	Value	Bias
trade_op	0.1178	43.7511	43.6141	-0.31%	57.3912	31.18%
fdi_infl_gdp	0.4751	0.715	0.7133	-0.23%	1.2853	79.77%
ln_popul	0.1477	17.1421	17.1265	-0.09%	16.3165	-4.82%
ln_military_exp_2015	0.0005	22.4874	22.0918	-1.76%	20.8935	-7.09%
ln_gdp_pc_2015(1963)	0.0151	7.9632	8.0264	0.79%	7.648	-3.96%
ln_gdp_pc_2015(1967)	0.2418	8.3211	8.3071	-0.17%	7.7608	-6.73%
ln_gdp_pc_2015(1977)	0.002	8.9455	8.968	0.25%	8.1658	-8.72%

Note: *V.weight* is the optimal covariate weight in the diagonal of V matrix. Synthetic Control is the weighted average of control units in the donor pool with optimal weights. Average Control is the simple average of control units in the donor pool with equal weights.

In this table we can observe that the bias for the Synthetic Control is very low with respect to the Average Control Bias. In addition in V.weight we can observe the contribution of every explanatory variable in explaining the outcome.

Table 2.3. Optimal Unit Weights:

Unit	*U.weight*
105	0.432
99	0.293
77	0.173
172	0.05
158	0.035
84	0.016

Note: The unit 3 16 35 43 46 48 57 58 59 69 71 91 97 102 121 128 155 180 186 190 193 in the donor pool get a weight of 0.

In table 2.3 are shown the countries that contributes to build up the Synthetic Control of the Iran GDP per Capita. They are, in descendent order: South Korea, Japan, Greece, Singapore, Portugal and Guyana. These countries are similar in terms of numbers, but not in terms of background. This is due to lack of data for other countries, in that specific period analyzed (1960 – 1989) that would look more like Iran, that is: Afghanistan, Azerbaijan, Jordan, Turkey, URSS and etc. So, in these cases we could be exposed to the interpolation biases, discussed in chapter 1.3.1. It should be pointed out that countries like Algeria, Syria that has similar background with Iran are in the sample pool.

Table 2.4. Prediction results in the post-treatment periods:

Time	*Actual Outcome*	*Predicted Outcome*	*Treatment Effect*
1979	8.6171	9.0829	-0.4658
1980	8.2606	9.0798	-0.8192
1981	8.1683	9.1122	-0.9439
1982	8.3664	9.1441	-0.7777
1983	8.4075	9.1993	-0.7918
1984	8.2751	9.2526	-0.9776
1985	8.2558	9.2987	-1.0429
1986	8.1084	9.3512	-1.2428
1987	8.076	9.4131	-1.3372
1988	7.9837	9.4886	-1.5049
1989	8.0099	9.537	-1.5271
Mean	8.2299	9.2691	-1.0392

Note: The average treatment effect over the post-treatment periods is -1.0392.

In Table 2.4 is contained the effect for every year after the treatment, so of how much the synthetic control diverge with respect to Iran. In this case we could ignore the year 1979, because we do not know the exact moment in which sanctions have been applied, if it was at the beginning ì, in the middle or at the end of 1979. Another think that we must consider is the Iranian revolution, so the effect that we are going to consider does not take only into account the effect that sanctions had on GDP per Capita, but the joint effect that both Iranian Revolution and sanctions had on the GDP per Capita. Deciding to ignore the 1979, the average effect per year is $ -7284.

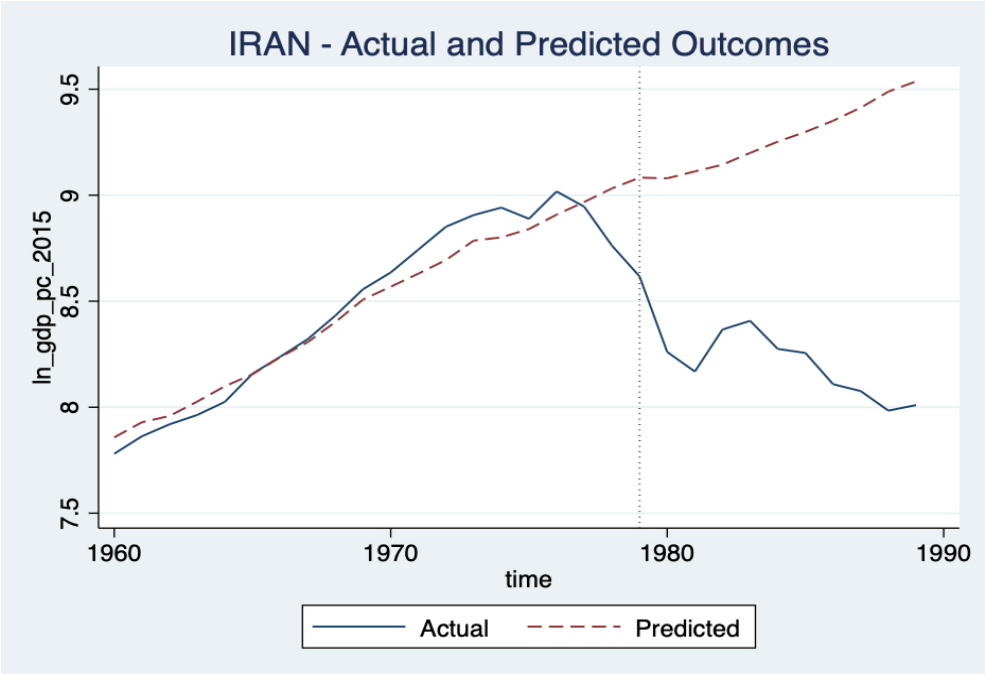

Figure 2.1. *Iran logarithm of GDP per Capita: Actual VS Predicted.*

In figure 2.1, we can observe graphically the Iranian evolution of the GDP per capita with respect to its synthetic control.

2.2.1 Placebo analysis

To fully understand if in reality there has been an event that has caused a drop in the GDP per Capita, we need to run the placebo test. The way in which it works is simple: we repeate the analysis that we have run for Iran, for every single state that we have in the sample pool. kind of like saying, what would have happened if instead of Iran there was another state that suffered the events that Iran suffered. After repeating the same analysis for each state in our donor pool, we will go on to compare the Mean Square error ratio of pre/post treatment of each state. If the ratio of the treated state turns out to be higher than the others and so the probability of encountering such a high ratio is very low, this indicates to us that the events of interest had an effect on our dependent variable. This method is the counterpart of using p-value to understand whether the effect of a variable is different from zero in an OLS regression model, for example.

Table 2.5. Placebo test results using fake treatment units:

Unit	***Pre MSPE***	***Post MSPE***	***Post/Pre MSPE***	***Pre MSPE of Fake Unit/Pre MSPE of Treated Unit***
92	0.0097	1.1803	121.1221	1
102	0.0053	0.0114	2.1563	0.5425
105	0.0199	0.3977	20.0146	2.0392
121	0.0017	0.0100	6.0594	0.17
128	0.0008	0.0083	10.6931	0.0797
155	0.003	0.0453	14.8722	0.3128
158	0.0014	0.0655	46.5706	0.1443
16	0.2052	0.8448	4.1166	21.0598
172	0.0228	0.4573	20.0379	2.3419
180	0.0012	0.0056	4.706	0.1211
186	0.0112	0.2429	21.7647	1.1455
190	0.0076	0.0448	5.869	0.7839
193	0.0052	0.0075	1.4287	0.5352
3	0.008	0.0277	3.4742	0.8196
35	0.0083	0.2502	30.229	0.8495
43	0.0026	0.0192	7.4385	0.2649
46	0.0061	0.0557	9.0779	0.6296
48	0.0049	0.043	8.7453	0.5045
57	0.0067	0.0057	0.8596	0.6845
58	0.0015	0.0116	7.8112	0.1525
59	0.0095	0.1874	19.7384	0.9743
69	0.0152	0.0045	0.2947	1.5618
71	0.0308	0.4028	13.0579	3.1654

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
77	0.0019	0.0078	4.0382	0.1992
84	0.0071	0.0219	3.1043	0.7249
91	0.0041	0.0517	12.7316	0.417
97	0.0004	0.0068	17.2273	0.0403
99	0.0041	0.0577	14.0404	0.4215

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 92's is 0.0357.

(2) Total 1 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 16.

From the note of Table 2.5, we know that the probability of obtaining a post/pre-treatment MSPE ratio as large as Iran is 0.0357, meaning that the Iranian Revolution and sanctions had an effect in decreasing the GDP per Capita.

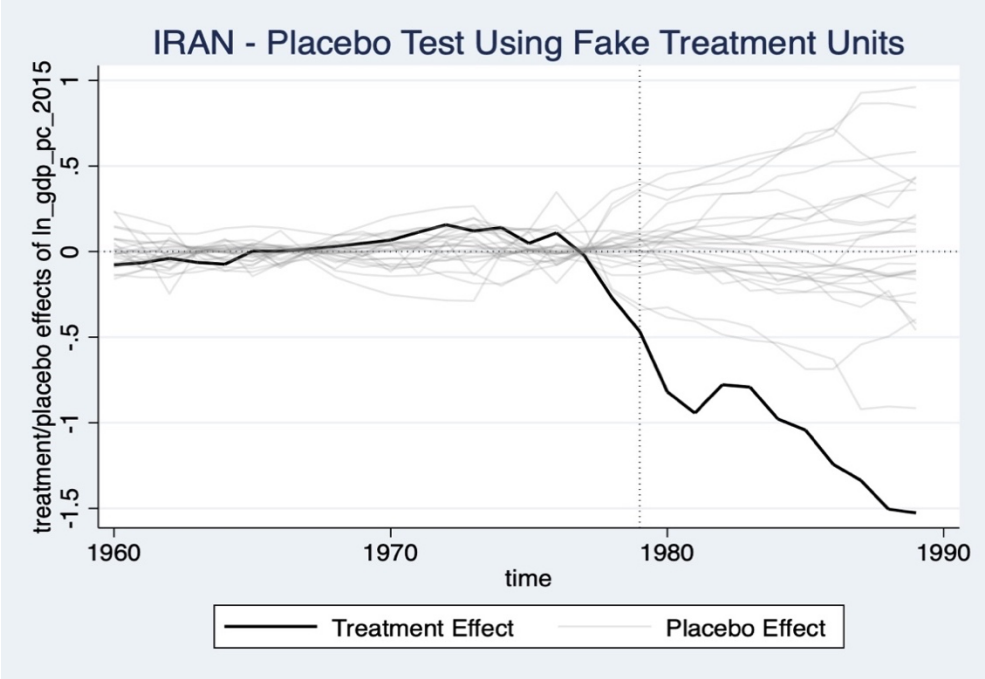

Figure 2.2. *Placebo Test for Iran GDP per Capita.*

In Figure 2.2 we can see graphically the placebo analysis, with a non-indifferent effect for Iran (line in black).

2.3 Export analysis

The other important variable to analyze when we consider the effect of sanctions is export. Not only in the case in which a country has been subject to trade sanctions, but even when it is not. This because, depending on the reasons that led to sanctions, some importer countries can think to stop importing from the sanctioned state. For example, we can think at the case in which there are human right violations. Then the export gives us an hint on how strong these sanctions have hit.

The variables chosen to analyze the export are: the logarithm of import, the logarithm of the Foreign Direct Investment inflows (FDI), the logarithm of the Gross Domestic Product, the level of inflation in consumer prices when consumer are going to buy a specific basket of goods and the logarithm of the value added by the industry: value added in mining, manufacturing, construction, electricity, water, and gas. Finally, for the same reasons explained in the chapter about the GDP per Capita, we have added three lagged period of the export: 1961, 1971, 1973.

Table 2.6. RMSE and R-squared

Treated Unit:	***92***	***Treatment Time:***	***1979***
Mean Absolute Error	0.1372	Number of Control Units	25
Mean Squared Error	0.0335	Number of Covariates	8
Root Mean Squared Error	0.1831	R-squared	0.8845

From Table 2.6, we observe a low Root Mean Squared Error, but a not so high R-squared. In the synthetic control analysis having a R-squared lower than 92 - 95% is not good. Meaning that the synthetic control poorly approximates the treated unit.

Table 2.7. Predictor balance in the pre-treatment periods:

Covariate	***V.weight***	***Treated***	***Synthetic Control***		***Average Control***	
			Value	Bias	Value	Bias
ln_imp_2015	0.0311	24.4638	24.9247	1.88%	21.6109	-11.66%
ln_fdi_2015	0.0231	21.1112	22.0602	4.49%	1844.60%	-12.62%
ln_gdp_2015	0.0045	25.6131	27.3425	6.75%	2348.30%	-8.32%
Inflationconsumerpricesannu	0.3072	6.5797	6.4669	-1.71%	1308.89%	98.93%
ln_industry_2015	0	25.002	25.9341	3.73%	2222.77%	-11.10%

Covariate	*V.weight*	*Treated*	*Synthetic Control*		*Average Control*	
			Value	Bias	Value	Bias
ln_exp_2015(1971)	0.1629	25.2882	25.0939	-0.77%	21.7555	-13.97%
ln_exp_2015(1973)	0.277	25.531	25.3383	-0.75%	21.9746	-13.93%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.

Looking at table 2.7, we can notice that our synthetic control approximates the treatment unit very well compared to the average control, that represent a synthetic control composed by all the units in the donor pool equally weighted. But is important to highlight that our synthetic control has a non-indifferent bias for the logarithm of the GDP. The lower is the bias for all our variables, the better is the fit.

Table 2.8. Optimal Unit Weights:

Unit	*U.weight*
69	0.958
105	0.042

Note: The unit 35 43 45 47 57 58 59 64 86 91 102 121 128 134 152 155 156 163 168 172 181 186 195 in the donor pool get a weight of 0.

The countries used as synthetic control are two: France with 96% and South Korea for the remaining part. Even in this case, as for the case of the GDP per Capita, we could be subject to the interpolation bias.

Table 2.9. Prediction results in the post-treatment periods:

Time	*Actual Outcome*	*Predicted Outcome*	*Treatment Effect*
1979	24.8591	25.7259	-0.8668
1980	23.7772	25.7555	-1.9783
1981	23.6642	25.8064	-2.1422
1982	24.3235	25.7964	-1.4729
1983	24.5214	25.8472	-1.3258
1984	24.2903	25.9149	-1.6246
1985	24.1913	25.9356	-1.7443
1986	24.0132	25.9388	-1.9256
1987	24.3914	25.9744	-1.583
1988	24.5226	26.0565	-1.5339
1989	24.6045	26.1443	-1.5398
Mean	24.2872	25.8996	-1.6125

Note: The average treatment effect over the post-treatment periods is -1.6125.

Deciding to ignore the year 1979, for the same reasons that we have seen in the GDP per Capita, the average effect, so the loss in terms of export that Iran potentially had is $ 146,560,191,648.09. So around 146 billion dollars. A huge loss, but in this case, it should be pointed out that this is not the effect that sanctions had on export, but the joint effect that the Iranian Revolution and the sanctions had on export.

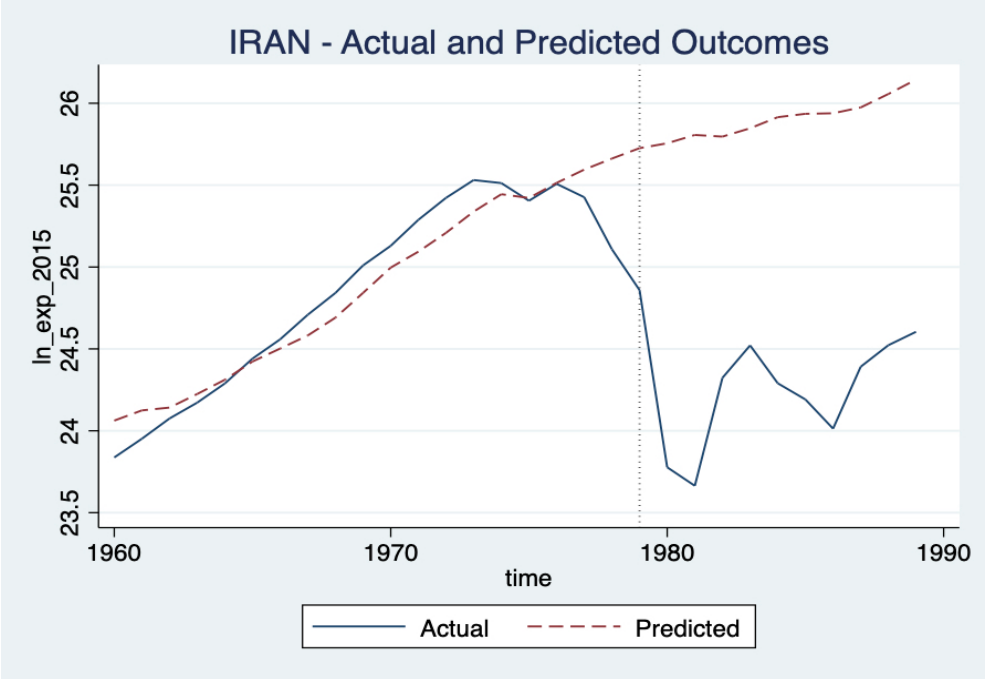

Figure 2.3. *Iran logarithm of Export: Actual VS Predicted.*

From Figure 2.3. we can see two things: the first one is that the fit is not too good and the second one is that the trend of this graph is very similar to the trend that we have analyzed for the GDP per Capita. For this latter affirmation there is an explanation: at that time the Export represented a big chuck of the GDP , around the 40%, so the Figure 2.2 and Figure 2.3 looks very similar.

2.3.1 Placebo analysis

Table 2.10. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
92	0.0335	2.7092	80.8252	1
102	0.0192	0.1024	5.3407	0.5721
105	0.9284	6.1925	6.67	27.6982
128	0.0161	0.1456	9.0276	0.4811
134	0.0151	0.0367	2.4313	0.4499
152	0.0096	0.0794	8.2792	0.286
155	0.0184	0.0407	2.2117	0.5487
156	0.0237	0.0129	0.5453	0.7082
163	1.6304	0.9639	0.5912	48.641
168	0.0161	0.3326	20.6431	0.4806
172	0.0197	1.806	91.5277	0.5887
181	0.015	0.0496	3.309	0.4472
186	0.0482	0.4861	10.08	1.4386
195	0.1835	0.0156	0.0848	5.4741
35	0.0071	0.6405	90.7054	0.2107
43	0.0046	0.0162	3.5036	0.1376
45	0.0389	0.163	4.195	1.1592
47	0.0335	0.1324	3.9533	0.9989
57	0.0212	0.0717	3.3879	0.6312
58	0.0679	0.04	0.5895	2.0255
59	0.042	0.2736	6.5169	1.2525
64	0.1305	0.1695	1.2984	3.8947
69	0.0605	2.9825	49.3342	1.8036
86	0.011	0.013	1.1881	0.3268
91	0.0419	0.0558	1.3307	1.2511

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 92's is 0.1154.

(2) Total 2 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 105 163.

For this placebo analysis we don't have taken into account all the units with a pre-treatment MSPE 20 larger than the treated unit, this is done to avoid having units with very strange path or with a post-treatment effect so large to be inconceivable. Units with such issues are South Korea and Rwanda. The probability of obtaining a post/pre-treatment MSPE ratio as large as Iran is 0.1154, meaning that probably our Synthetic Control are not so good in estimating the treated unit. We do not consider the possibility that there was no effect on Exports from sanctions and revolution, because representing the Export an important part of the GDP per Capita and having shown that the joint effect of sanctions and revolution on the GDP per Capita is non-zero, we can say that the cause is the lack of units close enough to Iran.

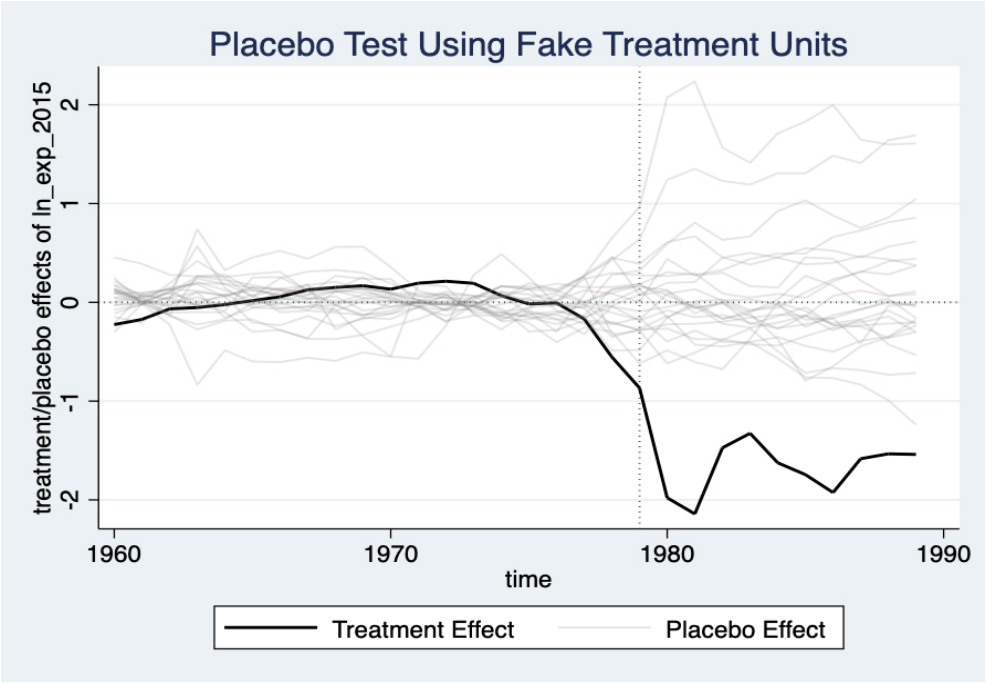

Figure 2.4. *Placebo Test for Iran Export.*

In figure 2.4 we have that Iran is not the only unit with a strange post-treatment behavior for the Export and as explained above the more plausible reason is lack of units close to Iran.

Chapter 3 – Kenya

3.1 Kenya's history and causes that led to sanctions

To analyze the causes that have led to sanction in Kenya, we need to go back to 1978, the death's year of the Kenya's president Jomo Kenyatta. Kenya has forty-eight tribes, with three (Kikuyu, Luo and Luhyia) of them representing almost 65% of the population. During the Kenyatta's years of presidency, he was able thanks to his charisma and statesmanship skills to prevent the delicate relations between the various ethnic groups from degenerating into internal division, calling into question the unity of the country. Basically, during Kenyatta's government the deal was pretty simple: the Kikuyu and their smaller relatives after having made an agreement with minority tribes, run everything. The Lou, that tried to challenge this order, were marginalized and the prudent Luhyia, stood by and watched. In the 1978, most of the country's wealth and power was in the hands of GEMA, and organization composed by three tribes: the Kikuyu, the Embu and the Meru. These three tribes at the time composed 30% of the Kenya's population. After the Kenyatta's death, his vice president, Daniel Arap Moi, belonging to the Kalenjin minority tribe inherited the power as long as he would not upset the deal made in order to keep the two other large tribes (particularly the Lou) out of power, but instead of following this path, he decided to cleverly divide his Kikuyu allies, so as progressively emarginate them. Moi had progressively concentrated all the power and much of the economic benefits on the hands of him and his Kalenjin tribe and handful allies from minority groups. During 1986 a series of amendments to the constitution allowed the strengthening of the pre-eminence of the head of state over the other constitutional bodies, in particular towards the parliament and the judiciary, while a reform of the rules that governed the electoral system helped to tighten the control exercised by KANU over public life and by the leadership over that of the party. For this reason, anti-government activity carried out in hiding, grew. In particular, it is worth mentioning the role of anti-government activity carried out by the movement *Union of Nationalists to Free Kenya* (*Mwakenya*), against which Arap Moi exerted a severe repression.

In 1988, Arap Moi was re-elected for the third time as head of state, the state's highest office. In the same year there were strong conflicts within the single party, KANU, accentuated by the recent reform of the electoral law. A serious political crisis broke out in 1990, following the killing of the Foreign Minister, Robert Ouko, highest representative of the Luo ethnic group in the executive. Serious riots ensued, against the Moi administration, which spread throughout

the country, fueled by the more general discontent for the continuous worsening of the economic conditions of the country. On the political level, the opposition forces managed to organize themselves, despite government prohibitions and repressions, in the *Forum for the Restoration of the democracy* (FORD) supported by Kenya's international creditors for the liberalization of the political system. Following these events, the United States in 1990 imposed military and financial sanctions, in order to restore democracy and prevent the violation of humanitarian rights. In 1991, after local and foreign pressure, Arap Moi was forced to thoroughly reform the constitution and to introduce a multi-party system with a series of amendments. In 1992, when the first multi-party elections were held, Moi again came out elected for the fourth consecutive time. In 1993, Moi's government agreed to put in act economic reforms long urged by the World Bank and the International Monetary Fund (IMF), in this way obtaining enough aid to service its foreign debt. In the same year of the deal between Kenya, World Bank and IMF, the United States decided to remove sanctions against Kenya.

3.1 GDP per capita's analysis

Table 3.1. RMSE and R-squared

Treated Unit:	***102***	***Treatment Time:***	***1990***
Mean Absolute Error	3.28%	Number of Control Units	18
Mean Squared Error	0.20%	Number of Covariates	6
Root Mean Squared Error	4.42%	R-squared	0.95141

The number of units included in this analysis are eighteen, this because after many simulations we have decided to trim the original donor pool, composed by more than eighteen units, to reach a higher fit. Like we can see from Table 3.1, the R-squared is good and the RMSE is low.

Table 3.2. Predictor balance in the pre-treatment periods:

Covariate	***V.weight***	***Treated***	***Synthetic Control***		***Average Control***	
			Value	**Bias**	**Value**	**Bias**
trade_op	0.1748	60.2385	60.2349	-0.01%	53.4519	-11.27%
mil_exp_gdp	0.4696	2.4917	2.4927	0.04%	2.2966	-7.83%
ln_fdi_2015	0.0595	18.2009	18.2047	0.02%	17.3308	-4.78%
ln_popul	0.2952	16.4151	16.4166	0.01%	15.5311	-5.39%
ln_gdp_pc_2015(1977)	0.0008	7.0463	7.0606	0.20%	6.9938	-0.75%
ln_gdp_pc_2015(1981)	0.0002	7.1247	7.0921	-0.46%	7.0185	-1.49%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.

"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.
"Average Control" is the simple average of control units in the donor pool with equal weights.

The variables chosen to conduct the analysis are trade openness, military expenditure in percentage to GDP, the logarithm of FDI, the logarithm of the total population and two lagged periods to increase the fit and reduce the possible interpolation bias. In terms of bias, Table 3.2 shows us that for our synthetic control is very low compared to the average control.

Table 3.3. Optimal Unit Weights:

Unit	***U.weight***
90	0.313
48	0.213
26	0.176
153	0.133
84	0.088
144	0.059
171	0.006
21	0.002
31	0.002
86	0.001
32	0.001
168	0.001
217	0.001
24	0.001
75	0.001
145	0.001
119	0.001

Note: The unit 46 in the donor pool gets a weight of 0.

After reducing the donor pool, we are left with the units that look most like Kenya. Among them we have, in descendent order, that the first six countries have an important weight in the composition of our Synthetic Control, that is India, Cote d'Ivoire, Botswana, Papua New Guinea, Guyana, Niger. While the others: Sierra Leone, Benin, Burkina Faso, Honduras, Burundi, Senegal, Zimbabwe, Bolivia, Ghana, Nigeria, Madagascar. Here the interpolation bias should be very low because the vast majority of these countries are close to Kenya.

Table 3.4. Prediction results in the post-treatment periods:

Time	*Actual Outcome*	*Predicted Outcome*	*Treatment Effect*
1990	7.1567	7.1654	-0.0086
1991	7.138	7.174	-0.0361
1992	7.0977	7.1946	-0.0969
1993	7.0697	7.2176	-0.1479
1994	7.065	7.2381	-0.1731
1995	7.0782	7.2656	-0.1873
1996	7.0897	7.3089	-0.2192
1997	7.066	7.3341	-0.2681
1998	7.0704	7.3409	-0.2705
1999	7.0655	7.3706	-0.3051
Mean	7.0897	7.261	-0.1713

Note: The average treatment effect over the post-treatment periods is -0.1713.

Premise: To consider the effect that sanctions have had on the Kenyan economy would be wrong, because given the internal situation within the country and the reason why the sanctions were applied, which is to restore democracy, we have to consider the joint effect of sanctions and the situation within the country. That premise having been made; we can go on to consider the effect on GDP for Capita.

The average effect on the GDP per Capita is a decrease of about $227 per year. This result seems not too much, but if we consider that the average GDP per Capita in a year is around $1427 for the Synthetic Control, in the period 1990 – 1999, the decrease is close to 19%.

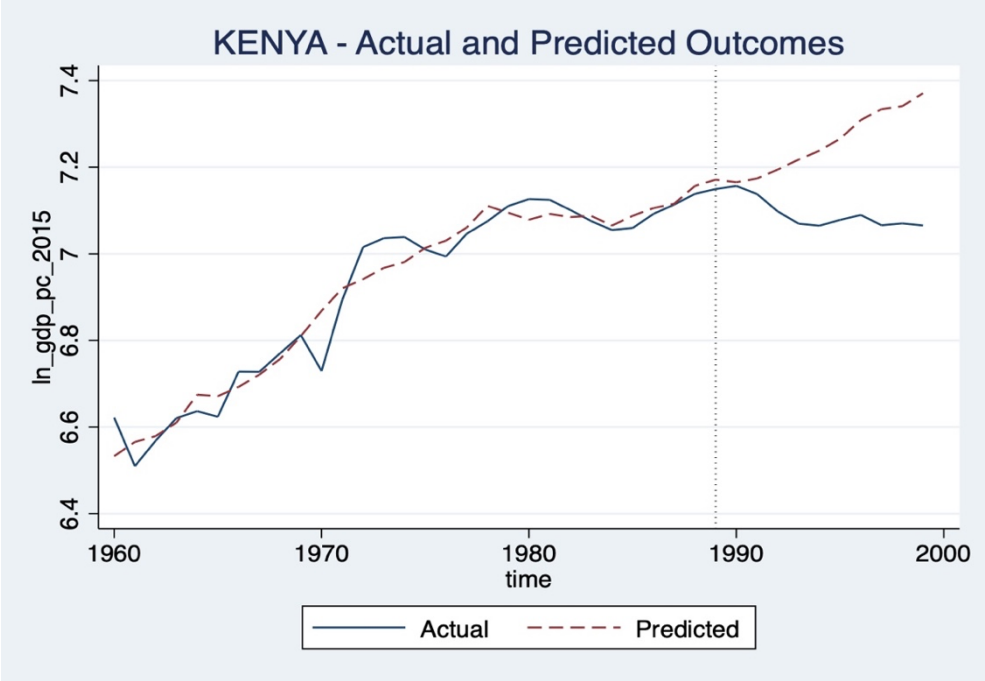

Figure 3.1. *Kenyan logarithm of GDP per Capita: Actual VS Predicted.*

3.1.1 Placebo Analysis

In the placebo analysis we are going to see whether the joint effect of sanctions and the internal situation inside the country have really sorted an effect on the GDP per Capita.

Table 3.5. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
102	0.002	0.0384	19.635	1
119	0.0119	0.1707	14.4022	6.0637
144	0.0337	0.1392	4.1298	17.2421
145	0.0158	0.0282	1.7886	8.0634
153	0.0046	0.1448	31.3076	2.3657
168	0.0276	0.0037	0.1339	14.0922
171	0.004	0.1035	25.6156	2.0661
21	0.0029	0.0316	10.9333	1.4786
217	0.0043	0.0127	2.9759	2.1846
24	0.0014	0.027	19.0419	0.7256
26	0.3919	0.5652	1.4422	200.4544
31	0.0281	0.0488	1.7386	14.3541
32	0.0053	0.0727	13.8167	2.6909
46	0.0202	0.0887	4.3899	10.3374
48	0.0056	0.1008	18.0718	2.8517
75	0.0125	0.1363	10.9335	6.3745
84	0.071	0.3355	4.7227	36.3376
86	0.0041	0.005	1.197	2.1222
90	0.0041	0.0864	21.1439	2.0913

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 102's is 0.2105.

(2) Total 2 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 26 84.

Looking at table 3.5, we can see that the probability of obtaining a post/pre-treatment MSPE ratio as large as Kenya is 21%, so we cannot say that there has been an effect on the GDP per Capita. Two possible reasons: a bad specification in terms of variables or lack of data; no real effect on the GDP per Capita. This could also be due to the fact that the sanctions lasted relatively short, from 1990 to 1993, and from the fact that since the situation had already been unstable for several years, the economy had already internalized these shocks.

In this analysis we do not consider countries with pre-treatment MSPE 20 times larger than the treated unit, to avoid having strange results which may be unreliable in a placebo analysis.

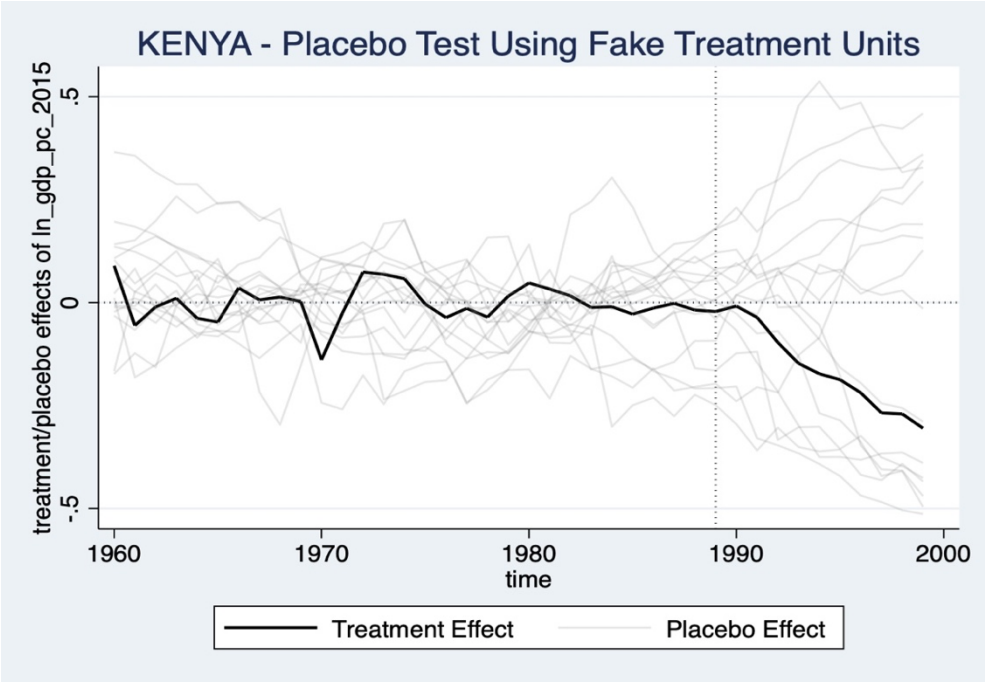

Figure 3.2. *Placebo test for the logarithm of GDP per Capita.*

We can clearly see that is not only Kenya to diverge after sanctions, but also the other countries and so we can reiterate what was said above.

3.2 Export analysis

In this analysis we can expect to find no obvious impact of sanctions, and this is justified by the fact that already the previous analysis showed no effect, as an impact on exports will most likely have an effect on GDP per capita.

Table 3.6. Export RMSE and R-squared

Treated Unit	***102***	***Treatment Time***	***1990***
Mean Absolute Error	0.05671	Number of Control Units	18
Mean Squared Error	0.00457	Number of Covariates	10
Root Mean Squared Error	0.06759	R-squared	0.6440

From Table 3.6, the first thing that we see is the very low R-squared. After having performed many simulations, this was the best trade-off. Trying to have a greater R-squared would have meant making some variables of zero significance in the construction of the synthetic control and others, specifically the lagged periods of the export entirely significant. That is, our synthetic control would have had to be based entirely only on past exports themselves and in doing so we would not have taken into account the other components that are part of the country, relying only on one.

Table 3.7. Predictor balance in the pre-treatment periods:

Covariate	*V.weight*	*Treated*	*Synthetic Control*		*Average Control*	
			Value	**Bias**	**Value**	**Bias**
ln_gdp_2015	0	23.7083	23.2907	-1.76%	23.9202	0.89%
ln_gdp_pc_2015	0.0001	7.0757	7.2538	2.52%	7.5743	7.05%
ln_fdi_2015	0.4164	18.2286	18.2064	-0.12%	18.7402	2.81%
trade_op	0.009	59.3851	59.2745	-0.19%	51.4198	-13.41%
ln_industry_2015	0.3264	22.0592	22.0322	-0.12%	22.6749	2.79%
ln_imp_2015	0.0003	21.6	21.8589	1.20%	22.3231	3.35%
ln_exp_2015(1972)	0.0009	21.6229	21.5428	-0.37%	21.7596	0.63%
ln_exp_2015(1976)	0.2434	21.7423	21.7174	-0.11%	22.019	1.27%
ln_exp_2015(1983)	0.0027	21.7579	21.7918	0.16%	22.3466	2.71%
ln_exp_2015(1989)	0.0009	22.0624	22.0709	0.04%	22.6441	2.64%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.

"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.

"Average Control" is the simple average of control units in the donor pool with equal weights.

Among the variables taken into account to construct our synthetic control, we have the logarithm of GDP, the logarithm of GDP per Capita, the logarithm of Foreign Direct Investments Inflows (FDI inflows), Trade Openness, the logarithm of the total value produced by mining, manufacturing, construction, electricity, water, and gas, the logarithm of import and four lagged periods to increase the fit.

The value of the bias for our synthetic control is good and the importance of the others non lagged variables, so their weight, is non indifferent compared to the lagged ones.

Table 3.8. Optimal Unit Weights:

Unit	**U.weight**
24	0.4760
134	0.143
121	0.115
195	0.09
91	0.084
163	0.077
178	0.006
31	0.005
35	0.002
155	0.001

Note: The unit 57 58 59 69 86 128 154 168 in the donor pool get a weight of 0.

The weights that compose our Synthetic Control, in descendent order of importance, are the following: Bolivia, Morocco, Colombia, Togo, Indonesia, Rwanda, South Africa, Burkina Faso, Cameroon, Peru. There could be the presence of interpolation bias due the presence of Colombia, Indonesia, and Burkina Faso. Trying to reduce even more this latter one, reducing at the same time the donor pool, means having a R-squared so low to be difficult trying to extrapolate a conclusion about the Kenyan Export.

Table 3.8. Prediction results in the post-treatment periods:

Time	**Actual**	**Outcome**	**Predicted Outcome**
1990	22.2657	22.1534	0.1123
1991	22.2532	22.2198	0.0334
1992	22.2453	22.2302	0.0151
1993	22.5193	22.2554	0.2639
1994	22.5077	22.2932	0.2145
1995	22.428	22.368	0.0600
1996	22.4726	22.4473	0.0253
1997	22.36	22.4801	-0.1201
1998	22.31	22.5291	-0.2191
1999	22.3987	22.4841	-0.0854
2000	22.41	22.5968	-0.1868
Mean	22.3791	22.3689	0.0103

Note: The average treatment effect over the post-treatment periods is 0.0103.

Looking at table 3.8, is very clear the fact that we have a mixed effect. After the release of sanctions seems that the Kenyan Export increase even more with respect to its Synthetic Control and then decrease. On average the joint effect of the internal situation and of sanctions is zero.

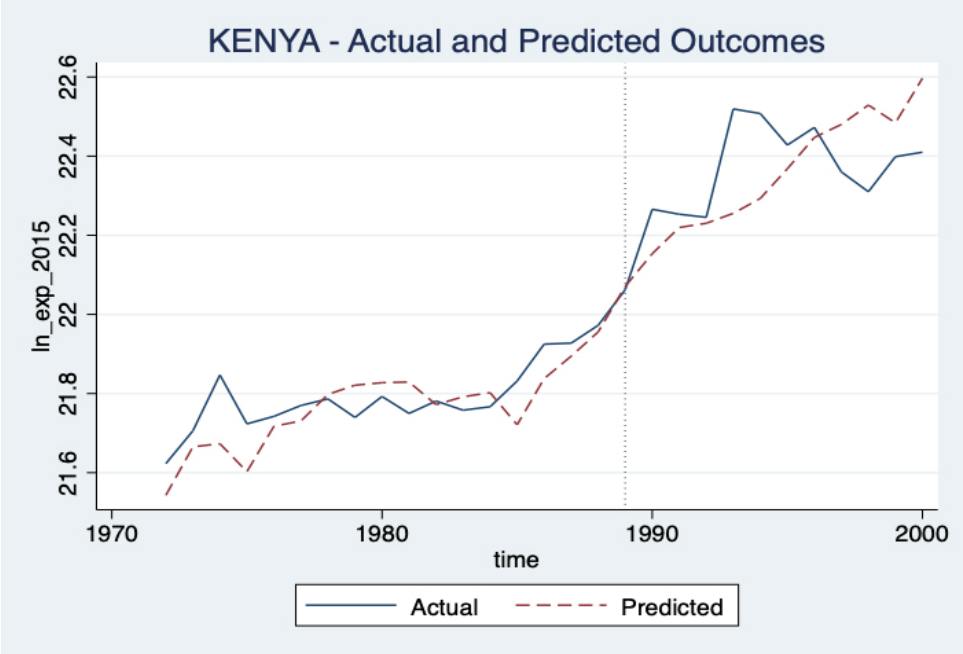

Figure 3.3. *Kenyan logarithm of Export: Actual VS Predicted.*

Figure 3.3 shows us not only that the fit is not perfect, but also that we do not have any effect. If in an attempt to increase the fit, we wanted to build our synthetic control taking only the lagged variables of the export, from 1972 to 1989, and leaving the others apart what we obtain is this following graph. This only to see where we ended up when the R-squared increase dramatically up to 96%.

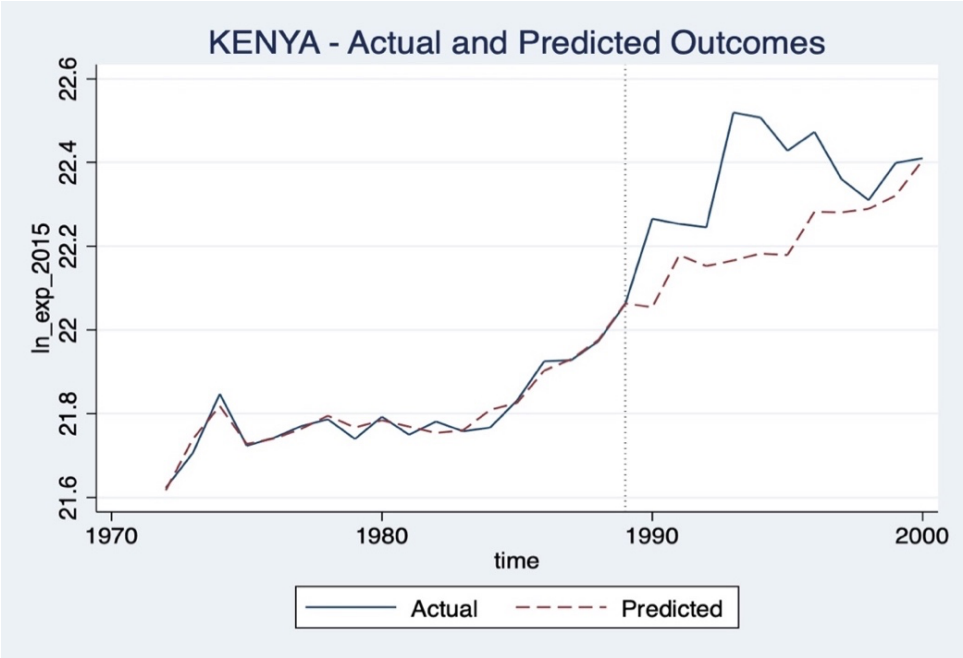

Figure 3.3. *Kenyan logarithm of Export (all lags): Actual VS Predicted***.**

What we find is that Kenya seems to increase the export after the imposition of sanctions, instead of experiencing a decrease in this latter one. This is a clear sign that from the placebo we can expect a negative result.

3.2.1 Placebo analysis

Returning to our analysis, where we have our six variables inherent in different sectors of the economy and four lagged variables, let us see if what we expect, namely a placebo with a negative outcome, materializes.

Table 3.9. Placebo test results using fake treatment units:

Unit	***Pre MSPE***	***Post MSPE***	***Post/Pre MSPE***	***Pre MSPE of Fake Unit/Pre MSPE of Treated Unit***
102	0.0046	0.0217	4.7458	1
121	0.0193	0.3677	19.0814	4.2182
128	0.0774	0.0440	0.5684	16.9478
134	0.0183	0.0189	1.0325	3.9967

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
154	0.2089	1.8052	8.6435	45.7117
155	0.0126	0.0166	1.3250	2.7488
163	0.3447	1.7222	4.9958	75.4516
168	0.0659	0.0759	1.1519	14.4235
178	0.0204	0.0136	0.6693	4.4609
195	0.0154	0.0647	4.2104	3.3624
24	0.0436	0.0053	0.1223	9.5470
31	0.0257	0.5014	19.4987	5.6283
35	0.0449	0.0155	0.3458	9.8206
57	0.0350	0.0373	1.0661	7.6635
58	0.0519	0.0492	0.9484	11.3542
59	0.0179	0.0411	2.3000	3.9139
69	1.9234	0.8940	0.4648	420.9830
86	0.0109	0.0090	0.8276	2.3894
91	0.0115	0.0666	5.8093	2.5091

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 102's is 0.3158.

(2) Total 3 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values,

including 154 163 69.

As it was intended to prove, our placebo is negative: that is, the probability of obtaining a post/pre-treatment MSPE ratio as large as Kenya is around 31%. As for the other cases we have excluded countries with pre-treatment MSPE 20 times larger than the treated unit.

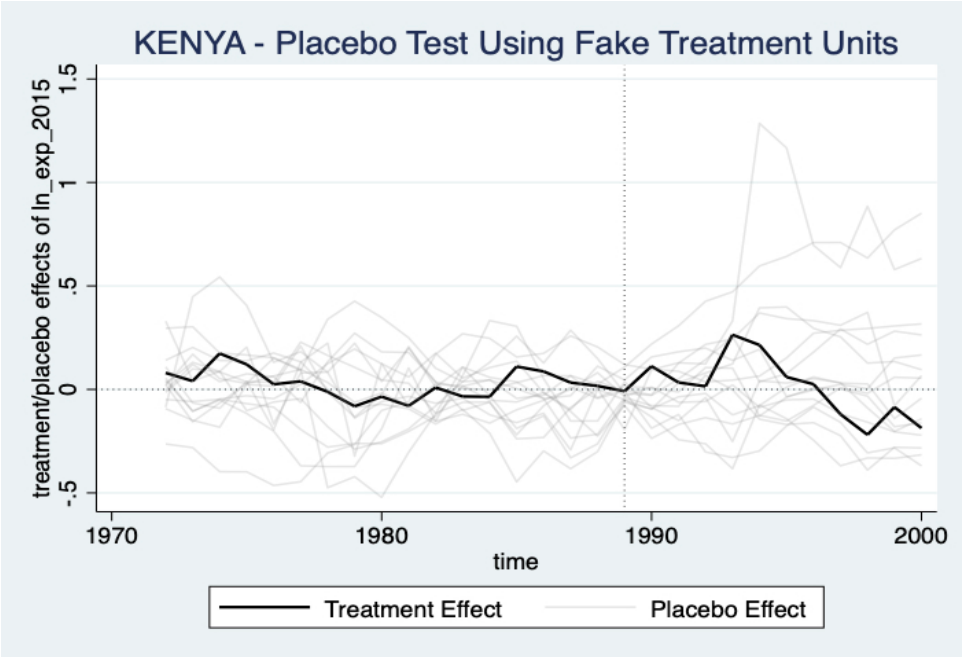

Figure 3.4. *Placebo test for the logarithm of the Export*

Chapter 4 – Nicaragua

4.1 Nicaragua's history and causes that led to sanctions

The history of Nicaragua and the causes that led it to be subject to sanctions has roots in the past: the close relations that had accompanied the Somoza family and the United States culminated in a breakup.

In 1936, with the help of the U.S., Anastasio Somoza Garcià seized power and set about to turn Nicaragua into a dictatorship. After his victory, he began diligently consolidating his power within the National Guard, which he had headed until before his election, in order to adhere to the constitutional requirements to run for president. Members of his family and trusted friends were given key positions within both the government and the army. The Somoza family also controlled the *Partido Liberal Nacionalista (PLN)*, which in turn controlled the legislature and the judiciary, thus giving Somoza absolute power in any sphere. Opposition was allowed as long as it did not threaten the government elite. Before 1938, he managed to appoint a Constituent Assembly that would give him additional powers and keep him in office for an additional eight years. Among this extension of power was precisely to decree laws concerning the National Guard without consulting Congress, thus ensuring absolute control over the state and the military. All this provided the basis for a permanent dictatorship.

Somoza was succeeded by his two sons, Luis Somoza Debayle and his brother Anastasio Somoza Debayle. The latter was very close to the United States, Anastasio having graduated from the military academy at West Point, New York State.

At first, taking the reins of the country after his father's death was Luis, who found himself having to fight the revolutionaries, already greatly strengthened by the Cuban Revolution, which provided hope and inspiration, as well as weapons and funding. The rebels, operating from Costa Rica formed the Frente Sandinista de Liberacion Nacional (FSLN), which became known as the Sandinistas, named after Augusto César Sandino. Again, the United States was instrumental in defeating the guerrillas by supporting the Somoza's family.

Following heavy pressure from the rebels, in February 1963, President Luis Somoza Debayle decided that national elections would be held. The opposition was very skeptical about the promises made by the then president and in fact the dictatorship eventually continued. Upon Luis's death, the government passed into the hands of Anastasio.

The Somoza family not only had dealings with the U.S. government, but also with several U.S. companies, including the Nicaraguan Long Leaf Pine Company (NIPCO), a company that paid millions of dollars to the Somozas in exchange for benefits for the company.

A first rupture began in 1972, with the Mangua earthquake, which killed more than 10,000 people and left more or less 500,000 homeless. Following this disastrous event, various international aid was sent, a good chunk of which ended up in the hands of Somoza and the National Guard. The fact that the funds allocated for the reconstruction of downtown Managua were never really used for the purpose for which they were intended infuriated Nicaraguans. The Sandinistas exploited the discontent within the country to revitalize their power, this time supported by Cuba and the Soviet Union.

In 1974, a group composed by nine warriors of the FSLN (Frente Sandinista de Liberación Nacional) killed an Ex-Agriculture's minister and three guards. The incident humiliated the government and greatly enhanced the prestige of the FSLN. Somoza reacted violently after one of his friends was taken hostage and executed. Martial law was declared, and the National Guard began razing villages suspected of helping the rebels. Human rights groups condemned the actions, but US President Gerald Ford refused to break the alliance with the Samoza, which instead his successor, Jimmy Carter, did.

The US knew that the Somoza were unpopular, so they pursued a policy of *Somozism without Somoza*, in order to destabilize the regime of Samoza and improving human right but trying to prevent power from falling into the hands of the FSLN, as it is strongly ideologically connected and supported by the Soviet Union. In 1977, United States imposed a series of sanctions affecting export, the financial and the military sector. The sanctions were lifted in 1979, when the Somoza government collapsed. The United States helped Somoza and the National Guard commanders escape, and the rebels advanced victoriously into the capital.

The United Nations estimated the material damage produced by the Revolutionary War at $480 million.

4.2 GDP per capita's analysis

Table 4.1. RMSE and R-squared

Treated Unit:	***143***	***Treatment Time:***	***1977***
Mean Absolute Error	0.02475	Number of Control Units	33
Mean Squared Error	0.00089	Number of Covariates	8
Root Mean Squared Error	0.02975	R-squared	0.95417

In terms of Root Mean Squared Error (RMSE) the Nicaraguan analysis of the GDP per capita presents is very low, while the R-squared here results to be high, around 95,4%. In this case, as opposed to the Iranian GDP per Capita analysis we have an higher fit, that is due to the data factor, in fact for Nicaragua we were able to include many more countries similar to this latter one in our synthetic control.

Table 4.2. Predictor balance in the pre-treatment periods:

Covariate	***V.weight***	***Treated***	***Synthetic***	***Control***	***Average***	***Control***
			Value	Bias	Value	Bias
trade_op	0.8266	59.2856	59.3266	0.0007	54.8752	-0.0744
ln_fdi_2015	0.0767	18.1084	18.1082	0.0000	18.1352	0.0015
ln_popul	0.0000	14.6334	15.3047	0.0459	15.7274	0.0748
ln_military_exp_2015	0.0000	18.4459	19.1535	0.0384	19.5448	0.0596
ln_gdp_pc_2015(1960)	0.0031	7.4271	7.4408	0.0018	7.2427	-0.0248
ln_gdp_pc_2015(1968)	0.0300	7.7761	7.7688	-0.0009	7.4214	-0.0456
ln_gdp_pc_2015(1973)	0.0062	7.8139	7.8525	0.0049	7.5785	-0.0301
ln_gdp_pc_2015(1976)	0.0575	7.9031	7.9026	-0.0001	7.6690	-0.0296

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.
"Average Control" is the simple average of control units in the donor pool with equal weights.

From table 4.1 we can see the variables that we have wanted to use, specifically the Trade Openness, the logarithm of Foreign Direct Investment, the logarithm of the total population, the logarithm of the military expenditure and four lagged GDP per capita periods.
Looking at the weights that make up our synthetic control, we can see how the trade openness variable takes on a fairly prominent role having a weight of 80 percent of the total. It is also important to note how the two variables logarithm of population and logarithm of military expenditure do not contribute to the formation of our synthetic control, having a weight equal to zero and a bias greater than the other variables, around 4% versus a bias around 0.

Table 4.3. Optimal Unit Weights:

Unit	*U.weight*
195	0.379
155	0.287
54	0.213
16	0.05
84	0.037
71	0.034

Note: The unit 21 31 32 35 43 46 48 57 58 59 68 75 86 91 102 119 121 128 143 158 163 171 172 180 186 188 190 193 in the donor pool get a weight of 0.

Among those countries that contribute to the formation of our Synthetic Control we find, in descendent order of importance Togo, Peru, Denmark, Bangladesh, Guyana and Gabon. One of these countries can cause interpolation bias, that is Denmark. But what happen in the analysis is that removing it cause a reduction in the R-squared of 3%, going from 95,4% to around 93%. So, if we accept to have some little degree of interpolation bias, we are able to increase the fit.

Table 4.4. Prediction results in the post-treatment periods:

Time	*Actual Outcome*	*Predicted Outcome*	*Treatment Effect*
1977	7.9527	7.9100	0.0427
1978	7.8406	7.9210	-0.0803
1979	7.5031	7.9023	-0.3992
1980	7.5189	7.9505	-0.4316
1981	7.5426	7.9357	-0.3931
1982	7.5065	7.9011	-0.3946
1983	7.5246	7.8321	-0.3075
1984	7.4829	7.8517	-0.3688
1985	7.4165	7.8661	-0.4497
1986	7.3827	7.8882	-0.5054
1987	7.3533	7.8923	-0.5391
1988	7.1986	7.8724	-0.6738
Mean	7.5186	7.8936	-0.3750

Note: The average treatment effect over the post-treatment periods is -0.3750.

Observing the prediction result in Table 4.4, for the 1977 we do not have a negative effect and so given that we do not know precisely in which period of the year these sanctions have been released, if at the beginning, in the middle or at the end, we do not take it into account for our post-treatment result. In analysis this results we need to point out that given that Nicaragua was affected by disorders during that period between Somoza and the Sandinistas, we have to

consider a joint effect effect of the sanctions and the situation that had arisen in the country. The average effect year by year on the GDP per Capita was minus $ 886.30.

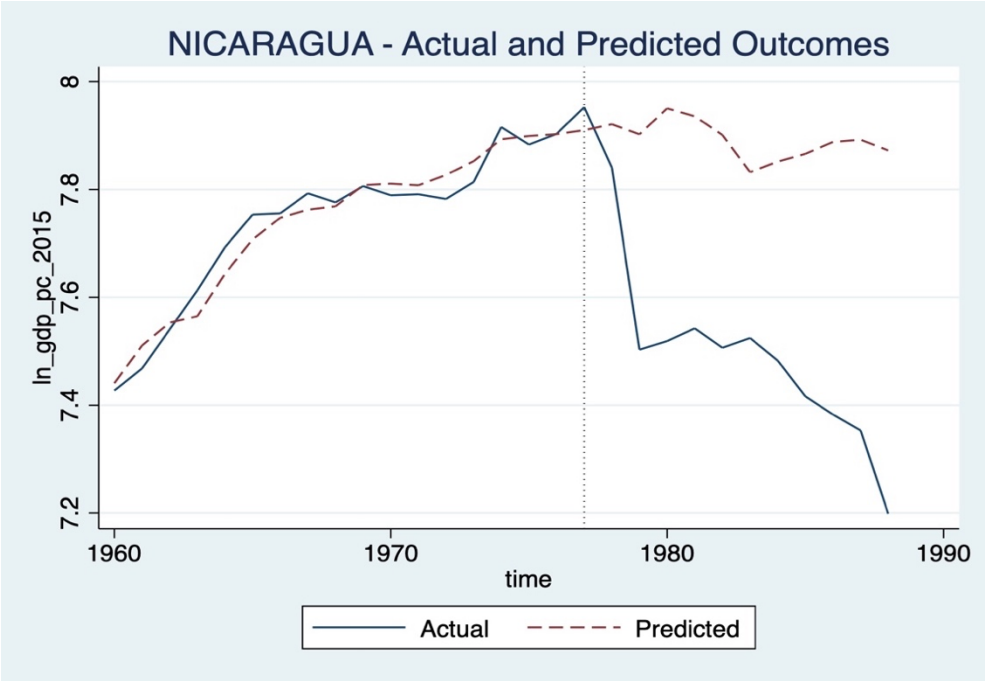

Figure 4.1. *Nicaragua logarithm of GDP per Capita: Actual VS Predicted.*

4.2.1 Placebo analysis

To understand whether there has been a real effect on the GDP per Capita caused by these two events we need to run the placebo analysis.

Table 4.4. Placebo test results using fake treatment units:

Unit	***Pre MSPE***	***Post MSPE***	***Post/Pre MSPE***	***Pre MSPE of Fake Unit/Pre MSPE of Treated Unit***
143	0.0009	0.1748	197.4224	1
102	0.0030	0.0286	9.4989	3.3984
119	0.0010	0.0539	53.4562	1.1400
121	0.0005	0.0067	13.3079	0.5670
128	0.0005	0.0095	19.2779	0.5564
155	0.0006	0.0383	66.9160	0.6458
158	0.0022	0.0125	5.7544	2.4547
16	0.0083	0.0049	0.5856	9.3842
163	0.0063	0.0084	1.3454	7.0780
171	0.0005	0.0069	14.8023	0.5272
172	0.0058	0.2161	37.4253	6.5222
186	0.0053	0.0892	16.6891	6.0352
188	0.0005	0.0034	6.8754	0.5648
190	0.0052	0.0202	3.8587	5.9031
193	0.0019	0.0938	49.4828	2.1425
195	0.0058	0.1291	22.3415	6.5294
21	0.001	0.0534	55.4729	1.0872

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
31	0.0217	0.0362	1.6666	24.5204
32	0.005	0.0059	1.1794	5.6524
35	0.0021	0.2689	127.1829	2.3881
43	0.0001	0.0016	17.5415	0.1052
46	0.0011	0.1241	116.6073	1.2027
48	0.0016	0.0456	28.3765	1.8163
54	0.0111	0.0187	1.6848	12.5328
57	0.0028	0.014	5.0857	3.1202
58	0.0007	0.0043	6.4164	0.7636
59	0.0019	0.076	40.8273	2.1034
68	0.0003	0.0024	8.6553	0.3192
71	0.0249	0.1889	7.5784	28.1549
75	0.0029	0.0043	1.5071	3.2499
84	0.002	0.0664	33.3534	2.2485
86	0.001	0.0062	6.0024	1.1719
91	0.0013	0.041	31.2269	1.4822

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 143's is 0.0294.

(2) Total 2 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 31 71.

The placebo analysis from Table 4.4 tells us that the probability of obtaining a post/pre-treatment MSPE ratio as large as Nicaragua is 0.0294, meaning that there has been an effect after these two events. So, what is called a sort of p-value for the Synthetic control has noted an effect different from zero. In addition, we have deleted units with a pre-treatment MSPE 20 times larger than the treated unit, to avoid having strange pattern in our graph that can be ignored.

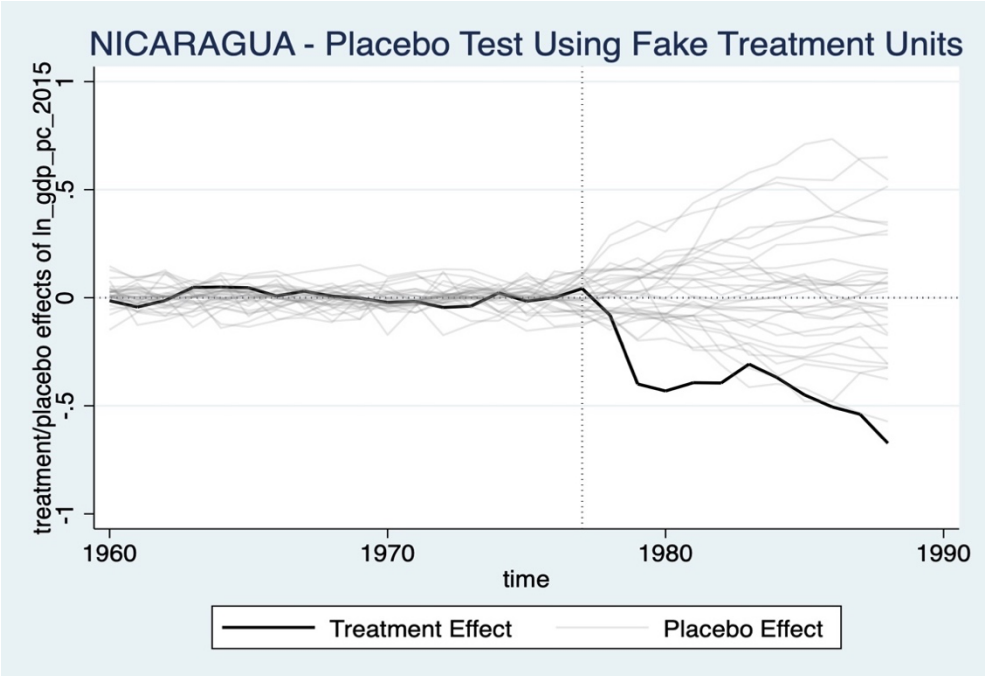

Figure 4.2. *Placebo Test for Nicaraguan GDP per Capita.*

4.3 Export analysis

Table 4.4. RMSE and R-squared

Treated Unit:	***143***	***Treatment Time***	***1977***
Mean Absolute Error	0.09061	Number of Control Units	24
Mean Squared Error	0.01185	Number of Covariates	8
Root Mean Squared Error	0.10887	R-squared	0.92632

The RMSE for the Export is low and acceptable while the R-squared seems to be not so high, but good enough to see the evolution of the Export versus its Synthetic Control. Twenty-four countries were used for export estimation and this to reduce as much as possible the interpolation bias.

Table 4.5. Predictor balance in the pre-treatment periods:

Covariate	***V.weight***	***Treated***	***Synthetic Control***		***Average Control***	
			Value	Bias	Value	Bias
trade_op	0.1057	59.2856	59.1537	-0.22%	49.7862	-16.02%
ln_fdi_2015	0	18.1084	17.655	-2.50%	18.1376	0.16%
ln_gdp_pc_2015	0	7.7356	7.0292	-9.13%	7.2723	-5.99%
ln_imp_2015	0.2419	20.5711	20.5508	-0.10%	21.186	2.99%
ln_exp_2015(1963)	0.0005	20.0038	19.9483	-0.28%	20.8205	4.08%
ln_exp_2015(1968)	0.0032	20.3556	20.34	-0.08%	21.2116	4.21%
ln_exp_2015(1976)	0.6488	20.8508	20.8288	-0.11%	21.7444	4.29%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.
"Average Control" is the simple average of control units in the donor pool with equal weights.

The variables selected for this analysis are Trade Openness, the logarithm of Foreign Direct Investment Inflows (FDI), the logarithm of the GDP, the logarithm of the GDP per Capita, the logarithm of import and four lagged period to increase the fit. The first think that we can notice are the zero weights for FDI, ln GDP and GDP per Capita. Seems that in this analysis their importance in building the synthetic control is null, while results to be much more important the trade openness, import and the lagged period before the application of sanctions. The biases is low, but results a bit high for GDP per Capita.

Table 4.6. Optimal Unit Weights:

Unit	*U.weight*
46	0.378
119	0.258
163	0.098
58	0.067
47	0.038
21	0.034
64	0.024
35	0.012
102	0.011
77	0.009
168	0.008
181	0.008
43	0.008
134	0.008
155	0.006
57	0.005
128	0.005
121	0.004
186	0.004
86	0.004
193	0.004
71	0.003
91	0.002
195	0.001

Note: The unit 143 in the donor pool get a weight of 0.

There is a lot to say about Table 4.5. First of all, we can see that all the units have been used in the estimation the Synthetic Control, even if starting from Costa Rica (47), the contribution to the estimation is very low. Among the first four units we have, in descendent order of importance, the Democratic Republic of Congo, Madagascar, Rwanda and Ecuador. The most worrying this is that in the estimation has been used all the units, causing a potentially huge interpolation bias. One thing that can be done in reducing the interpolation bias is to lose some degree of fit, so reduce our R-squared.

Table 4.7. RMSE and R-squared

Treated Unit:	***143***	***Treatment Time:***	***1977***
Mean Absolute Error	0.09628	Number of Control Units	24
Mean Squared Error	0.01257	Number of Covariates	8
Root Mean Squared Error	0.11213	R-squared	0.9103

Table 4.8. Optimal Unit Weights:

Unit	*U.weight*
46	0.365
119	0.269
47	0.17
163	0.093
58	0.063
35	0.029
181	0.004
21	0.001
43	0.001
134	0.001
102	0.001

Note: The unit 57 64 71 77 86 91 121 128 155 168 186 193 195 in the donor pool get a weight of 0.

After having performed many simulations, having changed the starting point in the V.weight matrix, Table 4.5; we can observe from the tables above, Tables 4.7 and 4.8, that the possibility of having an high interpolation bias has been reduced but at a cost: a lower fit, so a lower R-squared.

Now we can compare the two estimated effect for the Synthetic Control with a possible high interpolation bias and the one in which this latter one has been reduced.

Table 4.9. Prediction results in the post-treatment periods:

Time	**Actual Outcome**	**Predicted Outcome**	**Treatment Effect**
1977	20.8223	20.8417	-0.0194
1978	20.9087	20.956	-0.0473
1979	21.0436	21.0478	-0.0042
1980	20.5227	21.0317	-0.509
1981	20.6614	21.0166	-0.3552
1982	20.5775	21.0201	-0.4426
1983	20.6458	21.0503	-0.4045
1984	20.4124	21.1946	-0.7822
1985	20.288	21.2004	-0.9124
1986	20.094	21.1894	-1.0954
1987	20.0718	21.2181	-1.1463
1988	20.0369	21.2491	-1.2122
Mean	20.5071	21.0847	-0.5776

Note: The average treatment effect over the post-treatment periods is -0.5776.

Starting from 1978, for the case with high interpolation bias we have an average effect of minus $650,232,434.08, around 650 million dollars per year.

Table 4.10. Prediction results in the post-treatment periods:

Time	*Actual Outcome*	*Predicted Outcome*	*Treatment Effect*
1977	20.8223	20.8072	0.0151
1978	20.9087	20.9304	-0.0217
1979	21.0436	21.0094	0.0342
1980	20.5227	20.9701	-0.4474
1981	20.6614	20.9603	-0.2989
1982	20.5775	20.9647	-0.3872
1983	20.6458	21.0029	-0.3571
1984	20.4124	21.1583	-0.7459
1985	20.288	21.1584	-0.8704
1986	20.094	21.147	-1.053
1987	20.0718	21.1905	-1.1187
1988	20.0369	21.233	-1.1961
Mean	20.5071	21.0443	-0.5372

Instead, as we can see from Table 4.10, for the case in which we have reduced the interpolation bias, the effect is less severe with a loss per year of $592,350,835.38, around 592 million dollars per year.

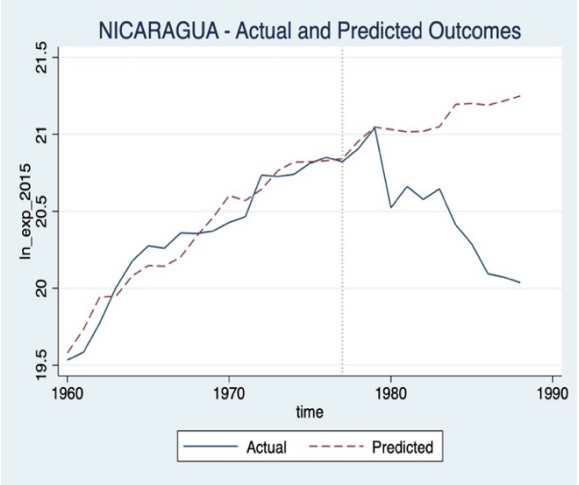

Figure 4.3. *Synthetic Control - high interp. bias*

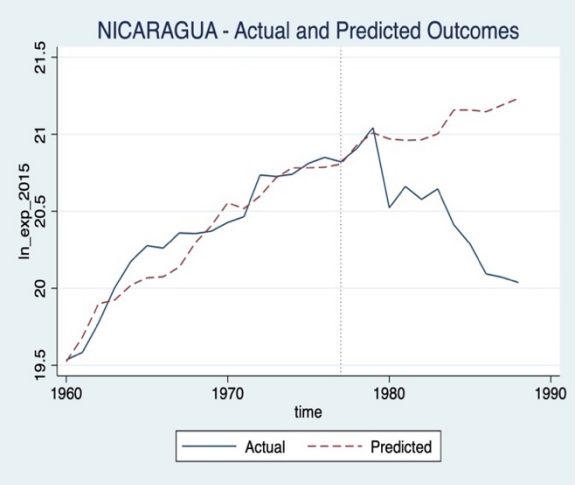

Figure 4.4. *Synthetic Control – reduced interp. bias*

Now we can look at the two graphs for having a comparison of the trajectories in the two cases. In figure 4.3 we have a greater fit in respect to Figure 4.4, and we can see it looking at the years 1960 – 1970.

4.3.1 Placebo analysis

To deeply understand if the joint effect of sanctions and revolution have had an effect, we run a placebo analysis, but at the same time we want to compare the placebo for the case with high interpolation bias and for the reduced interpolation bias, in order to know whether there are different results.

Table 4.11. Synthetic Control - high interp. Bias. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
143	0.0119	0.5146	43.4143	1
102	0.0036	0.0357	9.9081	0.3038
119	0.023	0.3816	16.6192	1.937
121	0.0029	0.2476	85.7637	0.2436
128	0.0373	0.7215	19.3649	3.1432
134	0.0057	0.0219	3.8247	0.4821
155	0.0233	0.2467	10.5697	1.9692
163	0.9912	0.7811	0.788	83.6251
168	0.0086	0.0689	8.0074	0.7255
181	0.0116	0.1121	9.6977	0.9754
186	0.0106	0.1696	16.0492	0.8913
193	0.004	0.0528	13.1008	0.34
195	0.0404	0.1604	3.9675	3.4117
21	0.082	0.0613	0.7478	6.916
35	0.0034	0.2965	86.4302	0.2894
43	0.0024	0.0213	8.8966	0.2024
46	0.0233	0.1483	6.3514	1.9694
47	0.0085	0.0424	4.9861	0.7169
57	0.0166	0.0299	1.8073	1.3966
58	0.0782	0.0205	0.2622	6.596
64	0.044	0.226	5.1345	3.7136
71	0.0245	0.0636	2.5985	2.0661
77	0.0079	0.02	2.5433	0.6627
86	0.0031	0.0591	18.9627	0.2631
91	0.0528	0.4772	9.0345	4.4559

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as NICARAGUA is 0.1200.
(2) Total 1 unit with pre-treatment MSPE 20 times larger than the treated unit are excluded, including 163.

From Table 4.11, we have that the post/pre-treatment MSPE ratio is 12%, so very high with respect to the acceptance rate of 5%. In this case we cannot conclude that a significant difference exists. In addition, we have deleted value with a pre-treatment MSPE 20 larger than the treated unit, to exclude strange results.

Table 4.12. Synthetic Control – reduced interp. bias. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
143	0.0126	0.4728	37.6004	1
102	0.0056	0.0247	4.431	0.4437
119	0.039	0.4032	10.3412	3.1009
121	0.0058	0.1952	33.9216	0.4577
128	0.0373	0.7265	19.4962	2.9636
134	0.0093	0.0309	3.3164	0.7417
155	0.0235	0.2276	9.6969	1.8667
163	0.9912	0.7811	0.788	78.8299
168	0.0118	0.0547	4.6371	0.9374
181	0.021	0.0732	3.4921	1.6669
186	0.0226	0.2885	12.791	1.7937
193	0.0163	0.1169	7.1625	1.2979
195	0.0658	0.1148	1.7437	5.2343
21	0.082	0.0606	0.7388	6.5198
35	0.0237	0.7097	29.9741	1.883
43	0.0069	0.03	4.3348	0.5502
46	0.0427	0.2965	6.9473	3.394
47	0.0219	0.2732	12.4841	1.7401
57	0.0261	0.0446	1.7108	2.0732
58	0.0813	0.0164	0.2015	6.4638
64	0.1083	0.3953	3.6494	8.6145
71	0.0272	0.0725	2.6708	2.16
77	0.0116	0.016	1.3874	0.9198
86	0.0057	0.0273	4.825	0.4503
91	0.0686	0.3311	4.8248	5.4578

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as NICARAGUA is 0.0400.

(2) Total 1 units with pre-treatment MSPE 20 times larger than the treated unit are excluded, including 163.

Different results have been obtained for the synthetic control in which we have reduced the interpolation bias, with a post/pre-treatment MSPE ratio of 4%. Here we can conclude to reject the null hypothesis. Even for this placebo we left out units with a pre-treatment MSPE 20 times larger than the treated unit.

These two different conclusions could be explained by the reduced interpolation bias. Using the entire donor pool is not good and this could lead to different results when we adjust the model, allowing a reduction in the R-squared in exchange to a reduction in the interpolation bias.

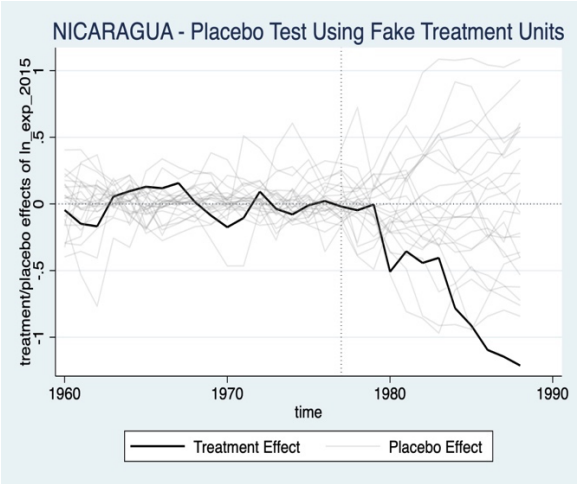

Figure 4.5. *Synthetic Control - high interp. bias.*

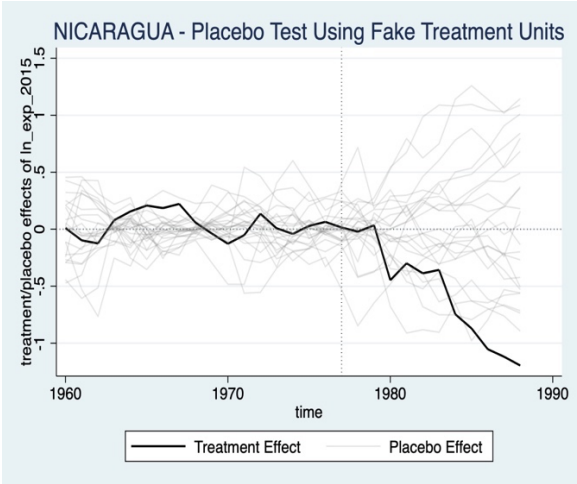

Figure 4.6. *Synthetic Control – reduced interp. bias*

In Figure 4.5, after the treatment period is noticeable a greater dispersion with respect to Figure 4.6, reflecting the results that we have discussed above.

Chapter 5 – Russia

5.1 Russia's history and causes that led to sanctions

Russian history is quite troubled and in particular to understand how the 2014 sanctions came about, one has to go back a few decades, specifically to the early 1990s, just after the fall of the Berlin Wall and the dissolution of the USSR. In 1991, with the dissolution of the USSR 15 of these Soviet republics became sovereign states again, specifically we are talking about: Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan. Russia, at that time had fallen into a deep crisis, so much so that it received humanitarian aid in terms of food. Russia had lost its title as a superpower gained in World War II, and in the hearts of Russians and those who had lived through the golden age of the USSR there was a feeling of revenge, of wanting to be a major player again. After the financial crisis of 1998, in 2000, Yeltsin (the then president of the Russian Federation) who was at the end of his political career, decided to resign, leaving the government in the hands of Prime Minister Vladimir Putin, a former KGB officer and current head of the FSB (which performed the same tasks previously performed by the KGB). In the same year Putin had managed to defeat his political opponent and win the presidential election. Putin, who had lived through the USSR's era of greatness had a different approach than his predecessors, creating a system of guided democracy through the subjugation of parliament, repression of the media, and placing major oil companies under state control.

It proves necessary to make mention of the Orange Revolution in Ukraine in order to fully understand what would happen next. In 2004, Kurchma who was president of Ukraine decided that he did not want to take part in the elections and run for president. Two major candidates emerged from the 2004 presidential election: Yanukovych, who was supported by both Kuchma and the Russian Federation, and Yushchenko, who was looking carefully at politics in the West and aimed at joining the EU. Yanukovych narrowly won, but Yushchenko and his supporters claimed that there had been fraud and that some Ukrainians (both voters and election officials) had been intimidated so that it cost him the election. A political crisis broke out after massive protests in the streets of Kyiv and other cities, the so-called Orange Revolution: the Supreme Court of Ukraine declared the elections null and void. The second round of elections saw Yushchenko as the winner. Russia sought to distance the satellite countries from a possible Atlanticist drift through political arrangements designed to keep the latter in check. A policy of indirect control through intimidation and bribery.

During Yushchenko's government, relations between Russia and Ukraine weakened and instead relations with the European Union strengthened.

In the 2010 elections, Yanukovych won against Tymoshenko, both candidates for Ukraine's presidency. During his tenure, Yanukovych and his party were accused are attempting to create a controlled democracy, and to block and sabotage Tymoshenko, his main political opponent. Just following what Putin had already done in his own country.

In 2013, President Yanukovych decided not to sign the Ukraine – European Union Association Agreemen, but instead tightened more relations with Russia and with the Eurasian Economic Union (an economic union of some post-soviet states located in Eurasia). This act sparked new protests on the streets of Kyiv. The protesters gathered at Maidan Nezalezhnosti, which literally means independence square. Between December 2013 and January 2014, Protestants began targeting various government buildings, first in Kyiv and later in western Ukraine. In February 2014, the protests erupted into a revolution, the *Dignity Revolution* also called *Maidan Revolution.* In February 2014, following strong protests, the Verkhovna Rada (the Ukrainian parliament) approved the agreement with the European Union, strongly opposed by Russia. The purpose of the protests was to lead to the resignation of President Yanukovych and the Azarov government. Protestants were tired of the growing corruption within the government and the abuse of power, the influence of the oligarchs, the brutality committed by the police and the violation of human rights in Ukraine.

On February 21, an agreement was signed between President Yanukovych and the opposition leader for the formation of a unity government in order to give the country adequate constitutional reforms and early elections. The next day Yanukovych fled the city and the parliament removed him from the post of president. Yanukobych claimed that parliamentary voting was illegal and asked the Russians for help. Russia considered the parliamentary gesture a coup and did not reconstitute the remaining government. In the same period there were several protests not only from the revolutionaries, but also from that slice of the pro-Russian population, which in 2010 had strongly supported the outgoing president. In particular, they were the eastern and southern areas. Such protests escalated into violence, as mentioned earlier in the southern and eastern regions. Meanwhile, the Russians decided to take a step forward and help the pro-Russians: on February 27, Russian troops captured strategic points in Crimea. Although the Russians initially denied their involvement in the operation, Putin later admitted that Russian troops were willing to support the pro-Russians. This led to the installation of a pro-Russian government and the declaration of independence of Crimea. Russia de facto annexed the crime on March 18, 2014.

Russia did not stop only in Crimea, but also helped pro-Russians in the eastern area, with the creation of the self-proclaimed separatist republics of Donetsk (Donetsk People's Republic - DPR) and Luhansk (Luhansk People's Republic - LPR), an event that fell into a war, that of the Donbas.

Former Secretary of United States Robert Zoellick said: “Putin does not see Ukraine as an independent and sovereign state,” he says. “He has a view of Russian history where the Rus [the medieval ancestors of the people who came to form Russia, Belarus, and Ukraine] began in Kyiv. He believes that they are all Russians, living in a greater Russia. And I think at age 69, Putin feels that this is a question not only of Russian history, but his place in Russian history.”

It is also curious to understand if Russia has started the preparation of this war before 2014. Russia probably already in 2013, expected that Ukraine would undergo a change of government, and so Putin and senior military officials may have been planning to increase military spending in anticipation of the eventual fall of the pro-Russian government and then an eventual invasion to reassert their influence. So, let's look at military spending as a percentage of government spending.

Figure 5.1. *Military expenditure (% of general government expenditure). Source: World Bank.*

Looking at Figure 5.3. we may think that Russia has probably allocated more resources to military spending than to social policies, going from 11.1% in 2013 to 11.8% in 2014. An increment of 0.7 percentage point, compared to 2012 – 2013 in which the increment was 0.3%,

in practice with an increase more than double. Another interesting graph might be the one regarding total armed forces personnel, to understand whether Russia amassed troops in preparation for the invasion.

Figure 5.2. *Armed forces personnel, total - Russian Federation. Source: World Bank.*

In the period 2013 – 2014, the increment was by 17,000 units more. One could argue that this increment is not huge, for sure, but it is still an increase, the first after 5 years of declining staffing levels.

5.1 GDP per capita's analysis

For the Russian case we have been able to have more similar countries to it, and this thanks to the availability of data from the World Bank. Starting from around 1995 the World Bank was able to access more data regarding developing countries, this probably due to an increasing importance of the financial markets and thus a greater need for investors to have more clarity about the data of the country issuing debt.

We decided to start precisely from 1995 as the starting point, not only because of the greater availability of data, but also because Russia immediately after the fall of the USSR in 1991 and thus its shrinkage in terms of territory, had suffered a not inconsiderable shock that would have created some matching problems in the analysis.

Figure 5.3. *Russian GDP growth. Source: World Bank. Source: World Bank.*

As we can see from Figure 5.1, the Russian Federation after the fall of the URSS has suffered a decrease in terms of GDP growth, going from -5% in 1991 to -12.6 in 1994. Only in 1995 there has been a sort of stabilization and a recovery in the country's growth.

Table 5.1. RMSE and R-squared

Treated Unit:	***162***	***Treatment Time:***	***2014***
Mean Absolute Error	0.02905	Number of Control Units	34
Mean Squared Error	0.00136	Number of Covariates	8
Root Mean Squared Error	0.03684	R-squared	0.98002

The Root Mean Squared Error is very low, around 3.6%, while the R-squared is very high, being around 98%. This is the best result among all the other countries we have analyzed so far, having a far higher fit than all the other countries surveyed.

Table 5.2. Predictor balance in the pre-treatment periods:

Covariate	*V.weight*	*Treated*	*Synthetic Control*		*Average Control*	
			Value	Bias	Value	Bias
trade_op	0.747	54.573	54.5047	-0.13%	79.444	45.57%
ln_fdi_2015	0.238	23.5892	23.5668	-0.10%	22.4323	-4.90%
ln_popul	0	18.7915	18.3598	-2.30%	16.4875	-12.26%
ln_military_exp_2015	0	24.2426	23.1515	-4.50%	21.7	-10.49%
ln_gdp_pc_2015(1995)	0.0001	8.4893	8.423	-0.78%	9.1156	7.38%
ln_gdp_pc_2015(2000)	0.0123	8.5799	8.5725	-0.09%	9.2625	7.96%
ln_gdp_pc_2015(2008)	0.0014	9.1153	9.0815	-0.37%	9.5542	4.81%
ln_gdp_pc_2015(2013)	0.0012	9.1718	9.1817	0.11%	9.6118	4.80%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.
"Average Control" is the simple average of control units in the donor pool with equal weights.

The covariates taken into account for this analysis are Trade Openess, the logarithm of Foreign Direct Investment Inflows (FDI), the logarithm of the total population, the logarithm of the military expenditure, and four lagged period to increase the fit.
The bias is low for all the covariates, perhaps we cannot say the same for military spending, but its bias anyway is not very high.
Talking about wights, we can notice that the first two variables are very important in determining our Synthetic Control while the others have a much lower importance, we could say residual. In fact, Trade Openness had a weight of around 74% and the logarithm of FDI around 23%.

Table 5.3. Optimal Unit Weights:

Unit	*U.weight*
161	0.428
42	0.277
180	0.189
97	0.059
90	0.04
27	0.006

Note: The unit 2 8 19 30 41 52 54 63 68 69 74 100 110 116 127 128 132 140 142 148 155 158 174 178 188 189 199 200 in the donor pool get a weight of 0.

Among the countries considered, our Synthetic Control is composed by 42% of Romania, 27% of China, 18% Spain, 5% Italy, 4% India and finally 0.6% Brazil. Three of them are part of

BRICS, two are developed countries from the west and one, Romania, was for many years influenced by the Soviet Union. Looking at the composition of our Synthetic Control we can affirm that probably the interpolation bias is very low, so shouldn't be a problem.

Table 5.4. Prediction results in the post-treatment periods:

Time	Actual Outcome	Predicted Outcome	Treatment Effect
2014	9.1613	9.2216	-0.0603
2015	9.1392	9.2634	-0.1242
2016	9.1393	9.3111	-0.1719
2017	9.1562	9.3692	-0.2129
2018	9.184	9.4135	-0.2295
2019	9.2046	9.453	-0.2484
Mean	9.1641	9.3386	-0.1745

Note: The average treatment effect over the post-treatment periods is -0.1745.

For this case, we can consider the 2014 cause perfectly know when the invasion has started and when sanctions have been applied. On 17 March 2014, the United States, the European Union, and Canada introduced specifically targeted sanctions, the day after the Crimean pseudo-referendum. For the Russian case we do not have any particular situation like an internal civil war or strange events, so we can understand the pure effect of sanctions on the Russian economy and not a joint effect like the other countries surveyed so far.

The average effect in the GDP per Capita, year by year, sorted by sanctions is of -$ 1855.7097.

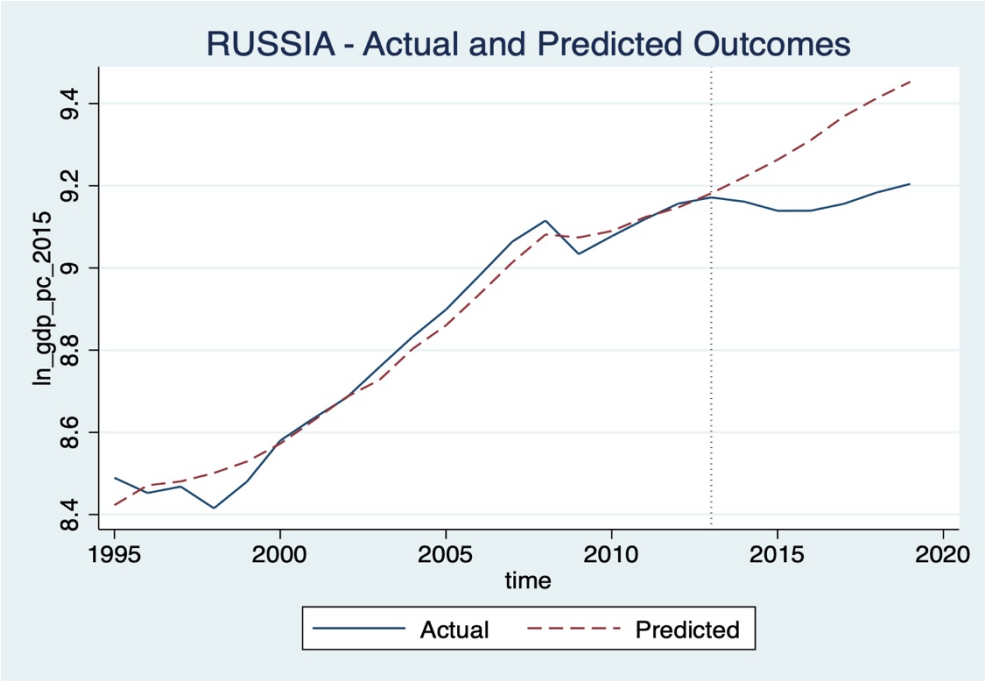

Figure 5.4. *Russian logarithm of GDP per Capita: Actual VS Predicted.*

Figure 5.2 shows us a decline in the GDP per Capita after the sanctions has been released back in 2014.

5.1.1 Placebo analysis

It's now time to have a look at the placebo analysis to see if these sanctions have sorted the wanted effect

Table 5.5. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
162	0.0014	0.0347	25.579	1
100	0.0022	0.0382	17.3202	1.6244
110	0.0014	0.0004	0.2923	1.0098
116	0.0003	0.0011	3.8697	0.205
127	0.0004	0.0026	5.7914	0.3286
128	0.0023	0.0001	0.0336	1.6709
132	0.0018	0.0011	0.6174	1.3362
140	0.0001	0	0.1437	0.0796
142	0.0002	0.0003	1.1806	0.1825
148	0.0005	0.0013	2.4685	0.4004
155	0.0005	0.0008	1.6695	0.3423
158	0.0002	0.0009	4.0866	0.1549
161	0.0005	0.0096	19.1227	0.371
174	0.001	0.0008	0.845	0.7252
178	0.0001	0.0002	1.6534	0.0678
180	0.0002	0.001	5.5115	0.1282
188	0.0002	0.0004	1.7092	0.1653
189	0.0094	0.0194	2.0519	6.9532
19	0	0.0002	5.9857	0.0278
199	0.0014	0.0316	22.337	1.0424
2	0.0025	0.0176	6.9325	1.8673
200	0.0036	0.0114	3.1814	2.6465
27	0.0004	0.0072	19.4711	0.2728
30	0.0012	0.0028	2.2888	0.8889
41	0.0002	0.0012	6.2945	0.1396
42	0.025	0.0508	2.0271	18.4518
52	0.0006	0.0029	5.2706	0.4076
54	0.0001	0.0048	68.3142	0.0514
63	0.0006	0.0001	0.1928	0.4478
68	0.0003	0.0034	11.8954	0.2099
69	0	0	0.9761	0.0317
74	0.0002	0.0012	5.0358	0.1709
8	0.0052	0.0024	0.4556	3.842
90	0.6477	0.7022	1.0841	477.1541
97	0.0012	0.0151	12.9545	0.8601

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 162's is 0.0571.

(2) Total 1 units with pre-treatment MSPE 20 times larger than the treated unit are excluded, including 90.

In this analysis as always, we have excluded units with pre-treatment MSPE 20 times larger than the treated unit. Here, our post/pre-treatment MSPE ratio is just above 5%, to be precise 5.71%, so we could say a barely acceptable result.

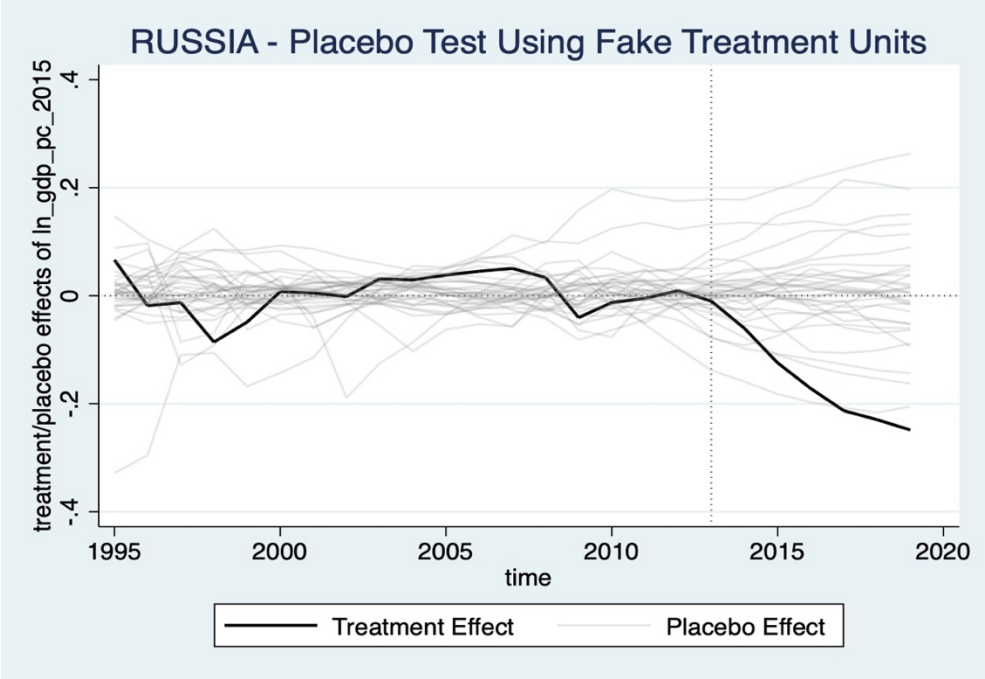

Figure 5.5. *Placebo Test for Russian GDP per Capita.*

5.2 Export analysis

With the export analysis we want to understand whether sanctions have had an effect on export considering that Australia, Canada, EU, Switzerland and United States had imposed sanction on it. Export is so important because Russia is one of the major exporters of natural gas and oil providing them to different countries around the globe. In 2021 Russia reached 10.5 million ballers per day, making up 14% of the world's total supply. In the same year, only in Europe it has exported 2.4 million barrels per day (bpd) and around 40% of the natural gas produced was demanded by the European Union. During the years, the natural gas dependence of the European Union to Russia has increase due to a decline in the European gas production.

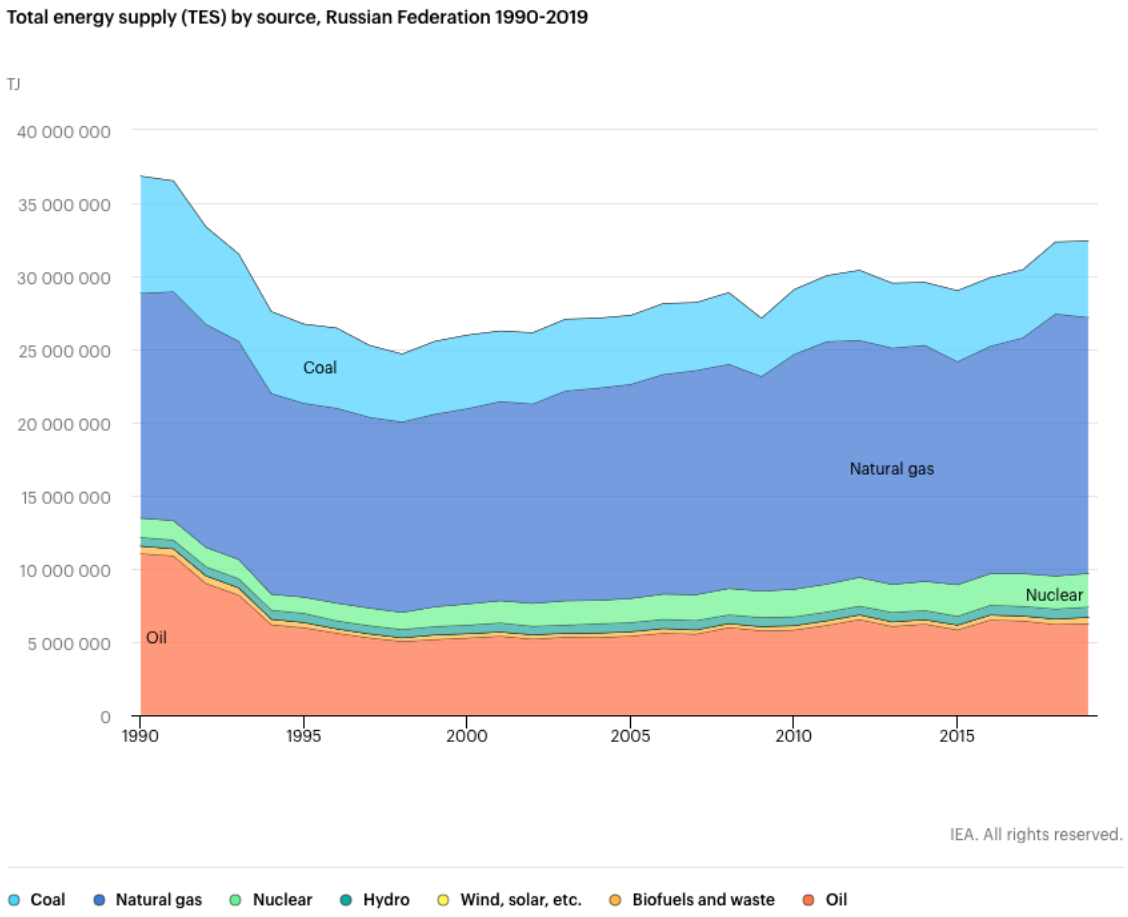

Figure 5.6. *Russian total energy supply (TES). Source: IEA*

Looking at the Figure 5.6, is noticeable that Russia has not been subject to a shrinkage of its total energy supply. In fact, what has been said by the IEA, find confirmation on data. The export of natural gas, oil, coal and nuclear does not appear to have been affected by the sanctions.

Going forward with our analysis, we want to understand if there has been a shrinkage in the export in light of what has been said and what we have seen so far.

Table 5.6. RMSE and R-squared

Treated Unit	***162***	***Treatment***	***Time***	***2014***
Mean Absolute Error	0.02863	Number of	Control Units	74
Mean Squared Error	0.00116	Number of	Covariates	7
Root Mean Squared Error	0.03407	R-squared		0.98916

The RMSE is low, being around 3.4%, while the R-squared is pretty high near to 99%. This numbers are a very good starting point for our analysis.

Table 5.7. Predictor balance in the pre-treatment periods:

Covariate	**V.weight**	**Treated**	**Synthetic Control**		**Average Control**	
			Value	Bias	Value	Bias
ln_gdp_pc_2015	0.0015	8.8112	9.3	5.55%	8.9081	1.10%
ln_gdp_2015	0.0023	27.6028	27.5074	-0.35%	25.064	-9.20%
ln_fdi_2015	0.8528	23.5892	23.5881	0.00%	21.4695	-8.99%
ln_imp_2015	0.0147	25.8323	26.1071	1.06%	23.976	-7.19%
ln_exp_2015(1995)	0.0488	25.755	25.6887	-0.26%	23.4505	-8.95%
ln_exp_2015(2005)	0.069	26.4336	26.407	-0.10%	24.0651	-8.96%
ln_exp_2015(2013)	0.0109	26.6517	26.645	-0.03%	24.35	-8.64%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.
"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.
"Average Control" is the simple average of control units in the donor pool with equal weights.

The variables used here, we have the logarithm of the GDP per Capita, the logarithm of the GDP, the logarithm of Foreign Direct Investment Inflows (FDI), the logarithm of import and three lagged period to increase the fit.
Looking at the weights in Table 5.6, the logarithm of FDI seems to be the determinant one in the construction of our Synthetic Control with a weight of 85,28%, with a residual 14.72% split among the other variables.
The bias is low in our Synthetic Control, except for the logarithm of GDP per Capita in which it is even greater than the Average Control in which every country is equally weighted.

Table 5.7. Optimal Unit Weights:

Unit	*U.weight*
74	0.461
101	0.206
90	0.143
3	0.122
207	0.058
186	0.01

Note: The unit 9 11 12 14 16 19 21 23 24 26 27 29 30 31 35 41 46 47 52 53 54 60 64 68 69 71 86 87 88 94 97 99 100 105 112 117 118 119 121 126 127 128 134 140 142 144 146 148 152 154 155 156 158 161 168 172 174 178 180 181 188 189 193 195 199 203 206 208 in the donor pool get a weight of 0.

From Table 5.7. the countries used to construct our synthetic control, in descending order of importance, are Germany, Kazakhstan, India, Algeria, United States and Sudan. The first four countries are close to Russia in terms of background in many ways. The east Germany has been for many years under the Russian control, also called at that time German Democratic Republic (GDR). Kazakhstan, India and Algeria have many things in common like the vicinity at the border and the economy. The remaining two have many less things in common with Russia, by the way they have a very low weight in composing our Synthetic Control, so we expect a very low interpolation bias.

Table 5.8. Prediction results in the post-treatment periods:

Time	**Actual Outcome**	**Predicted Outcome**	**Treatment Effect**
2014	26.6568	26.6718	-0.015
2015	26.6929	26.6798	0.0131
2016	26.7241	26.6968	0.0273
2017	26.773	26.7365	0.0365
2018	26.8271	26.7802	0.0469
2019	26.8342	26.7775	0.0567
Mean	26.7514	26.7238	0.0276

Note: The average treatment effect over the post-treatment periods is 0.0276.

Sanctions has not sorted the wanted effect. The Russian export in contrast to what one person could expect is increased and not decreased. In a certain sense this is a confirmation of the data provided by the IEA and discussed above. The strong dependance from the Russian gas and oil, by the various sanctioning countries, has weakened the effect of sanctions to such an extent that instead of decreasing, exports have increased. The average effect is an increase in the export by $ 11,802,089,812.05 year after year, with a figure close to 12 billion dollars.

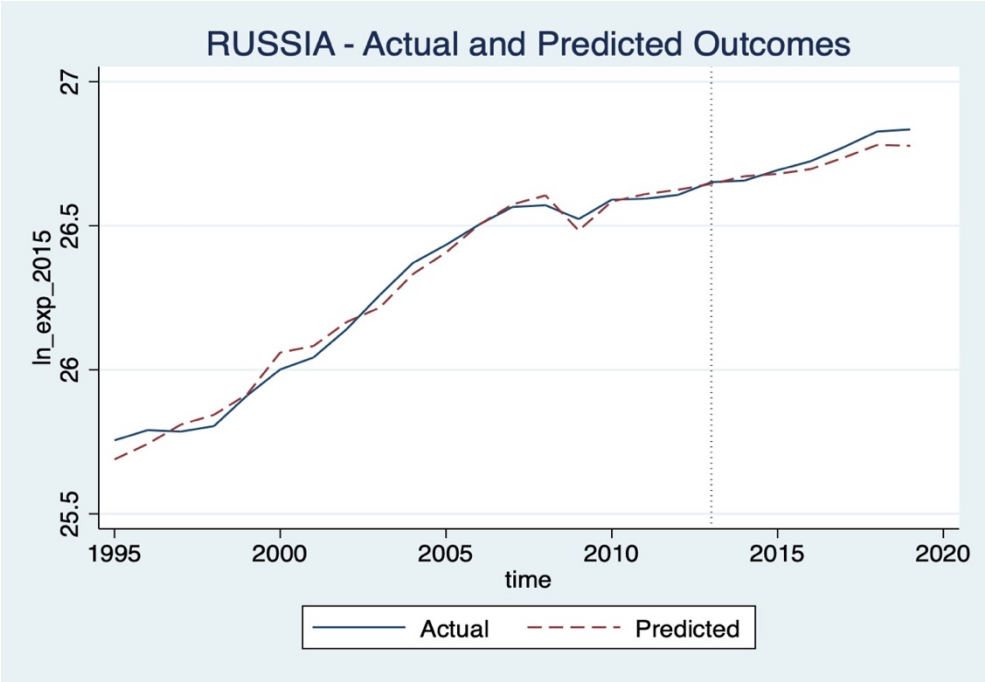

Figure 5.7. *Russian logarithm of Export (2015): Actual VS Predicted.*

As expected, Figure 5.7 tells us that there wasn't an effect on the export. Instead of incurring in a reduction, the Russian export has increased over years.

5.2.1 Placebo analysis

From what we have understood so far, we can expect that our post/pre MSPE will be at least over over 10%. This is fairly visible looking at Table 5.6 and Figure 5.7.

Table 5.7. Placebo test results using fake treatment units:

Unit	***Pre MSPE***	***Post MSPE***	***Post/Pre MSPE***	***Pre MSPE of Fake Unit/Pre MSPE of Treated Unit***
162	0.0012	0.0013	1.1314	1
100	0.0218	0.0456	2.093	18.7589
101	0.0109	0.009	0.8248	9.4332
105	0.0075	0.0011	0.1424	6.4927
11	0.0051	0.1189	23.4166	4.3747
112	0.1295	0.0533	0.4115	111.5999
117	0.0015	0.0181	12.4704	1.2519
118	0.0134	0.0605	4.5179	11.5389
119	0.0196	0.2492	12.6898	16.9185
12	0.0007	0.0099	14.031	0.6078
121	0.0015	0.0049	3.2862	1.279
126	0.0664	0.0318	0.4796	57.1882
127	0.0084	0.0045	0.5389	7.2253
128	0.0079	0.1072	13.6385	6.7738
134	0.0025	0.0004	0.1547	2.1283
14	0.0133	0.0539	4.0571	11.4553
140	0.0018	0.0147	8.3765	1.5087

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
142	0.0011	0.1097	98.0664	0.9642
144	0.047	0.034	0.7227	40.539
146	0.01	0.0636	6.3769	8.591
148	0.0049	0.0088	1.7855	4.2509
152	0.0094	0.0072	0.7697	8.0671
154	0.012	0.0038	0.3194	10.3176
155	0.005	0.0133	2.659	4.3128
156	0.0075	0.0908	12.0496	6.4916
158	0.0014	0.0589	42.9223	1.1819
16	0.0843	0.0322	0.3815	72.6783
161	0.006	0.1144	19.2151	5.1283
168	0.0142	0.0115	0.8116	12.2217
172	0.0007	0.0099	13.2195	0.6462
174	0.0065	0.0018	0.2764	5.5805
178	0.0012	0.0112	9.5959	1.0082
180	0.0089	0.0014	0.1557	7.6733
181	0.0032	0.0062	1.9631	2.7337
186	1.6915	4.3223	2.5553	1457.4974
188	0.0019	0.0091	4.9274	1.5941
189	0.0036	0.0023	0.6432	3.112
19	0.0003	0.0015	6.1562	0.216
193	0.0027	0.0016	0.5877	2.3203
195	0.0654	0.0875	1.3375	56.3418
199	0.012	0.0107	0.8898	10.3359
203	0.0286	0.0215	0.7514	24.63
206	0.0013	0.0003	0.2174	1.0949
207	0.2066	0.1271	0.6151	178.001
208	0.01	0.0038	0.3816	8.6134
21	0.0177	0.0088	0.4983	15.2666
23	0.2462	0.1779	0.7224	212.1389
24	0.011	0.0207	1.8861	9.4439
26	0.0594	0.012	0.2014	51.1659
27	0.0093	0.0021	0.2217	8.0318
29	0.0189	0.0627	3.3167	16.2848
3	0.0094	0.0344	3.6486	8.1307
30	0.0246	0.0182	0.7376	21.2302
31	0.0643	0.3702	5.7539	55.4379
35	0.0163	0.0177	1.0852	14.026
41	0.0065	0.062	9.5982	5.568
46	0.0203	0.0073	0.3611	17.4855
47	0.0027	0.0192	7.0922	2.3267
52	0.0032	0.0527	16.7056	2.7167
53	0.0112	0.0046	0.4047	9.6896
54	0.0012	0.0008	0.6803	1.0394
60	0.0397	0.0207	0.5223	34.1809
64	0.0398	0.0184	0.4619	34.2623
68	0.0023	0.0235	10.2003	1.984
69	0.0031	0.0001	0.047	2.697
71	0.0373	0.0137	0.3666	32.1101
74	0.0033	0.0026	0.7734	2.8813
86	0.0103	0.017	1.6574	8.8434
87	0.0019	0.0171	9.0211	1.6336
88	0.0033	0.0083	2.5045	2.855
9	0.1142	0.0777	0.6805	98.4118
90	0.0187	0.0117	0.6263	16.1288
94	0.0177	0.1799	10.1695	15.2394

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
97	0.004	0.0064	1.6119	3.4132
99	0.0054	0.0027	0.504	4.6586

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as 162's is 0.5067.

(2) Total 16 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 112 126 144 16 186 195 203 207 23 26 30 31 60 64 71 9.

In this placebo analysis have been removed all variables with a pre-treatment 20 times larger than the treated unit, to avoid having strange results. In total has been removed 16 countries. Table 5.7 shows clearly that our expectation about the post/pre-treatment MSPE was right, in fact it is much more above 10%, being around 50%.

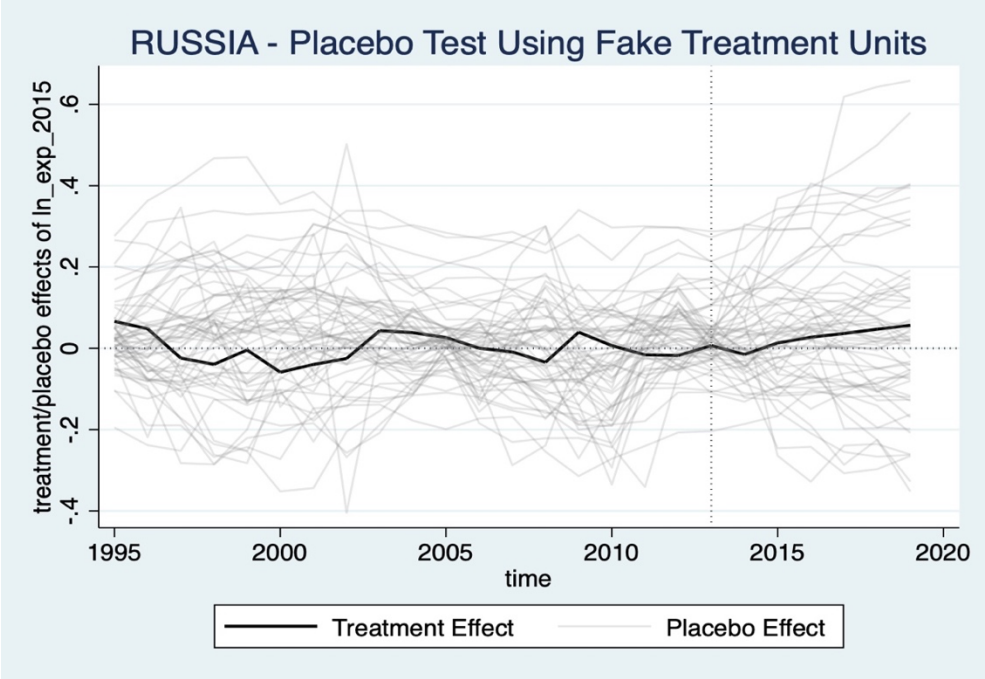

Figure 5.8. *Placebo Test for Russian Export*

5.3. FDI analysis

The other interesting part that we wanted to analyze are the foreign direct investments inflows and this why Australia, Canada, EU, Montenegro, Iceland, Albania, Liechtenstein, Norway, Ukraine, Japan, New Zealand, Switzerland and US have imposed financial sanction on Russia. Foreign direct investments are fundamental for a country. These investments help a developing economy like Russia to grow. Companies and investor that decide to invest in your country, in different forms, like by opening new facilities or buying the country's public debt are a very important part to create the field for the growth. To grow in terms of GDP, GDP per Capita, Export and so on.

Table 5.8. RMSE and R-Squared

Treated Unit	***162***	***Treatment Time***	***2014***
Mean Absolute Error	0.18908	Number of Control Units	90
Mean Squared Error	0.05558	Number of Covariates	24
Root Mean Squared Error	0.23576	R-squared	0.95352

In terms of R-squared, the Synthetic Control is quite good. In terms of Root Mean Squared Error, ours is not so high in the Synthetic Control Analysis. Here the control pool is quite big, with 90 units. It is the biggest donor pool utilized so far.

Table 5.9. Predictor balance in the pre-treatment periods:

Covariate	***V.weight***	***Treated***	***Synthetic Control***		***Average Control***	
			Value	Bias	Value	Bias
trade_op	0.0179	54.573	53.9997	-1.05%	90.2149	65.31%
ln_gdp_2015	0.3476	27.6028	27.5995	-0.01%	24.8337	-10.03%
ln_gdp_pc_2015	0.0424	8.8112	8.8088	-0.03%	8.802	-0.11%
ln_imp_2015	0.0007	25.8323	26.0125	0.70%	23.8586	-7.64%
ln_exp_2015	0.0001	26.2579	25.9194	-1.29%	23.8071	-9.33%
fdi_infl_gdp(1995)	0.0073	0.5223	0.8766	67.85%	3.2999	531.85%
fdi_infl_gdp(1996)	0.0167	0.6585	0.7653	16.23%	4.2993	552.94%
fdi_infl_gdp(1997)	0.0006	1.2014	1.2802	6.56%	3.0004	149.75%
fdi_infl_gdp(1998)	0.0049	1.0191	1.1549	13.33%	4.5048	342.03%
fdi_infl_gdp(1999)	0.006	1.6623	1.5099	-9.17%	5.3937	224.47%
fdi_infl_gdp(2000)	0.0045	1.0312	1.3761	33.46%	5.7122	453.96%
fdi_infl_gdp(2001)	0.0088	0.9287	1.1976	28.96%	5.2705	467.53%
fdi_infl_gdp(2002)	0.0027	1.0055	1.3106	30.34%	3.9596	293.78%
fdi_infl_gdp(2003)	0.0013	1.8424	1.5737	-14.58%	4.0011	117.17%
fdi_infl_gdp(2004)	0.0159	2.6062	2.0551	-21.15%	5.4052	107.40%
fdi_infl_gdp(2005)	0.0868	2.0298	2.2878	12.71%	8.9603	341.44%
fdi_infl_gdp(2006)	0.1698	3.7977	3.8418	1.16%	10.3546	172.65%
fdi_infl_gdp(2007)	0.0377	4.2989	4.41	2.58%	12.9332	200.85%
fdi_infl_gdp(2008)	0.0216	4.5027	4.1982	-6.76%	8.3502	85.45%

Covariate	*V.weight*	*Treated*	*Synthetic Control*		*Average Control*	
			Value	Bias	Value	Bias
fdi_infl_gdp(2010)	0.0219	2.8308	2.9456	4.06%	7.1444	152.38%
fdi_infl_gdp(2011)	0.0138	2.6924	2.6557	-1.36%	8.2299	205.68%
fdi_infl_gdp(2012)	0.1012	2.2908	2.2958	0.22%	8.5741	274.28%
fdi_infl_gdp(2013)	0.0147	3.0194	2.9093	-3.65%	5.8795	94.73%

Note: "V.weight" is the optimal covariate weight in the diagonal of V matrix.

"Synthetic Control" is the weighted average of control units in the donor pool with optimal weights.

"Average Control" is the simple average of control units in the donor pool with equal weights.

In this analysis there are things to pointed out. The first one is that among the variables used we can see from Table 5.9 that we have used the entire lagged time for FDI, and this to increase the fit as much as possible but at the same time trying to minimize their impact in terms of weights, in order to give the priority to the other most important variables like: trade openness, the logarithm of GDP, the logarithm of GDP per Capita and the logarithm of export and import. In terms of bias, the only variable with a huge one is the FDI 1995, with around 67% of bias, but when you have a lot of variables like in this case some with a non-indifferent bias is something we have to expect. Recall that the Synthetic Control is also based on the matching theory and so, finding for all the variables very small bias is challenging. If you are wondering why we have putted the entire lagged series, the answer is that with few lagged periods or without lagged periods the fit would have been very low.

Table 5.10 Optimal Unit Weights:

Unit	*U.weight*
90	0.341
99	0.277
207	0.115
167	0.081
30	0.032
46	0.027
108	0.024
172	0.021
135	0.019
121	0.017
71	0.014
118	0.013
161	0.01
11	0.007
126	0.002

Note: The unit 162 100 101 105 109 110 116 119 12 124 127 128 134 137 139 14 140 142 143 144 146 148 15 152 154 156 157 158 16 168 171 174 175 176 178 180 181 186 188 189 19 193 195 199 2 208 21 212 24 27 29 3 35 36 39 41 52 53 54 6

61 63 64 68 69 74 77 85 86 87 88 9 94 96 97 98 in the donor pool get a weight of 0.

From Table 5.10, we can see of how many countries is composed our Synthetic Control, that is, in descending order, India, Japan, United States, Saudi Arabia, Bulgaria, Congo, Kyrgyzstan, Singapore, Mozambique, Malaysia, Gabon, Macao, Romania, Australia and Mauritania. Some of them could be a problem, but their weight is very residual. The only one that maybe a bit problematic is Japan, with a weight of around 27%, because could cause interpolation bias. After having tried different setting in Stata, so to do what has been done for the Nicaraguan Export, I have decided not to include that additional analysis in an attempt to reduce the interpolation bias and this principally for one reason: in reducing the bias the drop of the fit was too high to make the R-square insignificant. In addition, in this case we have these different countries composing the Synthetic Control, but they are not as many as is the case in Nicaragua.

Table 5.11. Prediction results in the post-treatment periods:

Time	**Actual Outcome**	**Predicted Outcome**	**Treatment Effect**
2014	1.0699	2.8153	-1.7454
2015	0.5026	3.7675	-3.2649
2016	2.5485	2.8575	-0.309
2017	1.8141	3.2484	-1.4344
2018	0.5301	2.7659	-2.2358
2019	1.8949	3.2474	-1.3526
Mean	1.3933	3.117	-1.7237

Note: The average treatment effect over the post-treatment periods is -1.7237.

The average effect, year by year, that sanctions had on the FDI Inflows is of about -1.72% of GDP. This effect seems small but in reality, if we consider the historic series of the FDI inflows and its impact on this latter one is always had on the GDP, in percentage point, we will see that the drop is important.

For sure different investors has thought to leave or disinvest from Russia, but on the other hand others had ignored sanctions, and this is not a surprise, because investors probably have perceived this situation as a temporarily situation not believing in an escalation like the one that took place in February 2022. Thinking precisely that the Russian-Ukrainian situation would be resolved as soon as possible, companies like investors avoided divesting, in the possibility that if the sanctions were lifted and they would have divested before that event, someone else ready to replace them and to enter the Russian market there would have been and they would have lost tens of millions of dollars. The fact that some investors were more afraid of divesting than the sanctions themselves is evident in the agreement for the construction of North Stream 2 signed in 2015 between Gazprom, Royal Dutch Shell, E.ON, OMV and Engie. In 2017, when

the creation of a joint venture was blocked by Poland, in the same year Uniper, Wintershall, Engie, OMV and Royal Dutch Shell signed a financing agreement with Nord Stream 2 AG, based in Zug, Switzerland, a subsidiary of Gazprom responsible for the development of the Nord Stream 2 project. All this highlights the lack of interest on the part of companies in respecting the sanctions, seeing the whole situation as something not too serious. Everyone would have changed their minds with the invasion in February 2022.

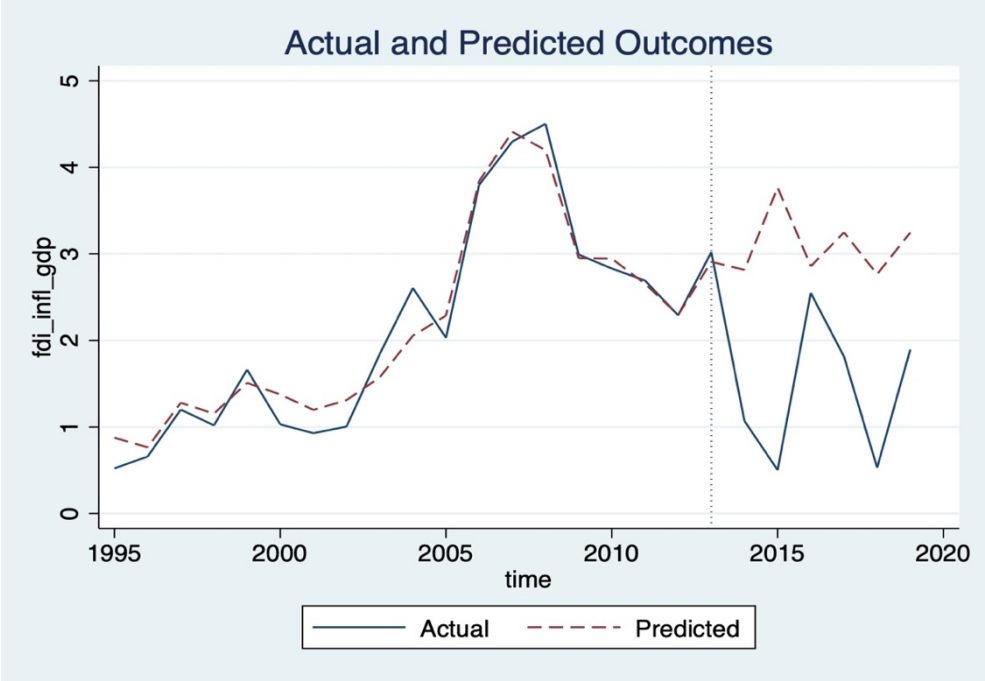

Figure 5.9. *Russian FDI in % to GDP Actual VS Predicted.*

From Figure 5.9, we can see that after sanctions the Russian FDI drops with the major one between 2014 and 2015. Between 2015 and 2016 that, Russian FDI restart to grow almost touching its Synthetic Control and then decrease again. For what concern the FDI we can conclude that the effect of sanctions has had an effect, but we are not sure about it, so we need to run a placebo analysis.

5.3.1 Placebo analysis

Table 5.12. Placebo test results using fake treatment units:

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
162	0.0556	3.7812	68.0301	1
100	4.0653	38.1562	9.3858	73.1427
101	1.8147	14.5233	8.003	32.6503
105	0.017	0.1328	7.7956	0.3064
108	3.0942	32.669	10.5581	55.6702
109	0.6583	17.5881	26.7159	11.8447
11	2.1278	4.9249	2.3146	38.2832
110	0.5476	2.9206	5.3335	9.8521
116	0.6468	2.8462	4.4005	11.6371
118	5.7734	35.9569	6.228	103.8746
119	0.9147	9.5391	10.4292	16.4563
12	15.9436	46.4431	2.913	286.8547
121	0.3391	1.3432	3.9617	6.1003
124	1.95E+04	1172.7402	0.0601	350806.167
126	26.9608	60.8212	2.2559	485.0738
127	0.4697	1.0978	2.3371	8.4509
128	0.0942	0.4222	4.4814	1.6951
134	0.4933	1.1751	2.382	8.8761
135	39.0354	81.9994	2.1006	702.3174
137	1.0152	23.7711	23.4148	18.2656
139	0.058	0.1432	2.4694	1.0437
14	0.1564	11.4398	73.1606	2.8133
140	56.5956	720.1883	12.7252	1018.2572
142	2.7389	1.6202	0.5916	49.2778
143	0.1371	2.6089	19.029	2.4667
144	0.8513	1.9224	2.2581	15.3171
146	2.2067	8.9827	4.0706	39.7026
148	0.1739	15.9638	91.7925	3.129
15	20.3484	74.7704	3.6745	366.1039
152	4.4225	3.4941	0.7901	79.5682
154	0.2465	0.2799	1.1355	4.4352
156	0.0472	2.1894	46.3389	0.8501
157	0.2845	4.6931	16.4974	5.1182
158	2.1	7.5013	3.572	37.7832
16	0.0173	0.1929	11.1691	0.3107
161	1.1655	0.8118	0.6965	20.9698
167	1.902	4.8724	2.5618	34.2195
168	0.0548	1.7465	31.8796	0.9857
171	9.0049	27.3964	3.0424	162.0153
172	22.4481	177.4152	7.9034	403.8817
174	1.3715	3.5511	2.5892	24.6754
175	0.4967	4.6927	9.448	8.9363
176	11.1371	10.7256	0.9631	200.3765
178	0.6583	0.5719	0.8687	11.8445
180	0.0731	4.1211	56.3907	1.3149
181	0.0406	0.6408	15.7694	0.7311
186	0.2394	2.104	8.7875	4.3078
188	3.0235	13.4075	4.4344	54.3989
189	5.937	252.452	42.5218	106.8174

Unit	*Pre MSPE*	*Post MSPE*	*Post/Pre MSPE*	*Pre MSPE of Fake Unit/Pre MSPE of Treated Unit*
19	96.6501	569.9201	5.8967	1738.9098
193	0.3466	2.2407	6.4655	6.2354
195	2.7298	13.4321	4.9206	49.1132
199	0.0343	0.4905	14.3081	0.6168
2	0.6898	2.7379	3.9692	12.4104
207	0.0115	0.6018	52.4232	0.2066
208	1.2123	16.764	13.8281	21.8116
21	0.3316	0.5614	1.6931	5.9656
212	0.5581	3.525	6.3159	10.0414
24	1.9502	3.4306	1.7591	35.0875
27	0.0447	1.6557	36.9986	0.8051
29	8.6926	3.8423	0.442	156.3962
3	0.0219	0.2395	10.9253	0.3943
30	3.4663	65.7357	18.9643	62.3647
35	0.3755	0.302	0.8043	6.7565
36	0.3364	3.4988	10.4017	6.0519
39	110.2049	36.8574	0.3344	1982.7853
41	0.1559	2.0054	12.8671	2.8041
46	21.341	657.5735	30.8127	383.9623
52	7425.3988	1.05E+04	1.4119	133596.3201
53	0.9991	5.1821	5.1869	17.9753
54	11.073	1.4068	0.1271	199.2224
6	55.7517	45.6518	0.8188	1003.0733
61	1801.5313	5.273	0.0029	32412.7988
63	6.2145	34.8369	5.6057	111.8103
64	3.6695	4.5885	1.2505	66.0202
68	5.5054	18.2283	3.311	99.0517
69	0.0334	0.9934	29.7654	0.6005
71	3.9071	33.1989	8.4972	70.2949
74	0.711	1.3005	1.829	12.793
77	0.1294	0.3307	2.5559	2.3281
85	0.1138	0.3758	3.3031	2.0469
86	0.0528	3.7242	70.5326	0.95
87	35.4909	470.5244	13.2576	638.5454
88	94.7535	1341.846	14.1614	1704.7869
9	1.3443	9.2205	6.8592	24.1855
90	0.0155	0.3606	23.2724	0.2788
94	47.3246	749.8728	15.8453	851.4541
96	0.3464	2.2854	6.5975	6.2324
97	0.1968	1.6118	8.19	3.5409
98	0.5066	3.5924	7.0916	9.114
99	0.0706	0.0534	0.7554	1.2709

Note: (1) The probability of obtaining a post/pre-treatment MSPE ratio as large as Russia is 0.0440.

(2) Total 43 units with pre-treatment MSPE 20 times larger than the treated unit are excluded in computing pointwise p-values, including 100 101 108 11 118 12 124 126 135 140 142 146 15 152 158 161 167 171 172 174 176 188 189 19 195 208 24 29 30 39 46 52 54 6 61 63 64 68 71 87 88 9 94.

From the placebo analysis in Table 5.12, we obtain that our post/pre-treatment MSPE ratio is 4% and so resulting that there is an effect. Sanctions had an effect on the FDI inflows, lowering it by around 1.72% of the GDP, year after year.

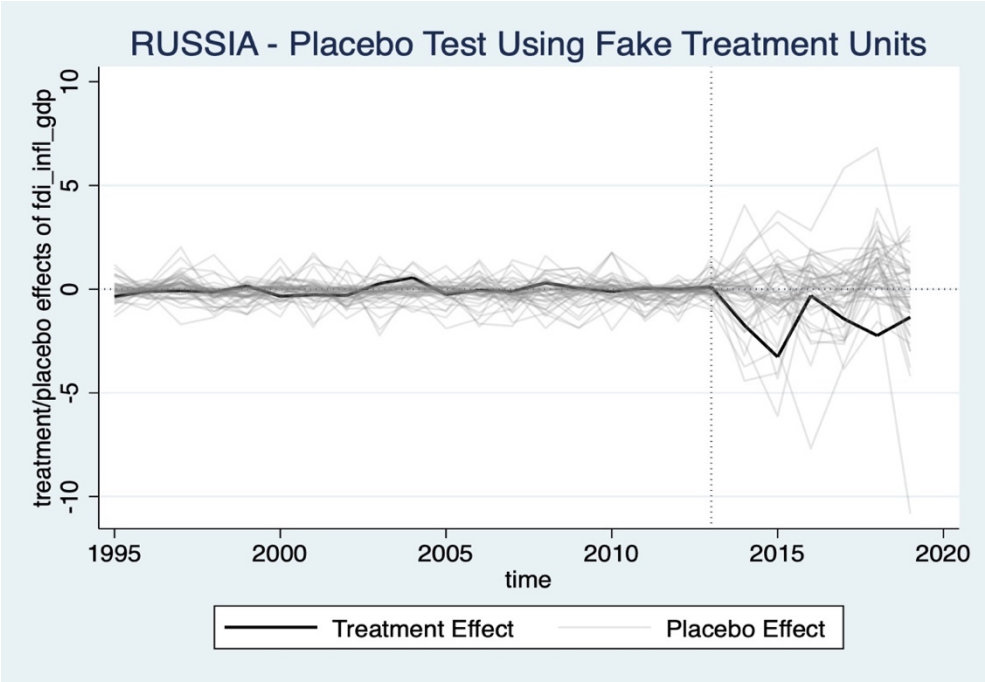

Figure 5.10. *Placebo Test for Russian FDI Inflows.*

Even in this case, we do not have considered units with pre-treatment MSPE 20 times larger than the treated unit, to avoid strange results: placebos so strange to be considered realistic.

Conclusions

In conclusion, after having analyzed these four countries we have to highlight different things. The first one is the availability of data, not only from the prospective of having data about countries that are close to our treated unit under different aspects, but even considering having data that cover longer period of time: the longer is our time series, the better will be the fit. So, both of them, that is having countries close to the treated unit and having data be part of a long time series are very important. We have seen in particular this issue hitting three of the four countries analyzed: Iran, Nicaragua and Kenya. This is due to the fact that old data are difficult to collect for the World Bank, on one hand sometimes these data are not available for a lack of transcription or miscalculation by governments, on the other hand even when these data are available, there is the possibility that the latter are not reliable enough, so the World Bank prefer not to publish. We also seen the importance of trim the donor pool in order to avoid possible interpolation bias and choose countries closer to the treated unit in terms of geographical proximity, background like culture, demographics, government and infrastructure.

Another relevant thing to consider is that many times sanctions are the consequences of very difficult situation inside the country, like human right violation and etc. So, estimating the cost of, for instance, a revolution and disaggregate\isolate these costs from sanctions is very challenging and not always we are able to retrieve the effect that sanctions had on the target economy and instead we must consider the joint effect of sanctions and others event.

N.B: the others event that we intend, are not episodes with small impact, but are something that can cause a non-indifferent shock for the country in question. That is: revolutions, localized economic crisis, or natural disasters.

When we do not have any of the above-mentioned shocks, we are able to analyze the target country without problems, as we have seen for the Russian case and understand the impact that these sanctions has on the core indicators of the economy, and that us in particular have chosen be GDP per Capita to intercept the impact on people' shoulders; the Export to intercept the behavior that the external actors have towards the sanctioned countries. As we have said different can be the behaviors of the various multinationals that collaborate with that country, for example deciding to ignore sanctions as long as profits are stable or continue to grow; and the FDI inflows to intercept the behaviors that investor have towards this type of situations.

The Synthetic Control method seems to be a valid instrument for this type of analysis, but we need to be careful and chose variables carefully, to trim in the right way the donor pool, to have enough data, sometimes to choose the right weight for the covariates as starting point for the estimation and be prudent in arriving at hasty judgments about the result found. The strength of the synthetic control method is that in its complexity lies simplicity, after estimating the effects and statistically ascertaining the existence of the same through verifications, one only has to look at the graph to understand the magnitude of the effect, and the graph is readable even by those who are not versed in the subject. In contrast, the synthetic control method can be easily manipulated, such as through the use of machine learning, actually making it more prone to interpolation biases.

List of countries

Country Code	Country Name	Country Code	Country Name
1	Afghanistan	**43**	Colombia
2	Albania	**44**	Comoros
3	Algeria	**45**	Congo, Dem. Rep.
4	American Samoa	**46**	Congo, Rep.
5	Andorra	**47**	Costa Rica
6	Angola	**48**	Cote d'Ivoire
7	Antigua and Barbuda	**49**	Croatia
8	Argentina	**50**	Cuba
9	Armenia	**51**	Curacao
10	Aruba	**52**	Cyprus
11	Australia	**53**	Czech Republic
12	Austria	**54**	Denmark
13	Azerbaijan	**55**	Djibouti
14	Bahamas, The	**56**	Dominica
15	Bahrain	**57**	Dominican Republic
16	Bangladesh	**58**	Ecuador
17	Barbados	**59**	Egypt, Arab Rep.
18	Belarus	**60**	El Salvador
19	Belgium	**61**	Equatorial Guinea
20	Belize	**62**	Eritrea
21	Benin	**63**	Estonia
22	Bermuda	**64**	Eswatini
23	Bhutan	**65**	Ethiopia
24	Bolivia	**66**	Faroe Islands
25	Bosnia and Herzegovina	**67**	Fiji
26	Botswana	**68**	Finland
27	Brazil	**69**	France
28	British Virgin Islands	**70**	French Polynesia
29	Brunei Darussalam	**71**	Gabon
30	Bulgaria	**72**	Gambia, The
31	Burkina Faso	**73**	Georgia
32	Burundi	**74**	Germany
33	Cabo Verde	**75**	Ghana
34	Cambodia	**76**	Gibraltar
35	Cameroon	**77**	Greece
36	Canada	**78**	Greenland
37	Cayman Islands	**79**	Grenada
38	Central African Republic	**80**	Guam
39	Chad	**81**	Guatemala
40	Channel Islands	**82**	Guinea
41	Chile	**83**	Guinea-Bissau
42	China	**84**	Guyana

Country Code	Country Name	Country Code	Country Name
85	Haiti	**127**	Mauritius
86	Honduras	**128**	Mexico
87	Hong Kong SAR, China	**129**	Micronesia, Fed. Sts.
88	Hungary	**130**	Moldova
89	Iceland	**131**	Monaco
90	India	**132**	Mongolia
91	Indonesia	**133**	Montenegro
92	Iran, Islamic Rep.	**134**	Morocco
93	Iraq	**135**	Mozambique
94	Ireland	**136**	Myanmar
95	Isle of Man	**137**	Namibia
96	Israel	**138**	Nauru
97	Italy	**139**	Nepal
98	Jamaica	**140**	Netherlands
99	Japan	**141**	New Caledonia
100	Jordan	**142**	New Zealand
101	Kazakhstan	**143**	Nicaragua
102	Kenya	**144**	Niger
103	Kiribati	**145**	Nigeria
104	Korea, Dem. People's Rep.	**146**	North Macedonia
105	Korea, Rep.	**147**	Northern Mariana Islands
106	Kosovo	**148**	Norway
107	Kuwait	**149**	Oman
108	Kyrgyz Republic	**150**	Pakistan
109	Lao PDR	**151**	Palau
110	Latvia	**152**	Panama
111	Lebanon	**153**	Papua New Guinea
112	Lesotho	**154**	Paraguay
113	Liberia	**155**	Peru
114	Libya	**156**	Philippines
115	Liechtenstein	**157**	Poland
116	Lithuania	**158**	Portugal
117	Luxembourg	**159**	Puerto Rico
118	Macao SAR, China	**160**	Qatar
119	Madagascar	**161**	Romania
120	Malawi	**162**	Russian Federation
121	Malaysia	**163**	Rwanda
122	Maldives	**164**	Samoa
123	Mali	**165**	San Marino
124	Malta	**166**	Sao Tome and Principe
125	Marshall Islands	**167**	Saudi Arabia
126	Mauritania	**168**	Senegal

Country Code	Country Name	Country Code	Country Name
169	Serbia	**211**	Venezuela, RB
170	Seychelles	**212**	Vietnam
171	Sierra Leone	**213**	Virgin Islands (U.S.)
172	Singapore	**214**	West Bank and Gaza
173	Sint Maarten (Dutch part)	**215**	Yemen, Rep.
174	Slovak Republic	**216**	Zambia
175	Slovenia	**217**	Zimbabwe
176	Solomon Islands		
177	Somalia		
178	South Africa		
179	South Sudan		
180	Spain		
181	Sri Lanka		
182	St. Kitts and Nevis		
183	St. Lucia		
184	St. Martin (French part)		
185	St. Vincent and the Grenadines		
186	Sudan		
187	Suriname		
188	Sweden		
189	Switzerland		
190	Syrian Arab Republic		
191	Tajikistan		
192	Tanzania		
193	Thailand		
194	Timor-Leste		
195	Togo		
196	Tonga		
197	Trinidad and Tobago		
198	Tunisia		
199	Turkey		
200	Turkmenistan		
201	Turks and Caicos Islands		
202	Tuvalu		
203	Uganda		
204	Ukraine		
205	United Arab Emirates		
206	United Kingdom		
207	United States		
208	Uruguay		
209	Uzbekistan		
210	Vanuatu		

Variables

N.B NUMBER 1: All the variables that contains *_2015*, are data in constant 2015 U.S. dollars.

N.B NUMBER 2: All the variables that do not have parenthesis, for instance: *ln_exp_2015(1996),* are not lagged and are averaged from the period in which we have the first data to the pre-intervention period. That is, if the time series considered is 1962 – 1989, and the event happened in 1979, these variables are averaged from 1962 to 1978.

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