Lisbon School of Economics & Management
Universidade de Lisboa

# MASTER

## MONETARY AND FINANCIAL ECONOMICS

# MASTER´S FINAL WORK

## DISSERTATION

# THE EFFECT OF WESTERN SANCTIONS ON THE RUSSIAN GDP PER CAPITA: A SYNTHETICAL CONTROL APPROACH

MIRKO DROSSARD

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**Abstract**

This work examines the casual effect of the 2022 western sanctions against Russia, due the invasion of Ukraine, on GDP per Capita using the synthetic control method. In general, the use of sanctions, as a foreign policy tool, rose remarkably during the end of the great financial crises of 2007/2008 and it finds more attention by researchers as well as politicians. In the context of the Ukraine conflict Russia already had to face a package of sanctions in 2014 due the Krim anexion. In the literature there are already a few papers that investigate the effects of these but regarding the more severe sanctions of 2022 there almost no existing literature. Thus, we aim with this early approach to contribute to a clearer view of the effect on the economy. We use the synthetic control as described in the literature and conduct robustness tests to verify our estimations. However, we found an overall negative effect in the period of 2022-2025 which includes estimations of the IMF World Economic Outlook. Our robustness analysis indicates a statistically significant effect in the first year after imposing the sanctions but not for the following years.

**JEL:** C33; F43; F51; O40; Y40
**Keywords:** Sanctions; Russia; Synthetic Control Methods; Ukrainian Conflict; Economic Growth

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## 1. Introduction

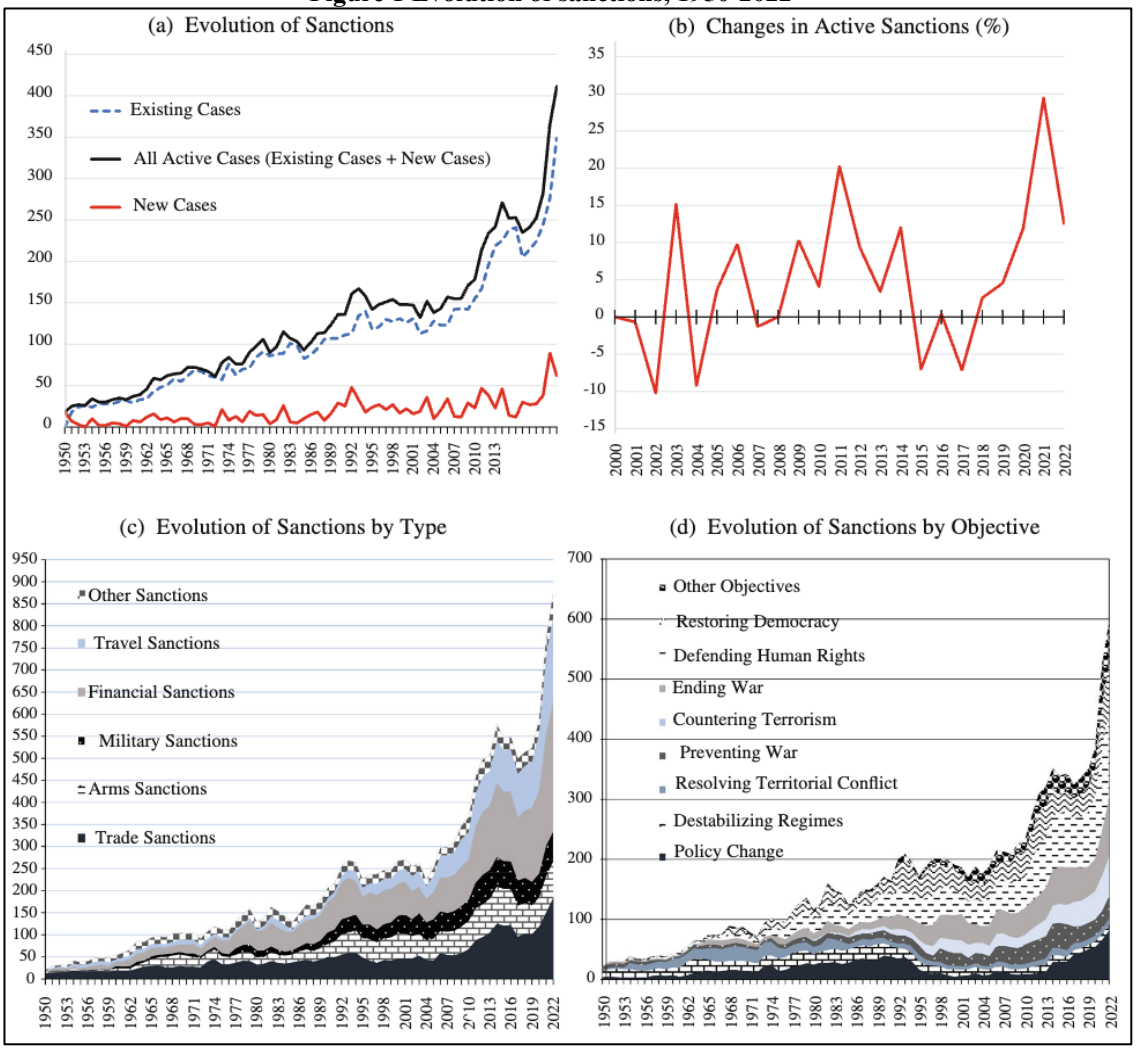
Throughout history, economic sanctions have been used as a tool for economic statecraft in foreign diplomacy and international relations. For instance, trade sanctions, such as the Athenian boycott of Megara, were used during the Peloponnesian Wars to trigger the conflict. Similarly, trading empires like Venice, Portugal, or the Netherlands used sanctions to weaken the economic power of their competitors (Drezner, 1999). Sanctions are threats imposed by sender states or international institutions to influence the behaviour of targeted states, private entities, and/or influential individuals, rather than using military force.

Felbermayr et al. (2020a) introduced the Global Sanction Database as a public resource to meet the growing demand for matching data for bilateral, multilateral, and plurilateral sanctions worldwide, which has already been updated several times and on a regular basis. Economic sanctions before World War II were typically associated with military efforts and took the form of trade sanctions and economic blockades. Sanctions have become more diverse in terms of content, implementation, and targets, as well as the type (e.g., financial or travel sanctions) and the reason for their imposition. Additionally, there has been a steady increase in the amount and evolution of sanctions by type, along with their objectives.

This development is illustrated in Figure 1 and was taken from the latest update of the global sanction data base (GSDB-R3). It displays key aspects of global sanctions and the evolution of the global sanctions. Panel (a) tracks the rise in sanctions from 1950 to 2022, noting a significant surge from 2019 onwards, with the United States and the United Kingdom (because of Brexit) being major contributors. Russia and Belarus were frequently targeted, primarily for human rights violations and geopolitical conflicts. Panel (b) shows the percentage changes relative to the preceding year in the number of active sanction cases (from 2000 to 2022) and a sharp increase in sanctions from 2019, with a notable 29.4% rise in 2021, attributed to COVID-19 shifting focus to global health issues and escalating political tensions. The US notably imposed sanctions on Myanmar's military leaders and Belarusian entities in 2021. Panel (c) illustrates the evolution of sanctions by type and therefore a shift towards targeted financial and trade sanctions, particularly against Russia and Belarus due to geopolitical events in recent times. Panel (d) depicts the shifting policy objectives of sanctions over time, with a rising focus on

human rights and policy change, while objectives like regime destabilization have declined since the 1990s.

**Figure 1 Evolution of sanctions, 1950-2022**




Source: Syropoulos et al. (2024).

The figure above shows that the use of economic sanctions as a foreign policy tool is steadily increasing, leading to a growing interest in the literature on the subject. The debate, among policymakers, economists, and researchers, typically centres on the effectiveness and impact of economic sanctions, or more generally, do they work?

In this dissertation, we estimate the causal effects of the multilateral sanctions program, launched in 2022, on the Russian economic growth. Beside the attention through international media or Policymaker, further interest for this case arises because it involves financial and economic sanctions imposed by mostly advanced western economies. To estimate these causal effects, we apply the Synthetic Control Method

(SCM) for comparative case studies described in Abadie and Gardeazabal, 2003; Abadie et al., 2010; Abadie et al., 2015. The method allows to determine the evolution of the Russian economy in terms of the desired outcome variables if it was not target to the western sanctions. The above-mentioned questions will be addressed in the second chapter and give an overview of related literature. The third chapter will describe the data and methodology of the empirical method used to examine the impact on the Russian economic growth. Chapter four presents the results and chapter five concludes.

## 2. Related Literature

The literature does not provide conclusive evidence on the effectiveness and impact of economic sanctions, despite ongoing advancements in theoretical and empirical understanding. Research in this field can be roughly divided into quantitative studies, which explore the effects of sanctions by combining large data collections with multiple case studies, and qualitative assessments, which focus on single-country case studies.

### *2.1 Success, effectiveness and impact of sanctions*

Starting with the quantitative side, Morgan et al. (2014) highlight the development for the last two decades and mentioned a significantly shift in research from the viewpoint that sanctions had not and could not perform (to name a few: Galtung, 1967; Hoffman, 1967; Baer, 1973; Schreiber, 1973; Olson, 1979; von Amerongen, 1980; Wallensteen, 1983), towards a far more nuanced view. The problematic, and therefore the general conclusion economic sanctions do not work, with these "older" studies is a selection bias. They typically concentrated on high-profile cases, which were known to be unsuccessful for extended periods. According to Morgan recent studies systematically working with data sets including information on hundreds of cases and therefore these studies may can provide a better insight into the general question whether sanctions work or not. In their studies three different definition of success were used, when employing a strict definition of sanctions success, which requires total or partial acquiescence from the target, 384 cases are identified as successful. Under this criterion, sanctions be considered successful in 27.2% of all cases, or in 37.5% of cases with available final outcome data. Notably, the rate of success significantly improves when negotiated settlements are included as successful cases. In such instances, a success rate of 40.8% is observed across all cases, move up to 56% when cases with missing final outcomes are excluded. This adjustment

considers negotiation as a form of success, implying compromises or some kind of arrangements made by the sender to the target.

Additionally, the third, adopting a definition based on settlement nature identifies 454 successes, resulting in a success rate of 32.2% across the full sample and 44% in the restricted sample. Hufbauer et al. (2007) present a multivariate statistical analysis from 174 case studies about economic sanctions, with, among others, the goal to address the record of success in achieving foreign policy objectives and the costs for both sender and target countries. Which, according to them, are two main doubts of sceptics in the debate over economic sanctions. However, they report that 34% of their investigated cases could be viewed as successful, which goes fairly along with the effectiveness rate, which was described above, from Morgan et al. (2014). Even though these two prominent elaborations of large case studies clearly suggest a blanket statement that sanctions do not work is not expedient, it remains that a significant portion of imposed sanctions could not be clarified as successful.

Felbermayer et al. (2020b) summarize a range of explanations for the seemingly constrained success of sanctions that were outlined by Hufbauer et al. (2007) and Drezner (1999). Starting that the chosen type of sanction may not be "optimal" for the considered objective. Followed by provoking an opposition of uniting citizens and domestic interests in the target country ("rallies behind the flag"), interventions by forceful allies of the target to counteract the consequences, the unequal distribution of sanction costs among the sender's allies and business interests could weaken cohesion in multilateral relationships, thereby diminishing their effectiveness. And lastly, policymakers might decide for sanctions viewing them as a less harmful alternative to military interventions. The empirical test and theoretical framework of Morgan and Schwebach (1997) indicate that economic sanctions are more likely to succeed the higher the costs for sanctioned countries are. Eaton and Engers (1992) also highlight the importance of costs, for sender and target countries, but as well as the critical role of timing for success of economic sanctions. Additionally, they discover that the sender's ability to ultimately achieve its objective is strengthen by the target's impatience and a low cost to the sender, yet conversely, compliance may be delayed by the cost to the target and the sender's patience.

In terms of the definition of success, about 60 to 70 percent of the cases could be considered as failures, but this does not necessarily indicate the impact they may have had, which is also criticized by Shin et al. (2016), who argue that existing studies are

mainly concerned with determining whether the sanctions imposed achieve their foreign policy objectives and are therefore successful, but often neglect to quantify the economic damage suffered by the sanctioned economies. Additionally, their empirical analysis with data from 133 countries from 1970-2005 could not find a significant impact on international trade, foreign direct investment and foreign portfolio investment and because of these results they questioned the potential damage of economic sanctions. However, there are contrary results from latest studies: Afesorgbor (2019) found a negative effect on bilateral trade between sender and target countries, Felbermayr et al. (2020b) and Gutmann et al. (2022) also show reductions in international trade. Biglaiser and Lektzian (2011) and Mirkina (2018) found significant negative effects on foreign direct investment (even though mostly in the short-run). A fairly novel event study by Gutmann et al. (2023) underscores these and other macroeconomic consequences of international sanctions for targeted states, showing significant negative effects on GDP growth, consumption, investment, trade, and foreign direct investment. Also, Neuenkirch and Neumeier (2015) is assessing econometrically the impact of economic sanctions on targets GDP growth rate by investigating, once multilateral sanctions set by the United Nations, and second unilateral sanctions set by the United States. They found that the multilateral sanctions had a significant influence on the target´s real GDP growth per capita, while on average the unilateral US-sanctions had a smaller impact on the real GDP growth per capita.

Although it may seem unsurprising that multilateral economic sanctions are on average more effective than unilateral ones, the results of Weber and Schneider (2020) support this statement, as they found that EU sanctions are on average more effective and therefore more successful than unilateral US sanctions, and that cases involving the EU and/or the UN are significantly more effective. Syropoulos et al. (2024) report contrary, in terms of international trade, that unilateral complete sanctions were more effective in reducing trade than multilateral sanctions after 1990. There may be nuanced differences between multilateral and unilateral, but nevertheless, economic sanctions seem to have an overall negative impact on economic growth, its components, and trade.

To demonstrate the impact of economic sanctions on a targeted country, the literature often employs qualitative analysis to interpret the effects of specific events on variables. The literature on sanctions is diverse and has examined a variety of cases, including the former Yugoslavia (Garfield 2001, Lamotte 2012) and South Africa (Levy 1999, Porter

1979) and more (like the cases of Cuba, China, Iraq). But the case of Iran stands out in the qualitative literature, according to Felbermayr et al. (2020b), since it's firstly one of the most intricate and widely debated instances in recent history. Secondly, the sanctions imposed on Iran exhibit multidimensional characteristics, varying in terms of country coverage (e.g., UN, US, EU), targeted sectors (e.g., military, finance, individuals), and duration (e.g., EU sanctions initiated in 2006 peaking in stringency by 2012). Thirdly, Iran sanctions are notable for their widespread international participation, as nearly all countries worldwide have implemented sanctions against Iran. And therefore, has provided a wealth of evidence on the impact of economic sanctions. Dizaji and van Bergeijk (2013) done a theoretical analysis of economic dynamics/adjustments and designed a broad set of vector autoregressive (VAR) models, for the economic sanctions against Iran (oil boycott), to investigate economic and political impact of economic sanctions. For that reason, the theoretical analysis and VAR approach form a "revealing picture", firstly, the most significant impact in terms of forgone utility is observed during the initial phase of the sanction episode. Secondly, the long-term benefit of compliance diminishes over the course of the sanction episode, proving to be lower in the long run. Consequently, they anticipate that sanctions are more likely to succeed in the early phase but have a reduced probability of success in the long term, since economic adjustments by the targets can alleviate the effects. To be concrete, the VAR models for the Iranian case indicate a significant impact on key economic variables (income, investment, government consumption, imports) in the first two years but turns negative after six to seven years.

Ghomi (2022) evaluate the macroeconomic effects (and poverty dynamics) of the sanctions against Iran, from 2012-2015, using the same Synthetic Control Method (SCM) that we will use later on too. He quantified the overall effect on the Iranian real GDP and found that the sanctions caused a 12.5% fall in the first year and around 19.1% 4 years after the imposition, which goes fairly along with similar results of Gharehgozli (2017) for the first three years (more than 17%). Additionally, Ghomi demonstrated that the impacts of the sanctions are persistent, as real GDP remained 5% lower even two years after their removal compared to what it would have been without them and concludes that the economic sanctions combined with poor domestic policies had a large significant negative impact on the economy. With a new time-series approach and an innovative measure of sanctions intensity derived from daily newspaper coverage, Laudati and

Peseran (2023) examined that the Iranian average annual growth, over the period 1989-2019, could have been around 4-5% instead of realized 3%. Simultaneously they reveal a significant decrease in oil export revenues, considerable depreciation of Iranian rial, increase in inflation and falls in output growth using a sanctions-augmented structural vector autoregressive (SVAR) model. The literature is even broader for the Iranian case for example the impact on the banking system (Dizaji 2021) or about impact on the informal/shadow economy (Farzanegan 2013, Farzanegan and Hayo 2019). However, in recent times, other sanctions have garnered significant attention from politicians, economists, and journalists, particularly the Western sanctions imposed on Russia in 2014/2015 and 2022. Despite this, there is still a relatively low amount of literature on the topic.

### *2.2 The Russian case*

Sanctions were first imposed on Russia in 2014 due to the annexation of Crimea. A second round of sanctions began in February 2022 following the Russian invasion of Ukraine. The EU and several other states, including the US, implemented the first sanction package. To date, the EU commission has imposed 13 sanction packages. It is worth examining the two sanction rounds and their effects separately, as the sanctions imposed in 2014 were significantly less extensive than the far more restrictive ones in 2022 in terms of scope. An early approach by Gurvich and Prilepskiy (2015) quantify and estimate the impact of financial sanctions on the Russian economy. The described several conclusions based on their quantitative evaluation first they estimated the total additional net capital outflow from 2014-2017 at USD 160-170 billion, secondly that the drop in oil prices had a much larger effect on the economy. The price drop leads to estimated GDP losses of 8.5 p.p. aggregately from 2014-2017, even though the estimated effect of the sanctions on GDP significant with -2.4% p.p. by 2017 the estimated effect of the oil price shock is 3.3 times larger. In 2019, the International Monetary Fund (IMF) analysed Russia's growth deceleration from 2014 to 2018 using international macroeconomic models. The study found that sanctions contributed to a reduction in Russia's growth rate by 0.2 percentage points annually during this period. However, the study also identified other significant factors, particularly Russia's macroeconomic policies. Low oil prices had a more substantial impact, subtracting approximately 0.7 percentage points from GDP growth each year. Furthermore, the implementation of restrictive macroeconomic

policies further suppressed growth rates. Ultimately, the impact of oil prices was greater than that of sanctions on Russia's economic performance. Underlining the more influential role of the oil price shock for the bad performance of Russian economy, Pestova and Mamonov (2019) using a Baysian VAR model to determine the effect of the sanctions in 2014-2015 on Russian GDP. They examine a decrease by 1.2% in Russian GDP and additionally suggest that sanctions worked through reduced investment from Russian entities. Kholodilin and Netsunajev (2019) investigate the direct and indirect impact of 2014 sanctions, on the Russian and European economies, using the SVAR method. The results show no strong evidence of negative direct effects on Russians GDP growth rate as well not on the euro areas GDP. Both parties' real effective exchange rates were subject to depreciation pressure, which may be attributed to the economic restrictions, that mostly made up by trade bans. However, for the ruble, a significant portion of the depreciation can be linked to the decline in oil prices in the summer of 2014, as noted by Dreger et al. (2016). Lastly Barseghyan (2019) used the SCM to estimate the causal economic effects of Russian sanctions and countersanctions and due this method they could estimate the pure effect excluding the effects of the oil price shock. They estimated an average loss of $1,337 per year in real GDP per capita due to sanctions and countersanctions. This suggests that GDP per capita would have been higher without them.

Regarding the impact of the recent sanctions, of 2022 and ongoing, the literature has still shortcomings. One approach to simulate the potential impact of the sanctions on Russia using a computable general equilibrium model of world trade is by Hosoe (2023). The model estimates that trade measures against Russia are expected to reduce its GDP by 3-7%, while the GDP losses for the senders would be minimal, at most 0.2% in Europe and 0.05% or less in other Western countries and Japan. The impact of sanctions would be more significant with a larger coalition. If non-Western countries, such as China, were to become involved - which is unlikely - it would have a significant impact. This would result in an additional one percentage point loss of GDP for Russia, while also increasing the effectiveness of sanctions and causing unintended harm to third parties. Also to mention is the possible impact on energy supplies that could affect all senders to some point. Another early approach by Pestova et al. (2022) forecast macroeconomics effects of the sanctions with a structural vector auto-regression model of the Russian economy. Their findings propose a decline in consumption, investment, and industrial production

and as well a contraction by -12.5% to -16.5% of the Russian GDP. Furthermore, they discussed a, at this time not yet entered into force, oil and gas embargo and its potential negative impact. Babina et al. (2023) discussed the impact on Russian crude oil and oil products exports using a high frequency Russian customs dataset. Russia was able to redirect their exports from Europe to alternative markets such as Turkey, India, and China. However, Russian exporters had to accept significant discounts in market segments affected by the embargo, resulting in lowered demand.

The literature on the impact of sanctions on Russia is quite clear: the 'weaker' sanctions from 2014 did not significantly impact the economy as a whole. Instead, the decline can mostly be traced back to the oil price shock. However, there is still no complete consensus on the impact of the 2022 sanctions, and often the assessments are from a forecasting perspective. Thus, we hope to be able to provide some further insights into the impact on Russia's economic growth with our work.

## 3. Empirical Approach

In order to estimate casual effects, related to case studies, the use of more advanced empirical methods offers several advantages. For example, the macroeconomic variables are normally identified to be non-stationary and extremely trending, therefore the risk that the estimated relationships could be spurious, and the use of OLS regressions would not be suitable (Beck, 2008; Kao, 1999). Billmeier and Nannicini (2013) mentioned that, many panel models only control for confounding factors that remain constant over time (fixed effect) or exhibit a shared trend (difference-in-differences) and regarding that issue Barseghyan (2019) note the advantage of using the SCM, which considers time-varying unobservable confounding factors. By using this method counterfactuals, also called synthetic control units, are built as a convex combination of unaffected units to estimate the causal effect of the intervention (imposed sanctions) as the difference in post-intervention periods between the constructed synthetic outcome and the actual outcome.

However, Newiak and Willems (2017, page 3.) in their IMF working paper give a short but clear explanation for the synthetic control method: "[SCM] involves constructing a 'synthetic control' for the treated unit. The synthetic control is constructed as a weighted average of units that do not undergo treatment over the sample period (the underlying idea being that a combination of non-treated units might make a better counterfactual than any individual one). The weights are chosen such that relevant economic characteristics

in the synthetic control unit, match the treated unit as closely as possible in the pre-intervention period. By comparing the subsequent evolution of an outcome variable in the synthetic control unit with that of the treated unit, one can obtain an estimate of the treatment effect."

### *3.1. Methodology*

Following Abadie and Gardeazabal (2003) and the further extensions of Abadie et al. (2010; 2015) it is supposed that there are J + 1 units observed over T periods, where only the first unit is exposed to the intervention and the remaining units build the potential controls. The set of possible controls will be known as the 'Donor Pool', and the referenced units are countries. Furthermore it is assumed that the sample is represented by a balanced panel so that all units are observed at the same time periods, t = 1, . . . , T. Additionally the sample includes a positive quantity of preintervention and postintervention periods, respectively $T_0$ and $T_1$ with $T = T_0 + T_1$. As stated above only unit one (Russia) is exposed to the intervention, in this case the imposed sanctions, during periods $T_0 + 1, \ldots, T$ and during the pre-treatment period $(1, \ldots, T_0)$ the intervention has no effect. The according objective of the study is the measurement of the impact of the intervention on a post-intervention outcome, which will be real GDP per Capita of the Russian economy. To let the SCM work properly it is necessary that the comparison countries, Donor Pool, are restricted to countries with outcomes which are thought to be driven by the same structural process as the country of interest. Obviously, the characteristics of the treated unit before the intervention can often be more accurately approximated by combining multiple untreated units rather than relying on a single untreated unit. Then the synthetic control is defined as a weighted average of the countries in the donor pool and can be represented by a J x 1 vector of weights $W = (w_2, \ldots, w_{J+1})'$, with $w_2 + \ldots + w_{J+1} = 1$ and $0 \leq w_j \leq 1$ for $j = 2, \ldots, J$. While choosing a synthetic control is equivalent to choosing a particular value for W. The authors recommend to selecting the values of W in a way that the characteristics of the treated unit are best resembled by the ones of the synthetic control, which follows Mill´s Method of Differences. It is important to mention that the critics of Mill's Method of Differences have raised valid concerns regarding its limitations. This is due to the fact that unmeasured factors can influence the outcome variable, and there is heterogeneity in the effects of both observed and unobserved factors. However, Abadie et Al. (2010) propose

the use of a linear factor model as a means of addressing these issues, they posit that by matching on preintervention outcomes, particularly when dealing with large datasets, it becomes possible to control for unobserved factors and the varying effects of observed and unobserved factors on the outcome of interest.

Now, let $X_1$ be a *k x 1* vector including the values of the treated country of the preintervention characteristics and $X_0$ be the *k x J* matrix containing the values of the same variables for the countries in the comparison group. The vector $X_1 – X_0W$ describes the difference between the preintervention characteristics of the treated country and a synthetic control. The synthetic control W*, that minimizes the size of this difference, is then selected. It can be concreted as followed. For $m = 1, \ldots, k$ and $X_{1m}$ as the value of the *m*-th variable of the treated country and the values of the *m*-th variables for the countries in the donor pool are contained in a 1 x J vector $X_{0m}$. According to the authors W* should be selected as the value of W that minimizes:

$$\sum_{m=1}^{k} v_m(X_{1m} - X_{0m}W)^2 \qquad (1)$$

Where $v_m$ describes a weight that reflects the relative importance that is assigned to the m-th variable when measuring the discrepancy between $X_1$ and $X_0W$. It is of critical importance that synthetic controls be constructed in such a way that they closely replicate the values that variables with a high predictive power on the outcome of interest take for the unit that has been affected by the intervention. This implies that those variables should be entrust with large $v_m$ weights.

Furthermore, let $Y_{jt}$ be the outcome of country *j* at time *t* and look at $Y_1$ as a ($T_1$ x 1) vector containing the postintervention values of the treated country, $Y_1 = (Y_{1, T0 + 1}, \ldots, Y_{1, T})'$. Additionally, $Y_0$ is a ($T_1$ x J) matrix, where the column j collects the postintervention values of the outcomes for the donor pool countries. Then the comparison of postintervention outcomes between treated country, which is the target of the sanctions in this case, and the synthetic control, $Y_1 – Y_0W$*, gives the synthetic control estimator of the effect of the treatment. In other words, for a postintervention period *t* (with $t \geq T_0$) the synthetic control estimator for the effect of the treatment:

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

Additionally, in Abadie et Al. (2015). the authors present an empirical application, using a cross-validation method, to choose the $v_m$ from equation (1). Where the pre-treatment period will be divided into a training period and a validation period. Using the measured predictors in the training, the weights $v_m$ are determined in such a way that the resulting synthetic control is optimized to minimize the root mean square prediction error (RMSPE). The RMSPE in our context measure the accuracy of how well the synthetic control fits the treated unit before the treatment.

$$RMSPE = \left( \frac{1}{T_0} \sum_{t=1}^{T_0} \left( Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2 \right)^{1/2} \tag{3}$$

It should be noted, for the later following empirical analysis, for the sake of clarity, that the RMSPE is not directly reported by STATA; rather, the root mean square error (RMSE) is reported. From a mathematical standpoint, both measures are highly analogous, employed to quantify the mean squared difference between predicted values and observed. The distinction between RMSE and RMSPE lies in their respective contextual contrast. RMSE assesses the overall fit of a model across both in-sample and out-of-sample data, whereas RMSPE is specifically tailored to evaluate the accuracy of predictions on out-of-sample data or in the pre-treatment period in SCM. In the context of SCM, Stata's RMSE is effectively used as RMSPE to assess the fit before the intervention.

After applying the methodology to examine the effect of the Western sanctions on the Russian economy, we additionally apply robustness exercises that were recommended by the authors. To be more concrete, we conduct placebo tests to figure the changes of observing effects of the same extent for the whole postintervention period and for each postintervention period if the treatment is assigned at random in the donor pool and a leave one out (loo) sensitivity analysis.

To apply the synthetic control method, we use the statistical program STATA including the software package of Synth2 by Yan and Chen (2023), which are written for this empirical analysis. Details on the selection of control countries and the data used are presented in the next section.

### *3.2. Data*

The data used in this empirical method comes from IMF world economic outlook, World Bank World Development Indicators (WDI) and EdStats Query database and are annual country level panel data of countries covering the period 2000-2025. This yields in a pre-sanction period of more than 20 years. The outcome variable, as previously stated, is the real GDP per Capita and comes from the World Economic Outlook database of the IMF. It is from crucial importance to mention that some value, especially from the period 2023-2025, are estimations calculated by the IMF (details which values are estimations can be seen in the dataset). In line with the approach employed by Gayane Barseghyan (2019), who utilized the synthetic control method to assess the impact of the 2014 Western sanctions on Russian real GDP per capita, the following pre-treatment characteristics were considered in examining economic growth: per capita real GDP, consumer price index (CPI), shares of industry (% of GDP) and agriculture(% of GDP) in value added, gross fixed capital formation (% of GDP), secondary education (Gross enrolment ratio), trade openness, GDP per capita growth, and lastly oil rents (% of GDP), since this is an important characteristic of the Russian economy. We further made clear that we use GDP per capita as a predictor but not as separated lags. Since the use of all outcome lags as separate predictors renders all other covariates irrelevant, regardless of their importance for accurately predicting post-treatment values of the outcome because it potentially threatens the unbiasedness of the estimator (Kaul et al. 2015). Lastly to mention that we took the logarithm for GDP per capita, shares of industry and agriculture, trade openness, gross fixed capital formation and secondary education to smoothen the values and reducing potentially outliers.

In identifying potential control countries within the donor pool, we utilize a country list of remaining countries (90 countries) provided in the Appendix by Neuenkirch and Neumeier (2015). This list was used to evaluate the impact of UN and US economic sanctions. It contains a diverse range of countries from different continents and economic characteristics, including developing countries with high natural resources and other

emerging markets. From these 90 countries we exclude all countries that imposed sanctions on Russia and therefore were subject to Russia's counter-sanctions. Furthermore, a number of additional countries are excluded from the analysis because of a poor or non-available data, including Venezuela. Conversely, two new countries are considered, namely Brazil and Turkey. The inclusion of both countries is predicated on their status as sizable, middle-income nations with a significant global impact and structural parallels with Russia. We end up with a total number of 59 remaining countries. In Abadie et al. (2010, 2015), the authors identify two potential issues for the donor pool: first, the concern about interpolation bias, which could arise when units in the donor pool exhibit disparate economic outcomes; and second, the possibility of an overly large donor pool, which could result in overfitting. To avoid these issues, we limit the donor pool further to a divergence of 80%, which has to be within 80%, in terms of the pre-period average value of the outcome variable of Russia. As a result, our baseline group consists of 19 countries.

## 4. Empirical Analysis

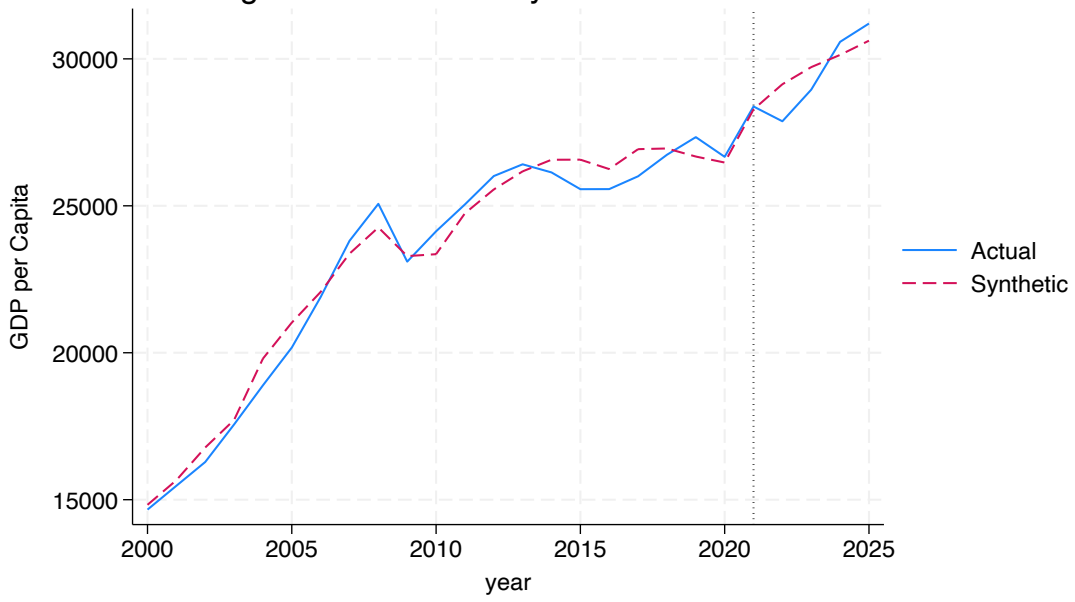
Our synthetic control estimates of the causal impacts of the western 2022 sanctions on the Russian GDP per capita, as well as the robustness and sensitivity analysis, are shown in this chapter.

### *4.1 Estimated effects*

Before we start with the actual Synthetic Control estimation it is advantageous to carry out the cross validation across the data as described before. The training period spanned the years 2000 to 2012, while the subsequent validation period extended from 2013 to 2021.

Through a convex combination of the countries in the baseline donor pool the Synthetic Russia is constructed in such a way that it, as close as, possible resembles the real Russia in terms of the predictor values of the outcome variable of the pre-sanction period. Figure 2 shows us already an accurate fit for the preintervention period of GDP per capita.

Figure 2 Actual and Synthetic Outcomes




The largest differences of the model to create the synthetic Russia can be seen in the time period of 2014-2018, this could be due to the first sanctions against Russia imposed in 2014. Immediately at the beginning of the treatment period, we observe a clearly different development of GDP per capita. When following the blue line of actual Russia, a clearly negative trend can be observed in the first year, which is 2022. If we follow the synthetic outcome, real GDP per capita would be noticeably higher had there been no sanctions imposed in 2022. This development seems to continue in 2023 and starts to do dimmish in 2024 and, very carefully interpreted, may even be positive in 2025.

The Synthetic Russia is constructed out of 60,50% Türkiye, 18,20% Kazakhstan, 17,00% Equatorial Guinea and 4,40% Oman (Table 1).

**Table 1 Optimal Unit Weights**

| Unit | Unit Weight |
|---|---|
| Türkiye | 0.605 |
| Kazakhstan | 0.182 |
| Equatorial Guinea | 0.17 |
| Oman | 0.044 |

Table 2a firstly presents some descriptive statistics, secondly it displays the covariate balance in the pre-treatment period which provides additionally the optimal weight each predictor variable receives and the comparison of the characteristics of actual Russia, Synthetic Russia and the average of the donor pool and lastly the treatment estimations

for the post-period. As we can see the synthetic control matches most of the predictors very well and our estimation is not relying exclusively or almost exclusively on the outcome variable GDP per Capita and most predictors had the opportunity to influence the construction of our synthetic Russia. The predictors with the largest weights are GDP per capita with 58,85%, oil-rents 34,12% and secondary education with 5,12%. Conversely, agriculture-share, gross capital formation, consumer price index and GDP per capita growth exhibited negligible or zero weights, as they were unable to adequately reflect the actual values of Russia. The model produces a root mean squared error value (RMSE) of 492,28458, which is a key metric in the Synthetic Control Method and provides information about the models fit. The Synthetic Control, for the 2014 sanctions, from Gayane Barseghyan (2019) reported 418,29. If we take into account that our model includes the 2014 sanctions and their potential impact, our RMSE is a valid value. Furthermore, we receive a $R^2$ of 0,98016 and it also indicates that the synthetic control model fits the pre-treatment data and as a consequence is a good approximation of the treated unit. Lastly, the synthetic control estimates a negative impact for the first two years and a lower positive in the last two periods. To be precise int 2022 the real GDP per capita would have been 1261,09$ more in the absence of western sanctions and in 2023 767,39$. However, as stated before the negative effect seems to dimmish in 2024 and maybe slightly further in 2025 and turns out to be positive for both years namely 444,79 and 583,11. It is from crucial importance to mention that this work is written during 2024 and thus these results should be viewed and considered with caution since the data of the actual outcome variable behind are based on estimations. This results in GDP per capita would have averaged 250,14$ more per year for the period 2022-2025.

When we take a look again into the literature of sanctions these results might be not too surprising. Neuenkirch and Neumeier (2015) found that the negative effect of UN and US sanctions both becomes smaller over time while the US sanctions effects are smaller and of less duration. In contrast to the preceding studies, Kwon et al. (2020) employ an instrumental variable (IV) approach. Their findings indicate that the negative impact of sanctions, as estimated by the standard OLS method, may be overstated. In other words, the effects of sanctions may be less severe than previously assumed. They observe an immediate impact on per capita GDP that dissipates over time, suggesting that the long-term effects of sanctions may be negligible. Lastly, Gardeazabal and Vega-Bayo1(2016) synthetic control found for some countries in their studies, about the effect of armed

conflicts on economic growth, positive estimations. They also named some more studies that received positive effects (see Guidolin and La Ferrara, 2007, 2010; Berrebi and Klor, 2010). The authors recognise that these can be classified into one of two categories. The first category comprises instances where the positive effect occurs after or before a strong negative effect. The second category encompasses cases where the years with positive effects are found to be non-significant.

**Table 2a Estimation Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| ***Treated Unit*** | Russia | | | | | |
| ***Number of Control Unit*** | 19 | | | | | |
| ***Number of Covariates*** | 9 | | | | | |
| ***Treatment Time*** | 2022 | | | | | |
| ***R2*** | 0.98016 | | | | | |
| ***RMSE*** | 492.28458 | | | | | |
| ***Covariate*** | ***Weight*** | ***Treated Unit*** | ***Synthetic Russia*** | ***Bias Synthetic*** | ***Average*** | ***Bias Average*** |
| ***GDP per capita*** | 0.5884552 | 10.0353 | 10.02514 | -0.101246 | 9.509859 | -5.235951 |
| ***Agriculture Share*** | 0.0000324 | 1.378975 | 1.63886 | 18.84626 | 1.899443 | 37.74309 |
| ***Gross fixed Capital Formation*** | 0.0000812 | 3.098056 | 3.282253 | 5.945573 | 3.250263 | 4.912999 |
| ***Industry Share*** | 0.0140777 | 3.416429 | 3.527623 | 3.254677 | 3.475398 | 1.726056 |
| ***Oil rents*** | 0.341239 | 9.705761 | 9.701905 | -0.0397327 | 5.976646 | -38.42166 |
| ***Trade Openness*** | 0.0031904 | 3.949885 | 4.172738 | 5.642012 | 4.329186 | 9.602845 |
| ***GDP per capita Growth rate*** | 0.0000379 | 3.580419 | 3.728164 | 4.126488 | 2.639163 | -26.28899 |
| ***Cpi*** | 0.0016622 | 99.86739 | 112.1877 | 12.33668 | 102.8505 | 2.987104 |
| ***Secondary Education*** | 0.051224 | 4.567111 | 4.461249 | -2.317917 | 4.134998 | -9.461403 |
| ***Time*** | ***Actual Outcome*** | ***Synthetic Outcome*** | ***Treatment Effect*** | | | |
| **2022** | 27876.858 | 29137.9453 | -1261.09 | | | |
| **2023** | 28952.704 | 29720.0918 | -767.39 | | | |
| **2024** | 30579.42 | 30134.6328 | 444.79 | | | |
| **2025** | 31202.544 | 30619.4336 | 583.11 | | | |

Note: The average treatment effect over the post-treatment period is -250.1444

It is worth to mention that the Cross Validation, that we have done before running the actual synthetic control, enhanced our estimation results in a positive way. We run the same code with all settings, same predictors and same donor pool just that we did not used a training period and a validation period. The fit of our model therefore gets noticeably poorer. We have condensed the most important results and summarized them in Table 2b. Without Cross Validation the model reports a RMSE of 560,19767 compared to 492.28458 of our used model which implies a poorer fit around 67,91319. Additionally, the $R^2$ is slightly less and we have a lower average effect over the post-treatment period.

**Table 2b. Main Estimations without Cross Validation**

| Treated Unit: | Russia |
|---|---|
| Number of Control Units | 19 |
| Number of Covariates | 9 |
| Treatment Time | 2022 |
| Average Treatment Effect | -158.3128 |
| R2 | 0.9759536 |
| RMSE | 560.19767 |

Especially the difference in the pre-RMSE reinforces the decision to use synthetic control with prior cross validation.

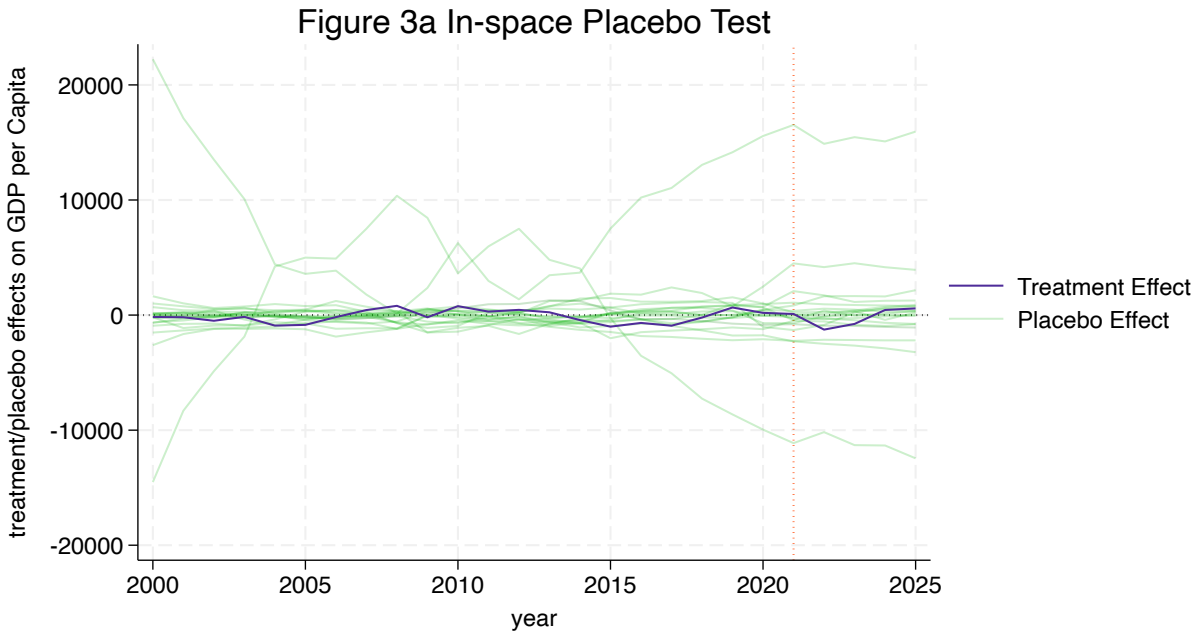
### *4.2 Robustness and Sensitivity Analysis*

In this section we will demonstrate a robustness test, so called in-space placebo test, to verify if our estimated treatment effects are statistically significant. After we run a leave one out sensitivity analysis to evaluate to what extent our results are driven by any particular control country from our chosen optimal units.

#### *4.2.1 In-Space Placebo-Test*

To evaluate if our estimations are significant, we conduct a so called in-space placebo test recommended by Abadie et al. (2010). This test basically runs the synthetic control method to the countries of the donor pool for the same sample period. If the placebo studies yield results that are of a similar magnitude to those estimated for Russia, our interpretation is that our analysis does not provide substantial evidence of a negative impact of sanctions on Russia's GDP per capita. Conversely, if the placebo studies indicate that the estimated gap for Russia is larger in comparison to the gaps observed in countries not subject to Western sanctions, our interpretation is that our analysis provides evidence of a negative effect. As mentioned by Abadie et al. (2010) the placebo runs even with poor fit in the pre-treatment period. Placebo tests using countries with poor pre-treatment fits are not useful for determining the rarity or significance of the post-treatment gap. Therefore, to maintain robustness, the analysis should exclude placebo countries with a high Mean Squared Prediction Error (RMSE) in the pre-sanction period, ensuring that only countries with a good pre-treatment fit are considered in the comparison.

Figure 3a shows the treatment effect for all countries when we would not exclude any countries based on their pre-RMSE.




We clearly can see some drastically outliers and decided to cut countries out of the placebo test that has a pre-MSPE three times higher than the one from Russia to enhance the robustness of our estimations which is illustrated in Figure 3b. After doing this common practice we see a clearly outstanding effect in the first post-treatment period of the blue line.

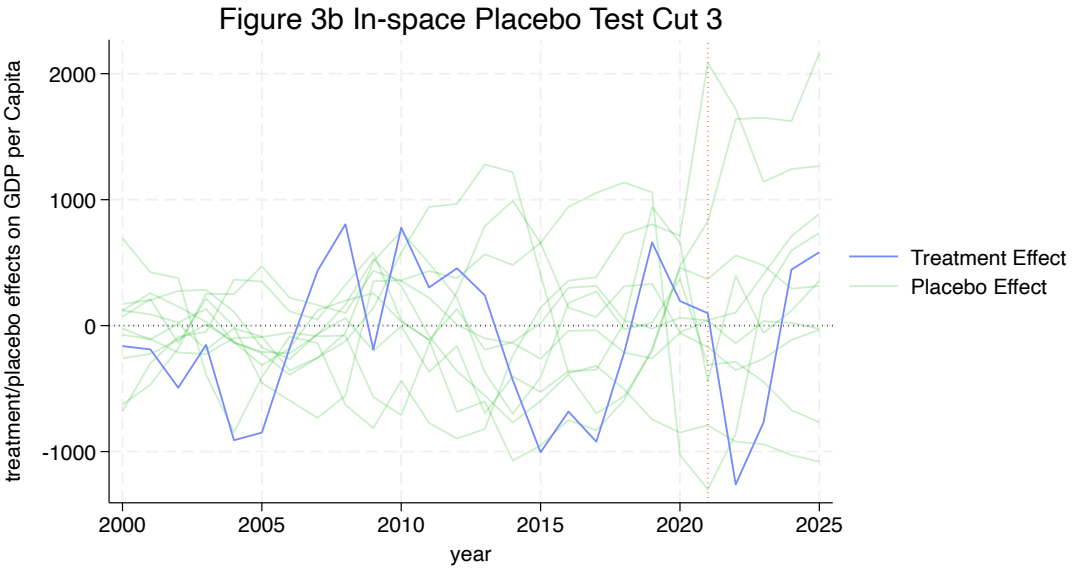


Table 3 provides the estimated p-values of the in-space placebo test. As stated in the notes below the table we should consider the left-sided p-value for negative treatment effect and the right-sided for positive.

**Table 3 In-Space Placebo Test**

| Time | Treatment Effect | two-sided p-value | right-sided p-value | left-sided p-value |
|---|---|---|---|---|
| 2022 | -1261.09 | 0.27 | 1.00 | 0.09* |
| 2023 | -767.39 | 0.36 | 0.91 | 0.18 |
| 2024 | 444.79 | 0.64 | 0.45 | 0.64 |
| 2025 | 583.11 | 0.64 | 0.45 | 0.64 |

Note: (1) The two-sided p-value of the treatment effect for a particular period is defined as the frequency that the absolute values of the placebo effects are greater than or equal to the absolute value of treatment effect. (2) The right-sided (left-sided) p-value of the treatment effect for a particular period is defined as the frequency that the placebo effects are greater (smaller) than or equal to the treatment effect. (3) If the estimated treatment effect is positive, then the right-sided p-value is recommended; whereas the left-sided p-value is recommended if the estimated treatment effect is negative. (4) Notes: * indicates the level of significance of 10%, ** a level of 5% and *** a level of 1%. In brackets we report the robust standard errors. Obs. are the observations for each regression.

In the case of real GDP per capita, the decline in 2022 is significant, which is estimated to be a $1261,09 loss compared to the synthetic counterpart. The probability of observing a decline of -767,39 in 2023 is 18%, which cannot be seen as statistically significant. The differences estimated for the other periods are not statistically significant (for 2024 and 2025, the estimated gains are $444,79 and $583,11, respectively).

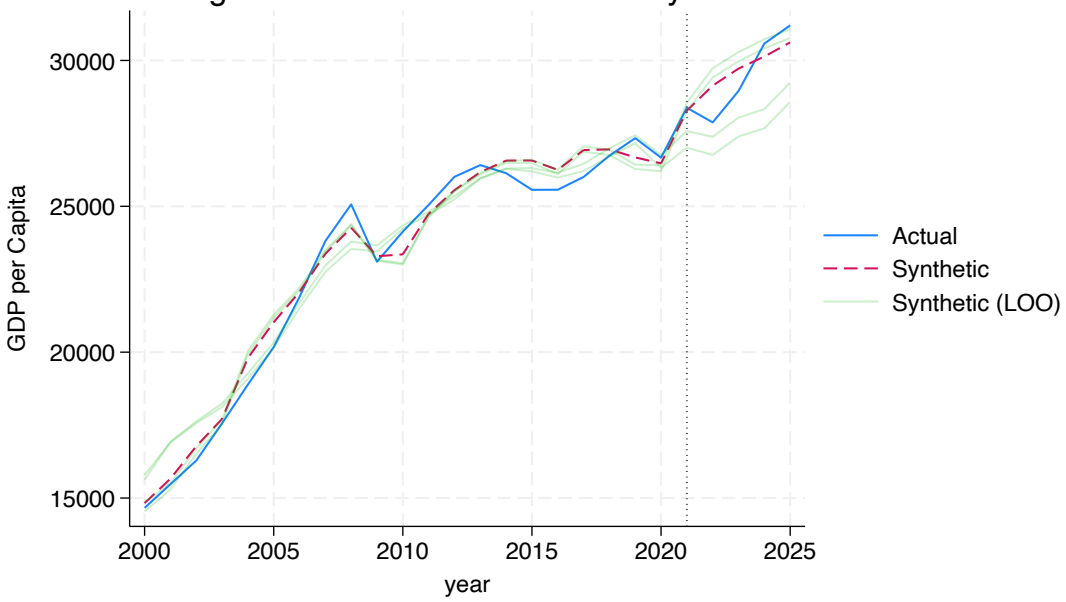
Additionally, Abadie et al. 2015 introduced another type of placebo study which they refer to as in-time placebo test. It is based on the premise that the confidence in synthetic control estimations is an accurate reflection of the impact sanction under scrutiny would be eroded if we were to observe estimated effects of similar or even greater magnitudes in periods where the intervention did not take place.

In this work we will not run the in-time placebo test. We decided not to conduct this additional test, because the authors explicit states that this test is feasible when there are available data for adequate large number of time periods without structural shocks to the outcome variable. Since our pre-treatment contains once the great recession from 2008-2009 and second the first sanctions against Russia from 2014/2015, we decided not to apply this test for our work to avoid potential biased conclusions.

### *4.2.2 Sensitivity Analysis*

This section runs a robustness check to test the sensitivity of our main estimations to changes in the country weights (see Abadie et al. 2015). Our optimal unit weights were Türkiye, Kazakhstan, Equatorial Guinea and Oman with decreasing weights. This test reestimate the baseline model to set up a synthetic Russia, leave out one of the countries that received a positive weight in each iteration. Although this approach sacrifices some precision in terms of fit, this sensitivity analysis enables us to assess to what extent our results are influenced by any particular control country. Figure 2 displays the result of the leave one out analysis while the grey line identifies the leave one out estimates.

Figure 4 Leave-one-out Sensitivity Test




Our analysis shows that the results we receive at the beginning cannot be justified as robust to the exclusion of any particular country from our donor pool of comparison countries. While the two grey lines above the synthetic control, namely Oman and Kazakhstan, point out a similar trend as our synthetic control even though they both would have estimated a slightly higher negative treatment effect, the two grey lines under our synthetic control, respectively Türkiye and Equatorial Guinea, differ strongly from the trend and indicate a positive treatment effect. Which means that our estimated treatment effects of the western sanction are relying on Türkiye and Equatorial Guinea and react sensitive to a removal.

## 5. Conclusion

In conclusion, this dissertation has examined a causal impact of the 2022 Western sanctions on Russia's GDP per Capita using the Synthetic Control Method (SCM). Our analysis shows that the sanctions have had a statistically significant negative effect on Russia's economy in the year where the sanctions were imposed, particularly in 2022, where GDP per Capita declined by approximately $1261,09 compared to the synthetic counterpart. While the effects seem to diminish in the following years, this may indicate some level of economic adjustment by Russia or other mitigating factors such as global economic recovery. The rising GDP per Capita could also be seen, when we look again at the actual development of it in the graph of Figure 2. Where we see a clearly decrease from the end of 2021 to the end of 2022 and after it an increasing trend occurs. Furthermore, it should be taken into account that Russia may have gained valuable experience from the sanctions imposed in 2014. This could have enabled the country to adapt its international relations and offset the negative effects of the more stringent sanctions introduced in 2022 more effectively. In light of this circumstance, even if the sanctions in 2022 were promptly and stringent, they may be in violation of the broader conclusion that, in particular when the objective is ambitious, sanctions should be imposed quickly and comprehensively, Elliot (2018). As a consequence, the effectiveness of these sanctions may be transient and did not have the long-lasting effect expected by policymakers. It is indisputable that the sanctions were a forceful political statement and a gesture of solidarity with the Ukrainian people. While they initially had a negative impact at the start, future research should investigate the economic toll the sanctions took on the countries imposing them and other potential effects the sanctions may had on various, more specific, fields in the economies as the energy industry, agriculture or financial sectors. It would be particularly illuminating to ascertain whether the burden fell primarily on the political elite or if the ordinary Russian citizenry bore a greater brunt. The decline in the GDP per Capita may suggest that the sanctions have had an impact beyond the immediate circle of the Russian elite, potentially reaching a broader population and, thus, ordinary civilians who bear no direct responsibility for the actions of their despotic leader or people in charge. However, this work is a relatively early approach to examine the effect of the Western sanction on Russia and should be looked at carefully since the post-period, as mentioned earlier, is relying on estimations and may

should be reconsidered for future research with more valid data available. Also, the role of the previous COVID-19 pandemic, at this point, is difficult to assess and if it should influence the choice of possible donor countries. In light of our sensitivity analysis, it may be advisable to consider a slightly altered Donor Pool, one that is more restricted to different limitations or expansive in scope.

In conclusion, it can be stated that the sanctions had a considerable impact on the Russian economy and its participants during the initial year of implementation, and that they had a discernible effect within Russia. Nevertheless, we know that the sanctions, whether they might too weak, too late, too few countries taking united action against the aggressions, or any other reason, had so far no impact on reversing Russia's actions and that the armed conflict continues and has even intensified.

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