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Where did it all go wrong for Russia in the 21st Century?

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Abstract

This paper uses the synthetic control method to predict how Russia could have developed under different scenarios in the 21st century. I construct the counterfactual for Russia starting in 2008, when Vladimir Putin's first tenure as president ended; starting in 2012, when Putin became president again; and starting in 2014, when Russia annexed Crimea and the Donbas War began. I find that Russia's GDP per capita growth path did not change after the presidential changes of 2008 or 2012; however, after the annexation of Crimea and the start of the Donbas War, the actual GDP per capita lagged behind the counterfactual one, with the gap between them reaching about 20% by 2019.

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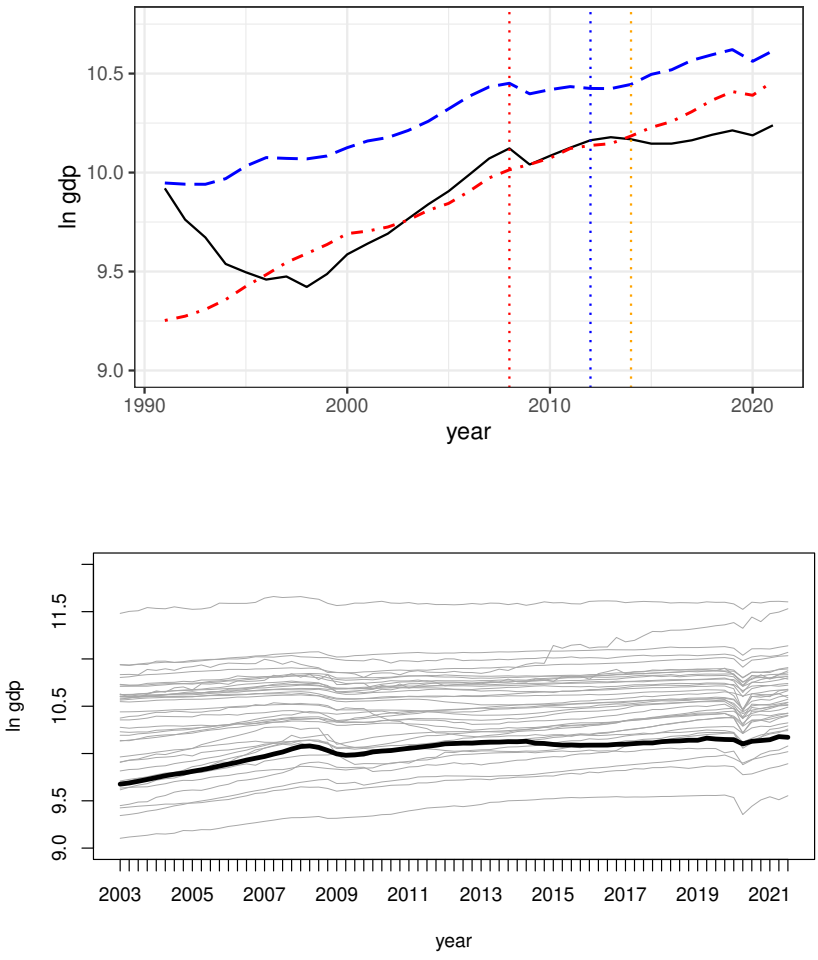
1 Introduction

Russia experienced a severe economic crisis in the 1990s, but by 2000, when Vladimir Putin first became president, Russia's economy began to grow. Compared with its former Eastern Bloc peers Poland and Czechia, Russia's real GDP per capita was growing substantially faster than Poland's between 2000 and 2008 and was catching up with Czechia's (see the top panel of Figure 1). After experiencing a downturn associated with the 2008 global financial crisis, Russia's economy continued to grow at the rate comparable to that of Poland. However, around 2014, when Russia annexed Crimea, the growth paths diverged: Russia's economy started to slow down, while Poland and Czechia continued to grow. This raises the question: when did it go wrong for Russia's economy in the 21st century? At what point did Russia's economic growth stall?

Figure 1: Real GDP per Capita in Russia and Other Countries



Notes: Top figure: dark black line – Russia's log real GDP per capita; red dash-dotted line – Poland's log real GDP per capita; blue dashed line – Czechia's log real GDP per capita. Bottom figure: dark black line – Russia's log real GDP per capita; light gray lines – log real GDP per capita in the control group.

To answer this question, this paper uses the synthetic control method (hereafter SCM),

proposed by Abadie and Gardeazabal (2003), along with its modifications, to predict how Russia could have developed under different scenarios in the 21st century. Following Korolev (2021), I apply the SCM to the logarithm of real GDP per capita. In addition to using the standard version of the SCM, I also utilize the demeaned version, which allows for a shift in levels and often results in a better match between the actual and synthetic unit, and the augmented SCM.

I construct the counterfactual for Russia starting in 2008, when Vladimir Putin's first tenure as president ended; starting in 2012, when Vladimir Putin became president again; and starting in 2014, when Russia annexed Crimea and the Donbas War began. These counterfactuals may be viewed as what could have happened to Russia if it had remained on the same path as during Putin's first tenure before 2008; if it had remained on the same path as under Dmitry Medvedev as president before 2012; and if Russia had not annexed Crimea and had not started supporting separatists in Eastern Ukraine in 2014.

I find that the counterfactuals for 2008 and 2012 match the actual performance of Russia's economy very closely all the way until 2014, meaning that Russia's economic performance did not change after the beginning of Dmitry Medvedev's tenure as president in 2008 or after Vladimir Putin's return to power in 2012. In contrast, after the annexation of Crimea and the start of the Donbas War, Russia's actual GDP per capita started to fall behind the counterfactual one. The gap between the counterfactual and actual units reached about 20% by 2019 and is statistically significant.

While this paper focuses on recent events, it contributes to the quickly growing literature on new Russian Economic History, reviewed in Zhuravskaya et al. (2024). The remainder of the paper is organized as follows. Section 2 provides background on the economic and political events in Russia in the 21st century. Section 3 describes the data and methods I use. Section 4 presents my main results. Section 5 contains a number of robustness checks. Section 6 discusses my results, and Section 7 concludes.

2 Background

On February 24, 2022 Russia invaded Ukraine, and a large-scale Russo-Ukrainian War began. The underlying conflict started much earlier, when Russia annexed Crimea and started supporting pro-Russian separatists fighting against Ukraine in the Donbas War in 2014.[1] In addition to the loss of life and major humanitarian crisis, the war also lead to wide-scale international sanctions on Russia (see, e.g., Babina et al. (2023)). While there may not be enough macroeconomic data to accurately assess the impact of the war on Russian or Ukrainian economy, there is enough data to evaluate the impact of the conflict that started in 2014. I also use alternative "intervention" dates, 2008 and 2012, to construct different counterfactuals.

The quarterly data that I use starts in 2003, when Vladimir Putin already was president of Russia. Figure 1 provides a background on Russia's economy. The top panel, which uses the annual World Bank data, compares Russia to two other Eastern European countries: Poland and Czechia, which were part of the Eastern Bloc and also experienced the transition to capitalism in the 1990s. The bottom panel of the figure compares Russia to the other

[1] https://commonslibrary.parliament.uk/research-briefings/cbp-9476/

countries in the OECD dataset.

After the collapse of the Soviet Union, Russia experienced a major downturn, but by the beginning of the 21st century, Russia's economy started to grow. During Vladimir Putin's first presidency, between 2000 and early 2008, Russian real GDP per capita was growing at about 7% a year. This growth may partly be explained by high oil prices. But in addition to the oil price dynamics, there were many economic and political events that might have played a role in Russia's economic growth in the early 21st century, some positive and some negative. Not all of these events affected the economy directly, but many of them affected Russia's institutions, and Acemoglu et al. (2005) argue that good institutions play a crucial role in economic growth and prosperity. In 2001, Russia's state-controlled energy corporation Gazprom seized control of NTV, Russia's major independent television network.[2] In 2003, Mikhail Khodorkovsky, a Russian tycoon and Vladimir Putin's critic, was arrested on charges of fraud and tax evasion and later sentenced to a lengthy prison sentence.[3] In 2004, Vladimir Putin signed a bill that eliminated direct gubernatorial elections in Russian regions.[4] Several notable journalists, such as Yuri Shchekochikhin, Paul Klebnikov, and Anna Politkovskaya, were assassinated or died under mysterious circumstances. All these events happened during Vladimir Putin's first tenure, and they can be viewed as an attack on political and media freedom.

At the same time, Russia's 2001 tax reform reduced the personal income tax rates and, as shown in Gorodnichenko et al. (2009), improved compliance and reduced tax evasion. In 2003, Russia became a member of the Bologna Process in higher education, which Vladimir Putin described as "a significant, serious step in Russia's integration in the global space."[5] Throughout the 2000s, Russia gradually introduced the unified state exam for high school graduation and college applications, and Francesconi et al. (2019) show that its introduction increased mobility and improved access to higher education.

In 2008, Putin's first tenure as president ended and Dmitry Medvedev became president. The counterfactual that corresponds to 2008 may be viewed as what could have happened if Russia had remained on the same growth path as during Vladimir Putin's first tenure. It is not clear ex ante whether one would expect Russia's growth path to change in 2008. On the one hand, Medvedev was endorsed by Vladimir Putin in 2007, when his candidacy was announced, and, as noted by Treisman (2012), there were also reforms that made Russia more authoritarian, such as lengthening the presidential term from four to six years. Moreover, Vladimir Putin was prime minister of Russia during Dmitry Medvedev's tenure as president, and Medvedev would arguably need Putin's consent for any reform (Treisman (2012, p. 145)).

On the other hand, some people believe that Dmitry Medvedev was more pro-Western and more liberal than Vladimir Putin (Treisman (2012, p. 138)), and during his tenure, there were some reforms aimed at battling corruption (Treisman (2012, p. 140)) or facilitating

[2] https://www.washingtonpost.com/archive/politics/2001/04/15/russian-network-seized-in-raid/e9679fb0-31cb-4b9c-b07f-204b488f40ad/

[3] https://www.washingtonpost.com/archive/politics/2003/10/26/russian-tycoon-and-putin-critic-arrested-in-raid/22e60f62-2db0-4dc3-b95c-cc90c0cbc1bf/

[4] https://www.rferl.org/a/1056377.html

[5] https://russiancouncil.ru/en/analytics-and-comments/analytics/russia-and-the-bologna-process-20-years-later/

economic growth. In 2010, the Skolkovo Innovation Center was established in an effort to facilitate innovation.[6] In 2011, Russia's Presidential Council for Civil Society and Human Rights conducted a public legal examination of the criminal case of Mikhail Khodorkovsky. This examinations was done by a group of Russian and foreign experts and concluded that there were serious violations of the rule-of-law during the trial.[7] Even as late as 2011–2012, there were some measures to improve Russia's integration into the international system of higher education: in 2012, it was announced that Russia would recognize degrees from top-ranked foreign universities as part of an effort to hire more professors with foreign degrees.[8]

In addition to other reforms that happened during Medvedev's tenure, Russia started implementing a large-scale military reform in 2008. The goal of the reform was to transition to a more professional and efficient army.[9] In particular, the proportion of conscripts in the army was supposed to decrease from 50% to 20%,[10] and Russia increased its spending on arms and military equipment.[11] It is not necessarily clear whether the reform was successful (de Haas (2011)), and Russia's then defense minister Anatoly Serdyukov was fired in 2012 over a corruption scandal.[12] As for the effects of the military reform on Russia's economy, military expenditure as percentage of GDP was roughly constant at about 3% between 2004 and 2008, then increased to 3.9% in 2009 before dropping down to about 3.5% in 2010 and 2011. Between 2012 and 2015, it steadily increased to 5.4%, but then decreased to about 3.5-4% in 2017-2021.[13] It is fairly unlikely that these fluctuations alone could have a large effect on Russia's economic performance. However, if the military reform itself did affect Russia's economy in a noticeable way, one would arguably see its effects in the counterfactual for 2008 or 2012.

In 2012, Vladimir Putin returned to power. His return to office happened amidst large-scale protests in December 2011, following the 2011 Russian parliamentary elections that many people viewed as unfair.[14] As argued by McFaul (2021), Dmitry Medvedev tried to engage the Russian opposition. In contrast, Vladimir Putin ended negotiations with his opponents, and Russia enacted new legislation to crack down on civil society, ban many rights and symbols of the LGBT community, and outlaw peaceful assembly and criminalize participation in unsanctioned protests (McFaul (2021, p. 22)). Thus, the counterfactual

[6] https://knowledge.wharton.upenn.edu/article/skolkovo-case-study-government-supported-innovation/

[7] https://khodorkovsky.com/resources/presidential-council-of-the-russian-federation-for-civil-society-and-human-rights/

[8] The announcement was made when Vladimir Putin became president again; however, the reform was prepared during Dmitry Medvedev's tenure. https://www.universityworldnews.com/post.php?story=20111202223553456, https://www.chronicle.com/article/russia-will-recognize-degrees-from-top-ranked-foreign-universities/

[9] https://www.iar-gwu.org/blog/2018/02/22/russias-new-look-military-reforms-and-their-impact-on-russian-foreign-policy

[10] https://css.ethz.ch/content/dam/ethz/special-interest/gess/cis/center-for-securities-studies/pdfs/CSSAnalyse152-EN.pdf

[11] https://valdaiclub.com/files/11447/, p. 31

[12] https://www.france24.com/en/20121106-russias-putin-fires-defence-minister-over-corruption-scandal-Anatoly-Serdyukov

[13] https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=RU

[14] https://www.bbc.com/news/world-europe-16122524, https://www.businessinsider.com/eu-court-putins-party-rigged-the-2011-russian-elections-2017-6

that corresponds to 2012 may be viewed as what could have happened if Russia had stayed on the same growth path as during Dmitry Medvedev's tenure as president, which arguably was less authoritarian than Putin's second tenure. If Vladimir Putin's second tenure had an immediate negative effect on Russia's economy, that would be visible in the counterfactual that starts in 2012.

Finally, in 2014, Russia annexed Crimea and started supporting separatists in Eastern Ukraine in the Donbas War. Eight years later, in February 2022, Russia began a full-scale invasion of Ukraine. Amid the growing tensions with the West, some of earlier policies and initiatives were reversed: for instance, in 2022–2023 Russia announced its shift away from the Bologna Process in higher education.[15] The counterfactual that corresponds to 2014 may be viewed as what could have happened during Vladimir Putin's second tenure as president if Russia had stayed away from Ukraine.

3 Data and Methodology

This section describes the data and methods used in this paper. In my main analysis, I use the quarterly real GDP per capita data, PPP adjusted, for 2003 Q1 – 2021 Q3, compiled by OECD.[16] Let $y_{j,t}$, $j = 1, ..., 31$, $t = 1, ..., 75$, be the outcome variable, such as the natural logarithm of GDP per capita, in country j in period t ($t = 1$ corresponds to 2003 Q1, while $t = 75$ corresponds to 2021 Q3). I use natural logarithms instead of levels based on my results in Korolev (2021), where I show that the synthetic control method tends to work better after the log transformation. I order the countries so that $j = 1$ corresponds to Russia, the treated unit. The period of treatment T_0 varies depending on the counterfactual I consider: 2007 Q4, 2011 Q4, or 2013 Q4. The observed outcome is

$$y_{j,t} = d_{j,t} y^1_{j,t} + (1 - d_{j,t}) y^0_{j,t},$$

where $y^0_{j,t}$ is the potential outcome of unit j in year t if it is not treated and $y^1_{j,t}$ is its potential outcome if it is treated. $d_{j,t}$ is the treatment dummy equal to 1 for $j = 1$ and $t \geq (T_0 + 1)$ and equal to 0 for all other observations. My goal is to predict how Russia could have developed in various counterfactuals, i.e. to estimate $y^0_{1,t}$ or, alternatively, estimate the "treatment effect" $y^1_{1,t} - y^0_{1,t}$ for $t \geq (T_0 + 1)$.

I estimate the counterfactual $y^0_{1,t}$ using panel data by

$$\hat{y}^0_{1,t} = \hat{\alpha} + Y'_{-1,t}\hat{\beta},$$

where $Y_{-1,t} = (y_{2,t}, ..., y_{J+1,t})'$, $J = 38$, are the outcomes for the countries in the control group, and $\hat{\alpha}$ and $\hat{\beta}$ are some estimates. These estimates are typically obtained from the estimated relationship between the observed outcome $y_{1,t}$ and the predictors $Y_{-1,t}$ using the period before the intervention.

However, estimating $\hat{\alpha}$ and $\hat{\beta}$ using the unrestricted regression may be problematic. From

[15] https://moderndiplomacy.eu/2022/06/13/who-is-cutting-ties-with-whom-russia-and-the-bologna-education-system/, https://meduza.io/en/news/2023/05/12/russia-s-higher-education-system-drifts-away-from-bologna-process.

[16] https://stats.oecd.org/index.aspx, the series code is HVPVOBARSA.

the statistical point of view, the primary concern is overfitting. Because the number of countries in the control pool, $J = 38$, is almost as large as, or even larger than, the number of pre-treatment observations, $T_0 = 20$, 36, or 44, depending on the counterfactual, estimating the unrestricted regression

$$y_{1,t} = \alpha + Y'_{-1,t}\beta + \varepsilon_{1,t}, \quad E[(1 \quad Y'_{-1,t})\, \varepsilon_{1,t}] = 0,$$

may result in unreliable estimates that have high variance or may even be completely infeasible (when $J > T_0$). Thus, one needs to use some form of variable selection or regularization in order to avoid overfitting. From the economic point of view, using the parameters that solve the unrestricted problem may be unattractive because they may be difficult to interpret. Imposing certain constraints may make the resulting counterfactual easier to interpret.

The synthetic control method addresses these concerns by requiring that the parameters be non-negative and sum up to one. From the statistical point of view, it regularizes the estimates, reducing the variance and preventing overfitting. From the economic point of view, it improves interpretability because the synthetic unit can be viewed as a weighted average of the units in the control group.

The requirement that the weights sum up to one may seem somewhat ad hoc, and Doudchenko and Imbens (2016) discuss various possible alternative restrictions on the weights. However, the restrictions that the SCM imposes make the results easier to interpret, which might explain why it has become popular in applied work (see, e.g., Abadie and Gardeazabal (2003), Abadie, Diamond, and Hainmueller (2010), Pinotti (2015)).

In my description of the SCM, I follow the exposition of Doudchenko and Imbens (2016), because their setting is closest to mine. In particular, I do not have any additional regressors based on which I could match the treated and control units. I also assign the same weight to all periods before the intervention (in other words, use the ordinary least squares objective function rather than the weighted least squares objective function) because there is no ex ante reason to assign different weights to different quarters. The synthetic control weights β_j solve:

$$\min_{\beta} \sum_{t=1}^{T_0} (y_{1,t} - Y'_{-1,t}\beta)^2 \quad \text{subject to} \quad \sum_{j=2}^{J+1} \beta_j = 1, \beta_j \geq 0, j = 2, ..., J+1$$

The counterfactual is given by

$$\hat{y}^0_{1,t} = Y'_{-1,t}\hat{\beta}_{sc},$$

where $\hat{\beta}_{sc}$ are the synthetic control coefficients (weights).

One potential drawback of the SCM is that it rules out a parallel shift in trends (see, e.g., Doudchenko and Imbens (2016)). In other words, if the treated country and all countries in the donor pool have parallel trends but different levels of the outcome variable, then the SCM will fail to find a good match. In order to solve this issue, one could include the intercept term in the synthetic control problem. Alternatively, one could demean the outcome variable in the pre-treatment period for each unit, i.e. compute $\tilde{y}_{j,t} = y_{j,t} - \bar{y}_j$,

where $\bar{y}_j = T_0^{-1} \sum_{t=1}^{T_0} y_{j,t}$, and then apply the SCM to the demeaned data:

$$\min_{\beta} \sum_{t=1}^{T_0} (\tilde{y}_{1,t} - \tilde{Y}'_{-1,t}\beta)^2 \quad \text{subject to } \beta_j \geq 0, \sum_{j=2}^{J+1} \beta_j = 1,$$

where $\tilde{Y}_{-1,t} = (\tilde{y}_{2,t}, ..., \tilde{y}_{J+1,t})'$. The counterfactual becomes

$$\hat{y}^0_{1,t} = \bar{y}_1 + \tilde{Y}'_{-1,t}\tilde{\beta}_{sc},$$

where $\tilde{\beta}_{sc}$ are the synthetic control coefficients obtained using the demeaned data.

I use both the standard and demeaned versions of the SCM and implement them using the **augsynth** package[17] in R by Ben-Michael et al. (2021).

4 Results

In this section, I present my main empirical results. Here, I focus on the SCM with quarterly data, and then consider additional methods later as robustness checks.

Figure 2 presents the counterfactuals that I obtain with the traditional SCM (top panel) and its demeaned version (bottom panel). The red dashed line corresponds to the counterfactual for 2008; the blue dashed one, for 2012; and the orange dash-dotted one, for 2014. The counterfactuals that I obtain for three different dates are virtually identical to each other, so the three lines look almost indistinguishable on the plots. The results of the standard SCM and demeaned SCM are very similar to each other, as well.

It appears that Russia remained on the same "growth path" as during Vladimir Putin's first tenure all the way up to 2014. Namely, the counterfactuals that start in 2008, when Dmitry Medvedev became president, match the actual performance of Russia's economy in 2008–2012 very closely. In other words, it appears that Dmitry Medvedev's tenure did not have any effect, positive or negative, on Russia's economy.

Vladimir Putin's return to power in 2012 did not have any effect on Russia's economy either, as the counterfactuals that start in 2012 very closely match the actual performance of Russia's economy in 2012 and 2013. These findings are consistent with the hypothesis that Dmitry Medvedev might not have acted independently, and Vladimir Putin's return to presidential office was not a major departure from the political regime of 2008–2012. In fact, Putin's role swap with Medvedev became known in Russia as "rokirovka,"[18] (castling in chess), implying that its actual significance was fairly limited.

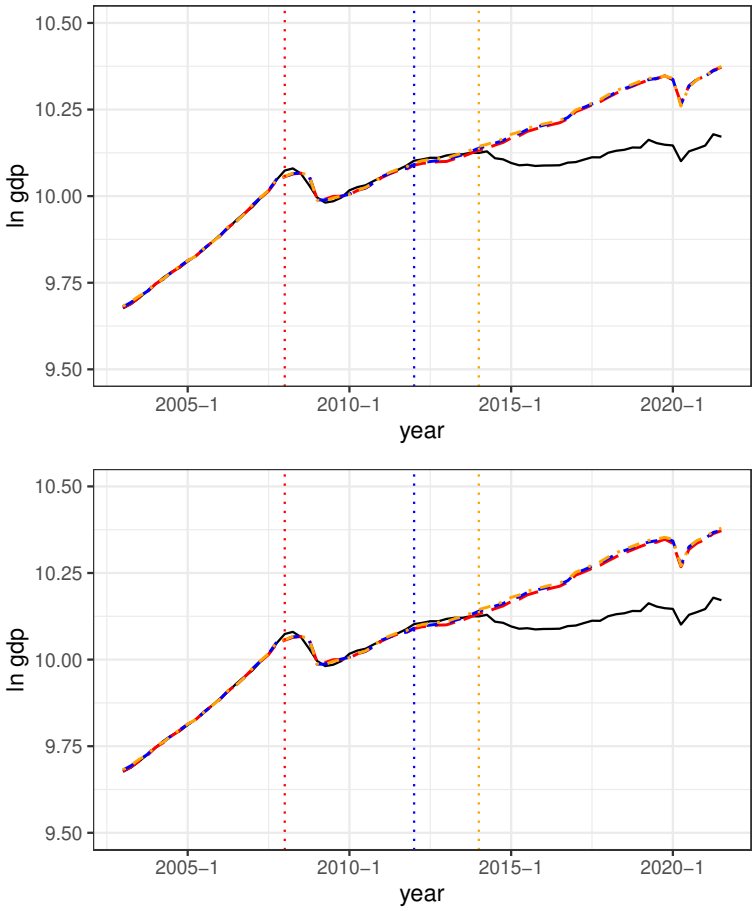
In contrast, the annexation of Crimea and the subsequent events in Eastern Ukraine led to a huge gap between the counterfactuals and the actual economic performance. The point estimates for 2015 in most specifications are around -0.1 and reach almost -0.2 by 2019. Given that I use logarithms, this implies that Russian GDP per capita decreased by about 10% around 2015 and by close to 20% around 2019 compared to the counterfactuals that I

[17] https://github.com/ebenmichael/augsynth

[18] https://carnegieendowment.org/2020/05/07/putin-regime-cracks-pub-81726, https://www.nytimes.com/2011/12/12/world/europe/huge-moscow-rally-suggests-a-shift-in-public-mood.html

construct.

Figure 2: Actual and Counterfactual Real GDP per Capita



Notes: Black solid line – actual log real GDP per capita. Red dashed line – counterfactual log real GDP per capita, 2008. Blue dashed line – counterfactual log real GDP per capita, 2012. Orange dash-dotted line – counterfactual log real GDP per capita, 2014. Top: synthetic control method. Bottom: synthetic control method, demeaned.

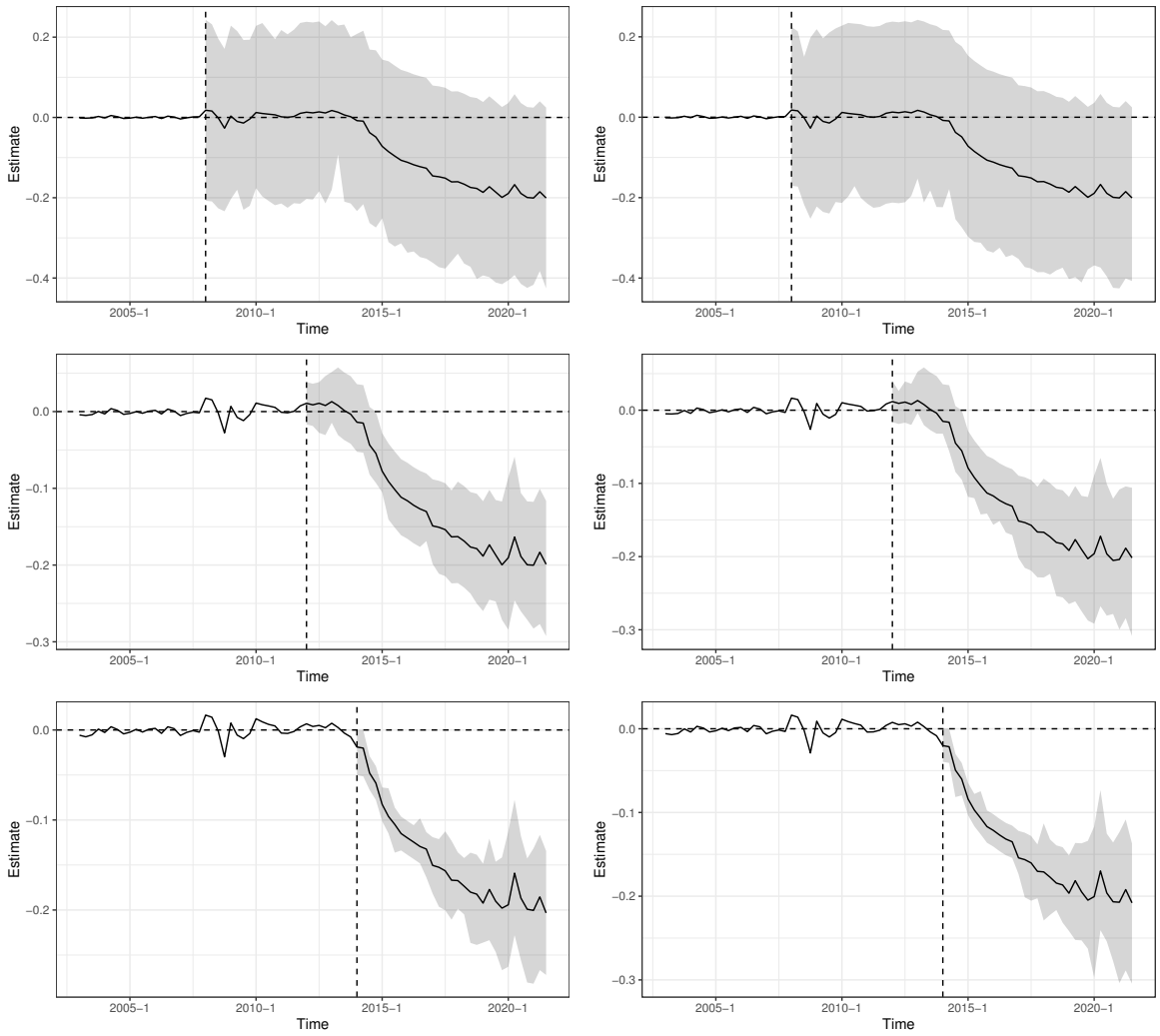
I conduct inference on my estimates using the conformal inference procedure developed by Chernozhukov et al. (2021) and implemented in the **augsynth** package by Ben-Michael et al. (2021). Figure 3 plots the estimated "treatment effects," i.e. the gaps between the actual and counterfactual log real GDP per capita, $y_{j,t} - \hat{y}_{j,t}$, for 2008, 2012, and 2014. The solid lines show the point estimates, while the shaded gray regions show the 95% pointwise confidence intervals.

The confidence intervals for 2008 are very wide and asymmetric. As a result, none of the point estimates for 2008 are statistically significant. For the remaining two intervention dates, 2012 and 2014, the confidence intervals are much narrower and are fairly symmetric around the point estimates. Point estimates become negative and statistically significant around the end of 2014 or beginning of 2015, soon after the annexation of Crimea.

I should point out that the inference procedure that I use was designed for the standard SCM and not for the demeaned SCM. Given that the demeaned SCM involves preliminary

estimation, the confidence intervals may become invalid. However, given that the results of the standard SCM and the demeaned SCM are virtually identical, I believe this is not a major concern in the current setting.

Figure 3: Synthetic Control Estimates



Notes: Black solid line – difference between the actual and counterfactual log real GDP per capita for Russia. Gray shaded region – 95% confidence interval. Left: synthetic control method. Right: synthetic control method, demeaned. Top panel: 2008. Middle panel: 2012. Bottom panel: 2014.

Table 1 presents the synthetic control weights in different specifications: the standard and the demeaned versions of the SCM for 2008, 2012, and 2014. The footnotes to the table lists all countries in the donor pool. While the exact weights vary, in all six specifications the synthetic unit consists mostly of Eastern European countries. Namely, Lithuania, Romania, and Slovak Republic receive the weight of around 0.2–0.3 each in most specifications, and their combine weight varies from 0.65 to almost 0.8. Two other countries that receive non-zero weights in all specifications are Korea and Latvia.

Table 1: Synthetic Control Weights

Country	Standard			Demeaned		
	2008	2012	2014	2008	2012	2014
Bulgaria	0.135	0.075	0.022	0.141	0	0
Chile	0	0	0.089	0	0	0.050
Colombia	0	0.032	0	0	0	0
Korea	0.135	0.118	0.037	0.133	0.170	0.086
Latvia	0.071	0.057	0.036	0.070	0.058	0.035
Lithuania	0.184	0.215	0.249	0.182	0.221	0.261
Poland	0	0	0.049	0	0	0.046
Romania	0.223	0.211	0.209	0.222	0.236	0.214
Slovak Republic	0.252	0.290	0.309	0.252	0.315	0.308

Notes: The table presents the composition of the synthetic control units in various specifications. The donor pool includes 38 countries: Australia, Austria, Belgium, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Korea, Latvia, Lithuania, Luxembourg, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, United Kingdom, and United States.

5 Robustness Checks

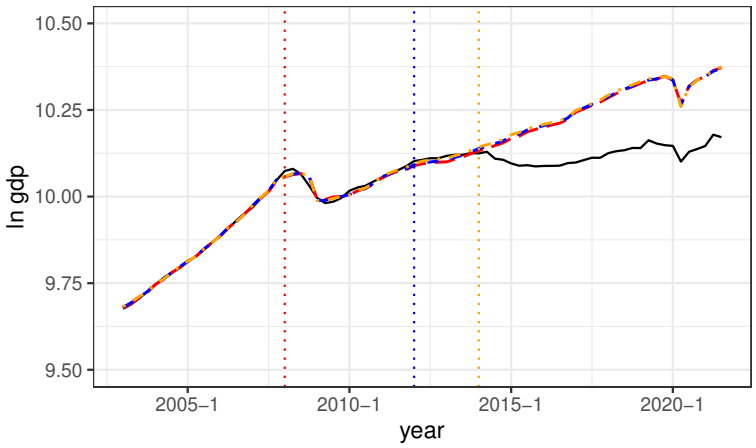
In this section, I present a number of robustness checks. I start with the augmented synthetic control method, then address possible concerns about oil dependence, and then utilize recently developed structural time series models.

5.1 Augmented Synthetic Control Method

First, I follow Ben-Michael et al. (2021) and use the augmented synthetic control method. They argue that the standard SCM only works well when the pre-treatment fit is excellent and propose an extension, the augmented SCM, that improves the SCM in settings when this is not the case. The augmented SCM estimates the bias due to the imperfect fit and de-biases the original estimate, using ridge regression as an outcome model. Unlike the standard SCM, the augmented SCM can result in negative weights on some of the donor units.

Figure 4 presents the counterfactuals from the augmented SCM. In the current setting, the estimated bias is exactly zero for all counterfactuals I consider, so the standard SCM and the augmented SCM estimates are identical. This indicates that the pre-treatment fit is indeed good and the standard SCM should work plausibly well.

Figure 4: Actual and Counterfactual Real GDP per Capita, Augmented SCM



Notes: Black solid line – actual log real GDP per capita. Red dashed line – counterfactual log real GDP per capita, 2008. Blue dashed line – counterfactual log real GDP per capita, 2012. Orange dash-dotted line – counterfactual log real GDP per capita, 2014.

5.2 Oil Dependence

One could be concerned that the synthetic units that I construct do not include any major oil producing countries, while in fact Russia's economy heavily depends on oil and gas production and exports. The global price of oil decreased rapidly in the second half of 2014, so one may wonder whether Russia's economic underperformance could be explained by falling oil prices. I perform two robustness checks to address this concern.

Table 2: Countries by Oil-Dependence

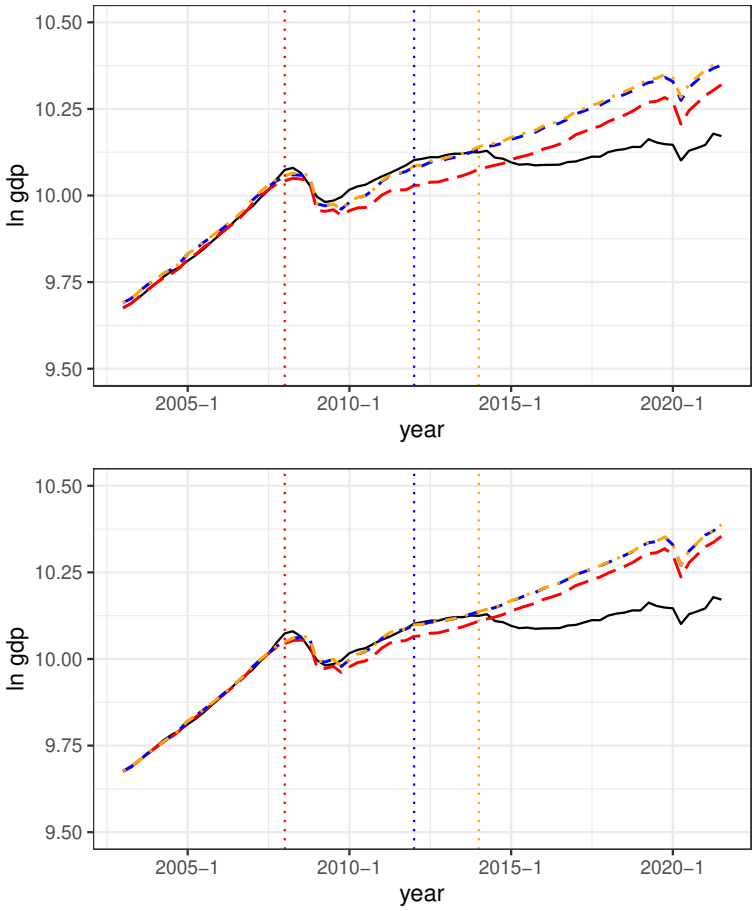
Country	Fuel exports (% of merchandise exports)	Oil rents (% of GDP)	Natural gas rents (% of GDP)	Natural resources rents (% of GDP)
Russia	63.01	10.73	3.19	16.27
Norway	67.62	7.50	1.92	9.50
Colombia	45.97	4.66	0.14	6.70
Australia	25.87	0.76	0.36	5.30
Canada	24.42	1.50	1.11	3.90
Lithuania	23.50	0.11	0.00	0.52
Greece	20.32	0.01	0.00	0.19
Bulgaria	13.28	0.03	0.04	1.60
Croatia	12.93	0.38	0.35	0.92
United Kingdom	11.01	0.66	0.19	0.86

Notes: The table shows the median values based on the annual data from 2003 to 2013.

First, I perform the robustness check using the quarterly OECD GDP dataset. It does not include major oil producing countries such as Brazil, Mexico, Saudi Arabia, or the United Arab Emirates. Nevertheless, I try to select countries where oil production or fuel exports

play a relatively important role. Table 2 displays the top-10 countries in the OECD dataset in terms of the fuel exports as a percentage of merchandise exports. These top-10 countries happen to be the ones where fuel exports exceed 10% of merchandise exports. The table also displays oil, natural gas, and total natural resources rents as a percentage of GDP.[19] The numbers displayed are the medians based on the annual data from 2003 to 2014. Norway has higher fuel exports than Russia but somewhat lower oil, gas, and total natural resources rents. Colombia has fairly high values of fuel exports, oil rents, and total natural resources rents, but lags behind Russia in terms of natural gas rents. Other countries trail Russia even more. Nevertheless, the 9 countries (other than Russia) displayed in the table are arguably the best available control group in the OECD dataset in terms of oil dependence, so I will use them as a robustness check.

Figure 5: Actual and Counterfactual Real GDP per Capita, Oil Dependence



Notes: Black solid line – actual log real GDP per capita. Red dashed line – counterfactual log real GDP per capita, 2008. Blue dashed line – counterfactual log real GDP per capita, 2012. Orange dash-dotted line – counterfactual log real GDP per capita, 2014. Top: synthetic control method. Bottom: synthetic control method, demeaned. The donor pool includes 9 countries: Norway, Colombia, Australia, Canada, Lithuania, Greece, Bulgaria, Croatia, and United Kingdom.

[19]The data are from the World Bank, https://data.worldbank.org/indicator/. The indicator codes are TX.VAL.FUEL.ZS.UN, NY.GDP.PETR.RT.ZS, NY.GDP.NGAS.RT.ZS, and NY.GDP.TOTL.RT.ZS, respectively.

Figure 5 plots the counterfactuals from the standard and demeaned SCM that are obtained when the pool of controls is restricted to the countries from Table 2. Table 3 displays the corresponding synthetic control weights. Bulgaria and Lithuania receive the highest weights in most specifications. The regular SCM fails to find a good synthetic control unit for Russia, as evidenced by the gap between the actual and counterfactual units that exists before the interventions. This is likely because the donor pool is pretty small, and some of the countries in the donor pool are quite different from Russia in terms of their GDP per capita. In contrast, the demeaned SCM, when applied to 2012 and 2014 (but not to 2008), finds a reasonable counterfactual for Russia. The results from the demeaned SCM for 2012 and 2014 are very similar to the main results in Figure 2. Even though the composition of the synthetic control unit is different, its trajectory remains essentially the same.

Table 3: Synthetic Control Weights, Oil Dependence

Country	Standard			Demeaned		
	2008	2012	2014	2008	2012	2014
Australia	0	0.137	0.126	0	0	0
Bulgaria	0.351	0.358	0.334	0.467	0.604	0.601
Colombia	0	0	0	0.055	0.062	0.062
Greece	0.122	0	0	0.058	0	0
Lithuania	0.510	0.506	0.540	0.420	0.334	0.337
Norway	0.017	0	0	0	0	0

Notes: The table presents the composition of the synthetic control units in various specifications. The donor pool includes 9 countries: Norway, Colombia, Australia, Canada, Lithuania, Greece, Bulgaria, Croatia, and United Kingdom.

Next, I turn to the World Bank real GDP per capita data, which includes more countries than the OECD dataset.[20] Unfortunately, the World Bank data are annual, meaning that the number of observations is much smaller than in the OECD dataset. The potential donor pool in the World Bank data is very large (217 countries), so it is impossible to perform sensible analysis with less than 20 years of data. To be consistent with my main analysis, I use the data from 2003 on. I could potentially start in 2000 or 2001; going father back arguably would not make much sense because Russia's economy was very different in the 1990s compared to the 2000s.

Instead of using all available countries in the dataset, I first select the countries that may be a sensible match for Russia. Table 4 shows Russia and 8 developing countries (Kazakhstan, Turkmenistan, Malaysia, Mexico, Colombia, Uzbekistan, Indonesia, and Brazil) that could arguably serve as a reasonable donor pool. Oil or natural gas production plays a fairly important role in these countries. For instance, Kazakhstan and Turkmenistan have higher oil rents than Russia; Turkmenistan and Uzbekistan have substantially higher gas rents than Russia. Oil rents as percentage of GDP vary from 2% to almost 19% in the selected group; gas rents vary from close to zero to over 20%. Total natural resources rents vary from about 4% to over 43%. Therefore, it is reasonable to think that oil price shocks that could affect Russia's economy would also affect these control countries.

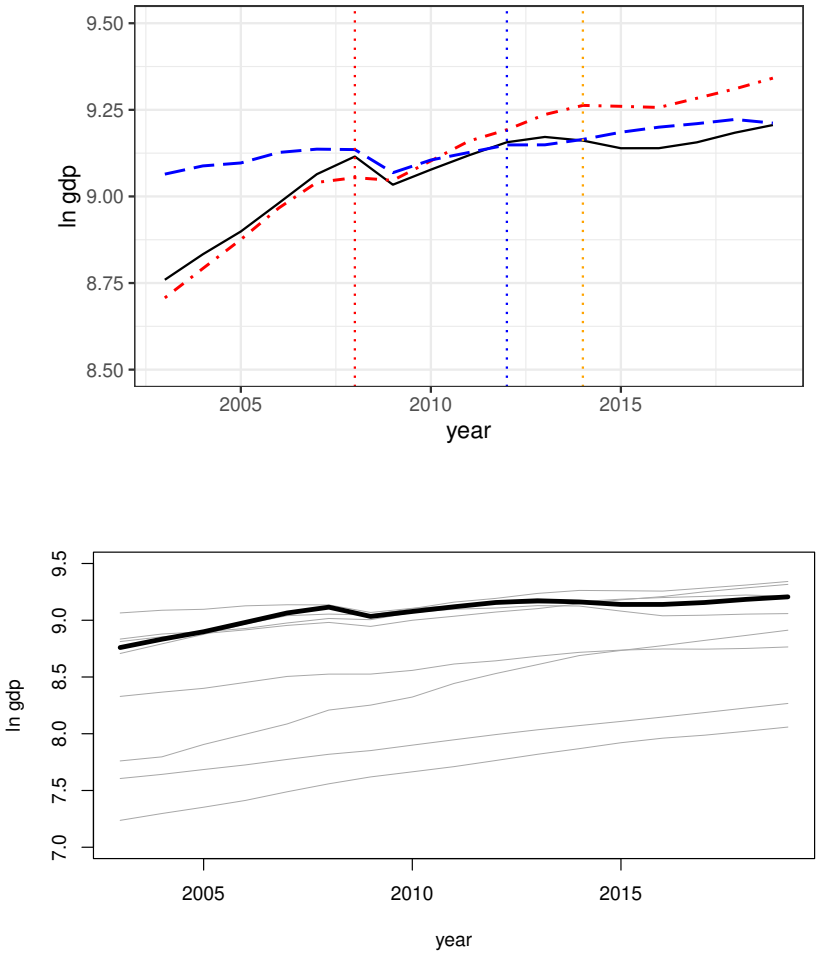
[20] https://data.worldbank.org/indicator/NY.GDP.PCAP.KD

Table 4: Russia and Other Developing Countries by Oil-Dependence

Country	Fuel exports (% of merchandise exports)	Oil rents (% of GDP)	Natural gas rents (% of GDP)	Natural resources rents (% of GDP)
Russia	63.01	10.73	3.19	16.27
Kazakhstan	69.51	18.72	1.06	25.77
Turkmenistan	NA	17.81	20.21	43.17
Malaysia	14.76	5.48	2.14	11.99
Mexico	14.07	5.08	0.18	5.64
Colombia	45.97	4.66	0.14	6.70
Uzbekistan	NA	4.12	11.90	18.78
Indonesia	28.28	3.06	1.00	8.56
Brazil	8.32	2.04	0.03	3.79

Notes: The table shows the median values based on the annual data from 2003 to 2013.

Figure 6: Real GDP per Capita in Russia and Other Countries, World Bank Data

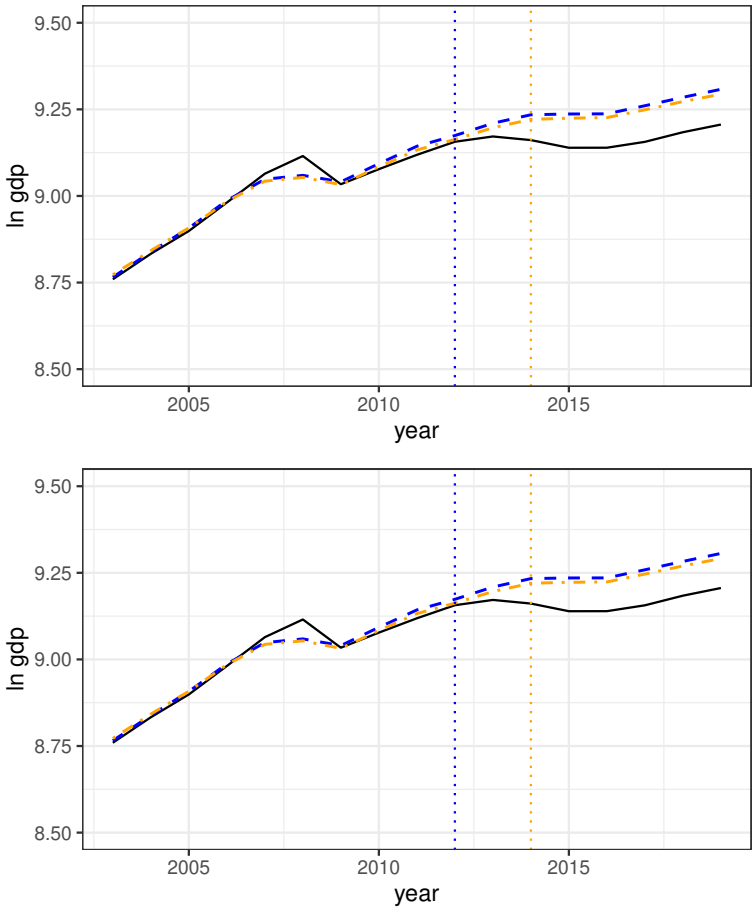


Notes: Top figure: dark black line – Russia's log real GDP per capita; red dash-dotted line – Kazakhstan's log real GDP per capita; blue dashed line – Mexico's log real GDP per capita. Bottom figure: dark black line – Russia's log real GDP per capita; light gray lines – log real GDP per capita in the control group. The donor pool includes 8 countries: Kazakhstan, Turkmenistan, Malaysia, Mexico, Colombia, Uzbekistan, Indonesia, and Brazil.

Figure 6 shows the evolution of Russia's log real GDP per capita along with the countries in the donor pool. Some of the countries were consistently poorer than Russia in the early 21st century, others (Brazil, Kazakhstan, Malaysia, and Mexico) were very close to Russia in terms of the GDP per capita. The standard SCM generally would not select the countries that were systematically poorer than Russia; however, the demeaned SCM eliminates systematic differences in levels and looks at the trajectories only.

Due to the small number of observations with annual data, I only consider 2012 and 2014 as the intervention dates. Figure 7 plots the results, while Table 5 shows the composition of the synthetic control unit. Kazakhstan and Mexico are the only countries that receive high weights. The evolution of the synthetic control unit does not match pre-intervention Russia as closely as with quarterly data (especially around 2008), but it is still fairly close. The results I obtain are similar for 2012 and 2014, and qualitatively they are similar to the baseline results. The point estimates, shown in Figure 8, become smaller, indicating that the counterfactual GDP per capita would be about 10% higher than the actual one, and the confidence intervals are very wide because of the limited number of observations.

Figure 7: Actual and Counterfactual Real GDP per Capita, World Bank Data



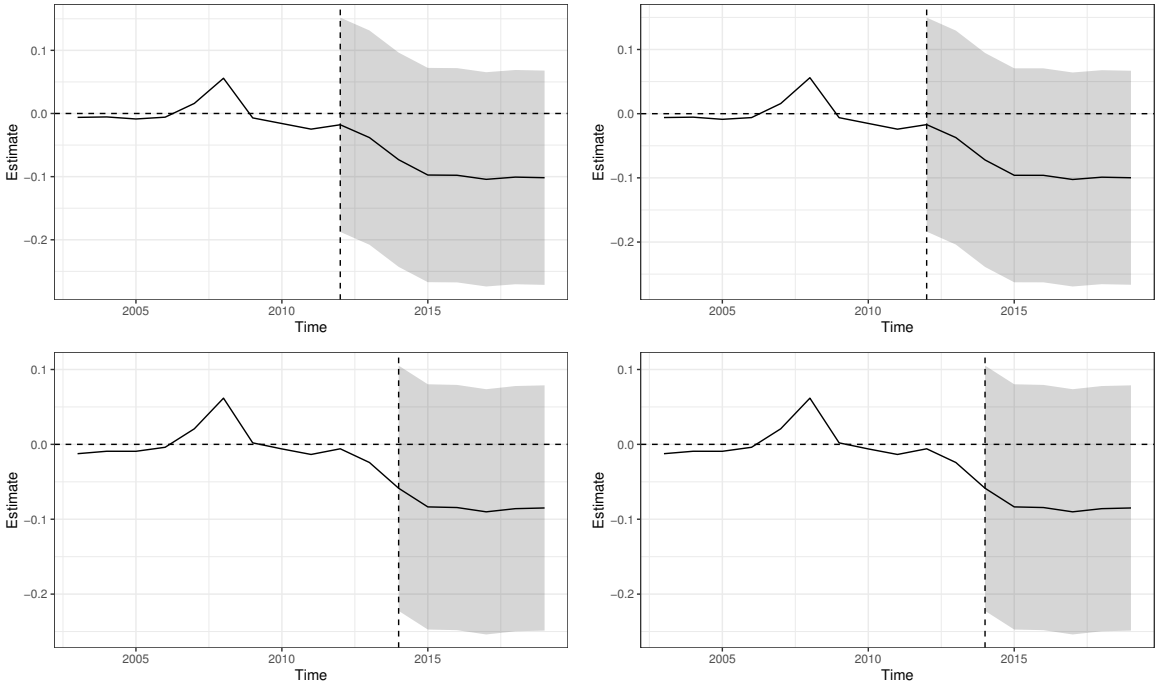
Notes: Black solid line – actual log real GDP per capita. Blue dashed line – counterfactual log real GDP per capita, 2012. Orange dash-dotted line – counterfactual log real GDP per capita, 2014. Top: synthetic control method. Bottom: synthetic control method, demeaned. The donor pool includes 8 countries: Kazakhstan, Turkmenistan, Malaysia, Mexico, Colombia, Uzbekistan, Indonesia, and Brazil.

Table 5: Synthetic Control Weights, Oil Dependence, World Bank Data

Country	Standard		Demeaned	
	2012	2014	2012	2014
Kazakhstan	0.801	0.749	0.807	0.764
Mexico	0.192	0.238	0.193	0.236
Uzbekistan	0.007	0.013	0	0

Notes: The table presents the composition of the synthetic control units in various specifications. The donor pool includes 8 countries: Kazakhstan, Turkmenistan, Malaysia, Mexico, Colombia, Uzbekistan, Indonesia, and Brazil.

Figure 8: Synthetic Control Estimates, World Bank Data



Notes: Black solid line – difference between the actual and counterfactual log real GDP per capita for Russia. Gray shaded region – 95% confidence interval. Left: synthetic control method. Right: synthetic control method, demeaned. Top panel: 2012. Bottom panel: 2014. The donor pool includes 8 countries: Kazakhstan, Turkmenistan, Malaysia, Mexico, Colombia, Uzbekistan, Indonesia, and Brazil.

Overall, using the annual data instead of the quarterly data decreases the ability of the SCM to find a good match for Russia before the intervention and results in smaller point estimates. This may reflect the fact that part of Russia's economy slowdown can be explained by the decline in the global oil prices, but it may also be a result of the reduced ability to find a good match for Russia before 2014. For instance, with the quarterly data, I have between 20 (for 2008) and 44 (for 2014) pre-treatment observations. With the annual data, I only have 9 (for 2012) or 11 (for 2014). With such a small number of observations, the performance of any econometric method, including the SCM, is likely to deteriorate. However, using the annual data does not change my qualitative findings, confirming that Russia's economy slowed down after 2014 compared to the counterfactual.

5.3 Structural Time Series Models

Recent papers by Harvey and Thiele (2021) and Dreuw (2023) propose structural time series models (STM) as an alternative to the SCM. The SCM uses all countries from the donor pool simultaneously but restricts the weights to be nonnegative and sum up to one. Instead, the STM approach aims to identify the control units that are co-moving (or, statistically speaking, are cointegrated) with the target unit prior to the intervention. Then only the units that are cointegrated with the treated unit are included in the potential donor pool, and the counterfactual is obtained by estimating and extrapolating the common trend. As a robustness check, I apply the STM to Russia in 2008, 2012, and 2014.

Table 6: Ordered KPSS tests for Cointegration

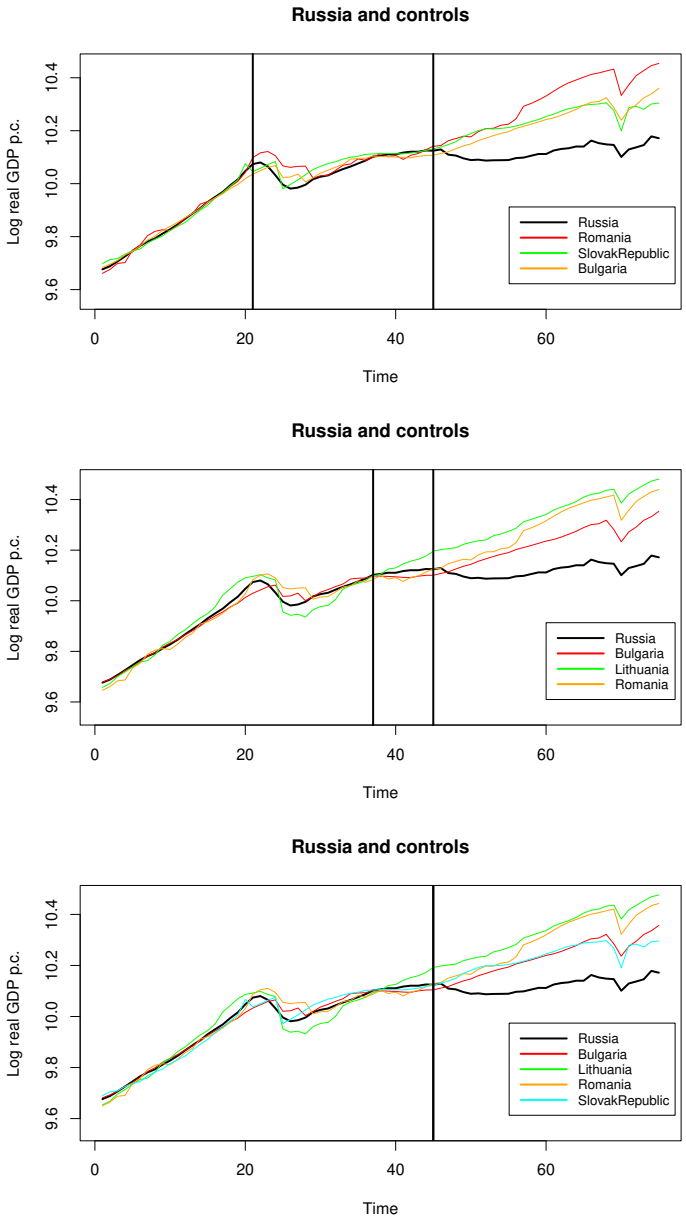
Name	KPSS-Level	P-Value	Variance	Mean GDP p.c. difference	Mean GDP p.c. pre intervention
Panel A: 2008					
Romania	0.1380	0.1000	0.0002	3,631	15,382
Slovak Republic	0.2626	0.1000	0.0002	-2,364	21,377
Estonia	0.4727	0.0478	0.0006	-5,658	24,671
Bulgaria	0.5204	0.0371	0.0001	5,498	13,515
Panel B: 2012					
Poland	0.2132	0.1000	0.0015	386	20,354
Bulgaria	0.2188	0.1000	0.0003	5,890	14,850
Lithuania	0.2525	0.1000	0.0011	-784	21,524
Romania	0.3018	0.1000	0.0008	3,675	17,064
Korea	0.4165	0.0701	0.0022	-9,455	30,195
Latvia	0.4410	0.0595	0.0054	596	20,144
Panel C: 2014					
Bulgaria	0.0970	0.1000	0.0003	6,153	15,306
Lithuania	0.1258	0.1000	0.0010	-920	22,378
Romania	0.1732	0.1000	0.0008	3,888	17,571
Poland	0.1752	0.1000	0.0012	387	21,071
Slovak Republic	0.3124	0.1000	0.0004	-2,892	24,350
Korea	0.3761	0.0875	0.0018	-9,731	31,189
Colombia	0.3791	0.0862	0.0018	10,379	11,079
Chile	0.4344	0.0623	0.0018	2,662	18,797

Notes: the P-values are capped at 0.1, i.e. the values greater than 0.1 are displayed as 0.1.

As in Dreuw (2023), I start by conducting the KPSS tests for cointegration between Russia and the countries in the donor pool. Table 6 displays the results. Generally, high P-values indicate the presence of cointegration, i.e. that the log real GDP per capita series for Russia and a given country from the donor pool tend to co-move. For 2008, there are only two countries, Romania and Slovak Republic, for which the KPSS test suggests the presence

of cointegration with Russia at the 10% significance level, or even at the 5% significance level. This is likely because the number of observations before 2008 is very limited. In the table, I display two more countries, Estonia and Bulgaria, for which the P-value exceeds 2%. In contrast, for 2012, there 6 countries (Poland, Bulgaria, Lithuania, Romania, Korea, and Latvia) that are cointegrated with Russia at the 5% significance level. For 2014, there are 8 such countries (Bulgaria, Lithuania, Romania, Poland, Slovak Republic, Korea, Colombia, and Chile).

Figure 9: Structural Time Series Model: Background



Notes: Black solid line – Russia's log real GDP per capita. Colored lines - log real GDP per capita of the countries suggested by the KPSS test. Top panel: 2008. Middle panel: 2012. Bottom panel: 2014.

The next step of the STM method is to select the potential controls from the pool of countries that are cointegrated with Russia. One practical issue here is that selecting too many possible control countries may result in the failure of the algorithm to converge. Based on the KPSS test results presented above, and after the visual analysis of data shown in Figure 9, I use Romania, Slovak Republic, and Bulgaria for 2008; Bulgaria, Lithuania, and Romania for 2012; and Bulgaria, Lithuania, Romania, and Slovak Republic for 2014.[21] The algorithm then selects a weighted average of the countries in the selected control group that fits Russia's pre-intervention growth path best.

Figure 10 displays the results of the STM method for Russia for 2008, 2012, and 2014. The counterfactuals are given by Synthetic Russia and Predicted Russia.[22] The weights assigned to different control countries are shown in the plot legend. Figure 11 displays the differences between the actual and counterfactuals units, similar to Figure 3.[23] The counterfactuals based on the STM look fairly similar to those based on the SCM and shown in Figure 2. The composition of the STM counterfactual unit is fairly similar to the composition of the SCM unit in Table 1, although the STM method generally selects fewer countries with nonzero weights.

6 Discussion

The counterfactuals that I obtain are pretty robust across different specifications that I try: the SCM with all countries in the donor pool, the augmented SCM, the SCM with the restricted donor pool ("oil-dependent" countries only), and the STM. In the majority of specifications, the results suggest that the counterfactual GDP per capita would have been about 20% higher than the actual one by 2019, before the COVID-19 pandemic started. Using the annual World Bank data instead of the quarterly OECD data, and limiting the donor pool to oil-dependent developing economies only, reduces the point estimates by about half but still yields the same qualitative results.

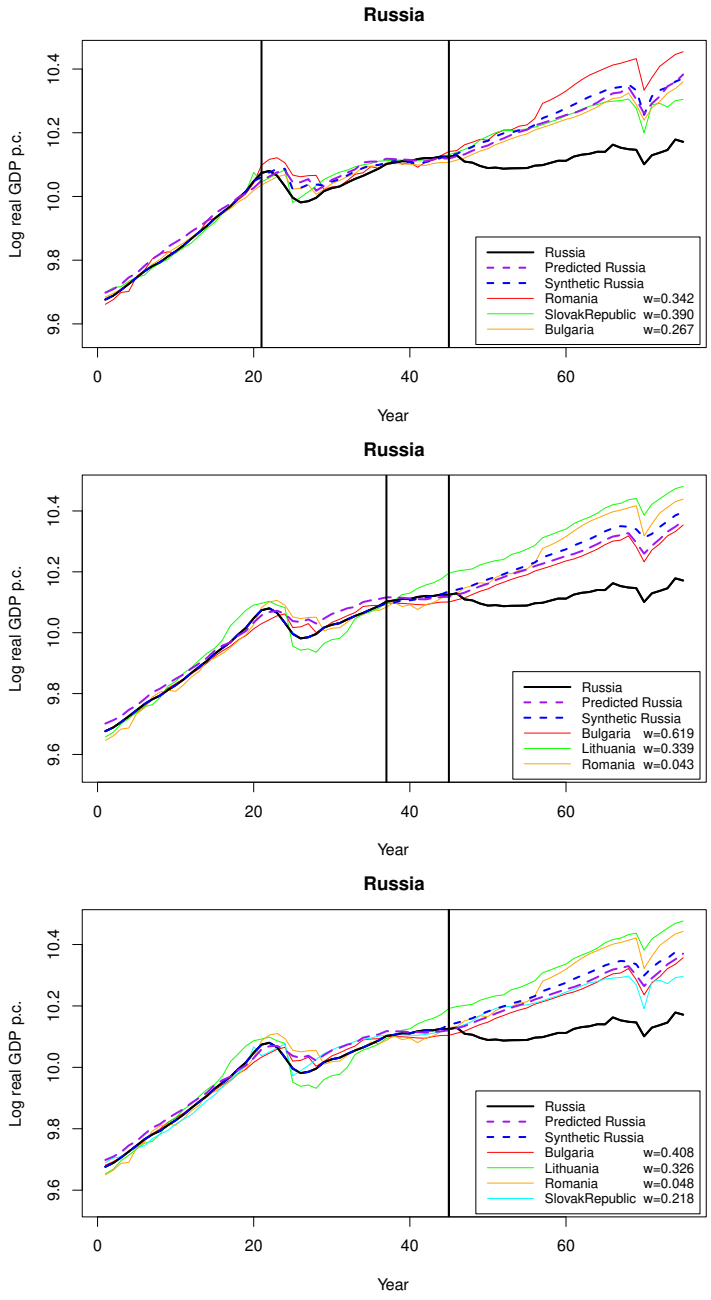
Regarding the composition of the counterfactual unit, the countries in the donor pool that consistently receive high weights include Bulgaria, Lithuania, Romania, and Slovak Republic. All these countries are located in Eastern Europe, and they were either part of the Soviet Union or part of the Eastern Bloc before the Soviet Union collapsed. The fact that all these countries are former Communist states that used to have similar political and economic system may explain why they consistently get selected as the best controls for Russia. When I use the World Bank data, the countries that receive high weights are Kazakhstan and Mexico. Both these countries are developing economies that are fairly similar to Russia in terms of their GDP per capita and that are both fairly significant oil producers. Ideally, I would prefer to use more granular, quarterly data on a larger number of countries, including major oil producers, to find a better match for Russia. However, I think that the synthetic control units that I obtain (Eastern European countries with the OECD data or developing oil-producing economies with World Bank data) are a sensible match for Russia.

[21] Although Poland is selected by the KPSS test, the variance of the differences between Russia and Poland is relatively large, and including Poland is particularly troublesome from the computational point of view.

[22] For the exact expressions, see equations (10) and (11) in Dreuw (2023).

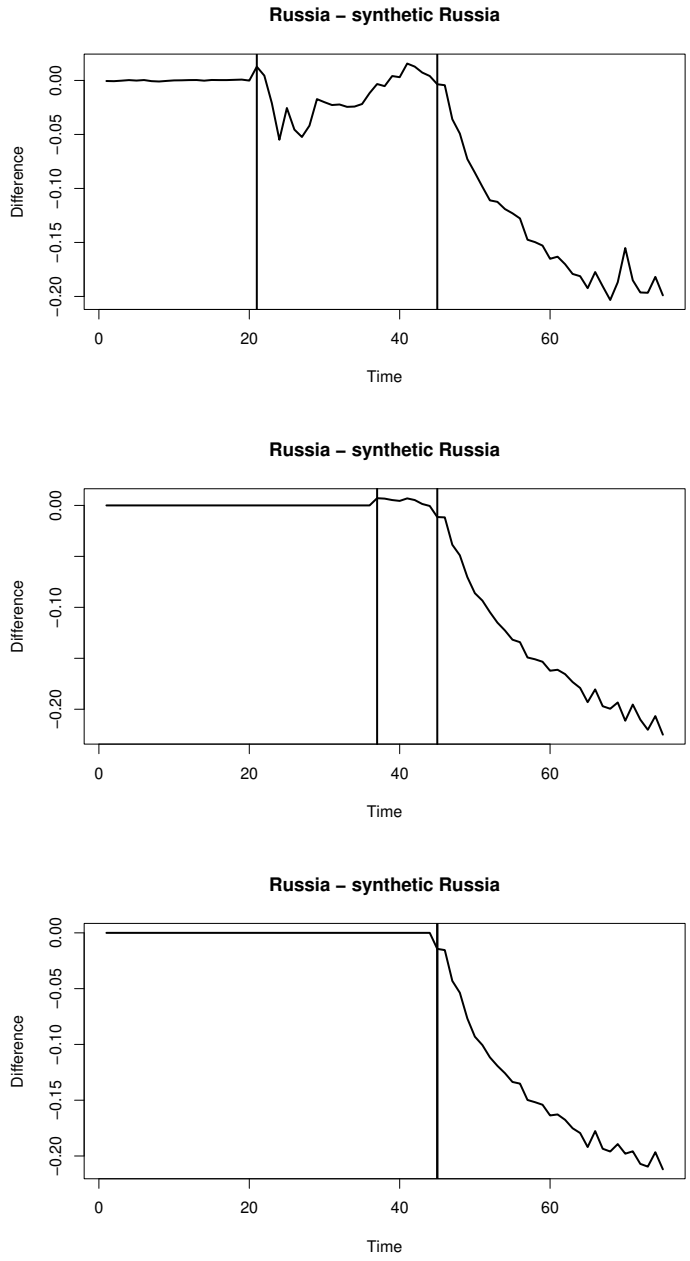
[23] Inference procedures that would yield confidence intervals are not yet available for the STM method.

Figure 10: Actual and Counterfactual Real GDP per Capita, STM



Notes: Black solid line – Russia's actual log real GDP per capita. Purple and blue dashed lines – counterfactuals from the Structural Time Series Model. Colored lines - log real GDP per capita of the countries in the control group. Top panel: 2008. Middle panel: 2012. Bottom panel: 2014.

Figure 11: Structural Time Series Model Estimates



Notes: Black solid line – difference between the actual and counterfactual log real GDP per capita for Russia. Top panel: 2008. Middle panel: 2012. Bottom panel: 2014.

There are many factors that may explain the results I obtain. The growing isolation of Russia's economy, the Western sanctions against Russia, Russia's restrictions on the freedom of speech and political freedoms, Russia's economy reorientation towards increasing military production, and increased emigration from Russia[24] might all have contributed to the slow-

[24]According to Russia's Federal State Statistics Service, the number of migrants from Russia to other countries increased from 7,000 in 2011 to 24,000 in 2012 to almost 55,000 in 2014, and has remained high

down of Russia's economy compared to the counterfactual. The methods that I use do not allow me to distinguish which of these, or other, factors were most important. However, one could arguably say that after 2014, Vladimir Putin and Russia's political elites have become more interested in pursuing their geopolitical goals, such as increasing their influence in Ukraine, often at the expense of Russia's economy, and my result seem to suggest that these actions might have had serious economic consequences.

7 Conclusion

In this paper, I construct the counterfactuals for Russia's economy in the 21st century. I consider three "intervention" dates: 2008, when Vladimir Putin's first tenure as president ended and Dmirty Medvedev became president; 2012, when Vladimir Putin returned to power; and 2014, when Russia annexed Crimea. I find that the actual and counterfactual growth paths prior to 2014 are virtually identical, and the point estimates are insignificant. This likely means that the political changes that Russia went through in 2008 and 2012 were relatively minor and did not have any significant effect of the economy. However, the annexation of Crimea and the beginning of the Donbas War might have had a large and significant negative effect on Russia's economy. The point estimates that I obtain using my preferred specifications imply that by 2019, Russian GDP per capita decreased by about 20% compared to the counterfactuals. Thus, even though I do not have enough data to assess the economic impact of the large-scale Russo-Ukrainian war that started in February 2022, it appears that decision to annex Crimea in 2014 alone was very costly in economic terms.

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