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Autocracy in democracy's cradle:

A Synthetic Control Method Analysis of the 1967–1974 Greek military coup and junta and its impact on GDP growth

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Abstract: This paper investigates the consequences of autocratic governance on real GDP growth using the Greek military coup and junta of 1967-1974 as a case study. It does so by utilising the synthetic control method. The predictor variables used are the log of lagged real GDP and the log of 3-year averages of lagged real GDP, and the outcome variable is the log of real GDP. The model uses data from 1950-1985 and 55 donor countries to create a counterfactual synthetic Greece. The initial result suggests that real Greece's growth exceeded that of synthetic Greece, i.e. that autocratic governance resulted in better growth than democratic governance. However, robustness and placebo testing proves the result is statistically insignificant.

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1. Introduction

In the 21st century, parties and movements with authoritarian ideologies have increased their influence and power, with examples such as Fidesz in Hungary, Law and Order in Poland and AKP in Turkey.

Simultaneously, a key factor in long-term economic success and growth is institutional quality, often qualities that are well aligned with democratic societies. The 2024 Nobel Prize in Economics awarded to Acemoglu, Johnson and Robinson was presented with the motivation that they had "*demonstrated the importance of societal institutions for a country's prosperity. Societies with a poor rule of law and institutions that exploit the population do not generate growth or change for the better".* (Nobel prize outreach, 2024)

This paper is a case study to see whether this idea holds up in practice. For this thesis the theory is modified and focuses on effects in the relative short-term, which differs from the long-term time-horizons presented by Acemoglu, Johnson and Robinson. To accomplish this, the Synthetic Control Method (SCM) is applied to explore the effects of the Greek coup and junta of 1967-1974. The purpose is to explore whether weakened institutional quality had a statistically significant impact, using dictatorial governance as a proxy for worsened institutional quality.

The SCM is a method which utilizes "donor units", i.e. entities other than the one of interest, to construct a synthetic counterfactual, also known as a synthetic control (SC). This method is especially useful for cases where there is no practical counterfactual. It was debuted by Abadie and Gardeazabal with their paper examining whether terrorism in the Basque region of Spain had a noticeable impact on local GDP growth (Abadie and Gardeazabal, 2003). The method will be elaborated on further under section *6.1. The Synthetic Control Method*.

2. Background

To provide a backdrop for the study, some background with regards to the economic and political history of Greece in the 19th and 20th century will be provided.

2.1. The 19th century

Greece was fully established and recognised as a sovereign state in 1828, after previously being under the rule of the Ottoman empire. However, poor leadership and other societal issues resulted in the country's first military coup occuring in 1843. This ultimately resulted in a new constitution and increased suffrage. Still, public discontent remained, with a new coup occurring in 1862, which resulted in further revisions of the constitution ultimately providing greater democratic freedoms. In 1875, the king allowed the government to whomever could form a majority in parliament, effectively turning the previous multi-party system into a two-party system. (Britannica, 2025)

2.2. The first half of the 20th century - 1900-1949

Greece remains politically turbulent, with a coup and subsequent one-year junta 1909-1910, after which a new constitution was drafted. The first world–war saw the establishment of rival governments, repeated prime minister resignations and a temporary forced ousting of the Greek king by the entente, with the king returning in 1920. (Ibid)

In the interwar period, another military junta seized power 1922-1923. The country came under yet another one–year junta in 1925-1926. After once again being free from dictatorships, the country encountered hardship in 1929 as a consequence of the crash on Wall street, which heavily affected the export reliant Greek economy. (Ibid)

The 1930s saw two coup attempts, 1933 & 1935. And from 1936 the country was effectively under a dictatorship as the constitution was suspended until it became occupied by the Axis powers in 1941-1944. During the 2nd world war, Greece lost 5%-7% of its total population, with the majority of the deaths stemming from starvation. This was in part attributed to destruction of infrastructure, weakening the overall economy, but most importantly by the seizure and destruction of crops and livestock. By the end of the war and the occupation, industrial production was 1/5th of what it used to be and agriculture output was halved. (Vetta, 2014)

Post occupation an election was held in 1946. That same year the Greek civil war broke out as communists occupied the north of the country, a war which would continue until the victory of the central government in 1949.

2.3. The postwar period - 1950-1967

The 1950s and 1960s were characterized by relative political stability and the rapid growth of the Greek economy. This was in part due to Marshall plan funding, reformed economic policy and national investment strategies. The government aimed to utilize the country's comparative advantages within agriculture, shipping and tourism, and strategic policies were implemented to bolster the economy through infrastructure investments that would be utilized contra-cyclically. There were also attempts to make the country a more attractive place for foreign investment, which mostly ended up in the Greek shipping industry. These economic developments and strategies maintained their general direction even during the 67-74 military junta. (Vetta, 2014)

2.4. The military junta - 1967-1974

The 1967-1974 military junta, known as the "Colonels", took power, justifying their actions as a way to protect the country from a communist conspiracy. It had an ideology characterized by staunch anti-communism and christian nationalism. It infringed on civil liberties through the abolishment of labor rights and heavy press-censorship, amongst other things. Given the anti-communist stance of the regime, individuals associated with the left were subject to arbitrary arrests, exile, imprisonment, torture and surveillance.
Furthermore, freedom of speech was heavily punished. The junta was ultimately dissolved in 1974 from a combination of economic & military failures as well as public pressure and discontent, with the transition to a democratic republic taking place in 1975. (Rosa-Luxemburg-Stiftung, 2024; EBSCO, 2024; Britannica, 2025; Vetta, 2014)

3. Literature review

3.1. Research concerning democracy, associated transmission channels and GDP

There is plenty of research regarding whether the state of democracy and democratic governance in a country has any effect on GDP growth. While the papers found for the purpose of this thesis seem to skew towards the idea that there are benefits to growth when democratic governance is in place, the results are often highly nuanced and specific, i.e. there are no clear conclusions on an absolute set of variables that drive this positive relationship between growth and democratic governance in every case.

3.1.1. Studies finding no direct correlation between democracy and growth

Some larger studies e.g. meta-analyses as well as those using a large number of countries over a long timeframe come to the conclusion that democracy in itself does not matter directly, but could have an indirect impact on economic growth.

To begin, a meta-analysis looking at 483 estimates derived from 84 studies on democracy and economic growth by Doucouliagos & Ulubaşoğlu (2008). The study finds, using methods such as fixed and random effect meta regression models, that the effect of democracy seems to be indirect through a variety of channels. These channels include "*higher human capital, lower inflation, lower political instability, and higher levels of economic freedom*". I.e the authors conclude that the effect of democracy is not through the state of governance itself, but indirectly through improving other variables that then act as transmission channels. Furthermore, they restate and clarify that economic freedom benefits growth, while democracy's direct effect on growth is zero. The authors conclude the article by highlighting that despite there being no evidence of democracy improving growth necessarily, there may be beneficial effects of political freedom on a welfare level.

Another study by Jacob and Osang (2020), using a panel dataset consisting of 160 countries between 1961-2010 and a GMM method, found that democracy in itself lacks a statistically significant impact on the economic growth of a country. They do however find that associated concepts such as "*quality of institutions, regime stability, openness*" have a statistically significant and positive impact on growth, thus coming to a similar conclusion as Doucouliagos and Ulubaşoglu (2008). They likewise mention that "*it is possible that the impact of democracy on growth occurs mainly through indirect channels rather than the direct effect estimated in this paper*". Nonetheless, they do end up with a final remark, "*If the growth-enhancing and growth-reducing effects of indirect democracy pathways more or less offset each other, there will be no aggregating effect of democracy on growth, which is precisely the finding of this paper*", very much echoing the final sentiments of Doucouliagos and Ulubaşoglu once again.

3.1.2. Studies finding nuanced relationships between democracy and growth

Moving on, other papers have found more nuanced and complicated interactions with regards to democratic governance and economic growth.

A paper by Shabbir (2017) suggests that corruption in countries experiencing weaker levels of democracy improves growth, in the author's words the corruption "*greases the wheels*" and "*sands*" those of bureaucracy. This is done using fixed and random effects models. They find that the opposite holds in countries with stronger democratic indicators, that corruption in these countries results in worse growth. Although the categorization of what constitutes a more or less democratic country might be worth bringing into question, as the study employs a quite strict cutoff point. Finally, the author stresses that promotion of democracy overall results in a net benefit, as democracy brings with it well-functioning institutions and monitoring systems, greatly incentivizing investment and thus citizens are able to have both democratic freedom while experiencing growth. The paper focuses on the D-8 countries (Bangladesh, Egypt, Indonesia, Iran, Malaysia, Nigeria, Pakistan and Turkey) which with the exception of Turkey aren't necessarily reflective of current day Greece. However, they might be reflective of past Greece as it was somewhat of a developing economy itself in the middle of the 20th century.

Another interesting relationship is put forth by Hsin-Yi Lin and Yu-Hsiang Hsiao (2021) using a quantile regression method, who find that democracy has a positive impact on growth rates. However this depends on the current state of the country's economic growth, with low growth countries gaining the largest returns on transitioning towards democratic governance. Thus, in the case of Greece, given the high growth level pre-junta, if there is a positive effect it might be negligible.

Knutsen (2018) explores the effects of time under autocracy and democracy and the effects of this on economic growth, using over 180 different governments. Their findings are that autocratic forms of government in general result in higher volatility with regards to growth, and thus, democracy produces more stable growth patterns.

3.1.3. A study finding a clear positive correlation between democracy and growth

And finally, for the sake of presenting a variety of perspectives and findings, one of many Acemoglu papers looking at democracy, institutions and growth.

"*Democracy does cause growth*" by Acemoglu et al. (2019) suggests long run positive effects of democratization on GDP, more specifically by 20-25% over a 25 year period following democratization. Furthermore their results claim that this effect is homogenous across various levels of societal development. They suggest this is likely "*driven by greater investments in capital, schooling and health*", but also by less tangible things such as reduced social unrest.

3.1.4. Summary

In short, there are differing opinions and no clear consensus with regards to the impact of democracy and democratization of countries and the effect on GDP, with different studies claiming negative, positive or no effect on GDP at all. Multiple studies seem to point at the fact that economic liberalisation and other transmission channels that might have positive correlation with democracy or democratization do have positive impacts on growth, but the state of democracy in itself is simply a means to those ends.

3.2. Research utilizing SCM in the context of democracy and GDP

A study by Sun (2024) concerning the effects of Pakistan's military dictatorships and its possible effects on economic growth through SCM finds that while growth did occur, it was only one fourth of what the synthetic counterpart delivered, suggesting that the dictatorship had negative effects on growth. It is however difficult to infer if this was a direct consequence of the democratic state of the country or but rather an effect of poor governance by the leadership. So while the lack of democratic practices and institutions itself might not have caused worse growth, the outcome in this case was a worse economy

A paper by Melcarne, S. Mora-Sanguinetti and Spruk (2021) looks at the effects of institutional transitions as well as economic transitions to see the effect of economic growth by utilising the synthetic control method on 20th century Spain on a provincial level. Their findings suggest that the growth effect of liberalisation within both the economy and institutions has positive impacts on growth, but note that the impact on growth from economic liberalisation is four times higher than that of institutional liberalisation. This is likely coincidental, but it mirrors the relationship to the previously mentioned study in magnitude. Furthermore they conclude improved growth of 40% from economic liberalization alone, and a 10% increase from democratization. Lastly, the improved growth trajectory from democratization is temporary, and the growth path returns to what real Spain experienced.

Uhr et al. (2017) find, when studying the effects of Chile's transition to democracy using the synthetic control method, "*significant positive effects*" from the democratization process on long-term GDP growth. Worth noting is that this transition did not involve major civil conflict, similarly to the case examined in this paper. The authors do however note that economic policy enforced during the autocratic regime could be a contributing factor working in parallel with the democratization efforts. As a final note, they point out, like many others, that further research should look at different variables that might correlate with democracy, in order to understand how different transmission channels affect growth.

The paper *"Democracy, Corruption and Economic Growth Post-Arab Spring in Tunisia and Libya"* by Muktad (2023) explores the effect of the Arab spring on Tunisia and Libya using the SCM, with regards to democracy, corruption and economic growth. They conclude that

the short-term economic effects of the event were negative, while democracy and anti-corruption indexes improved. I believe this paper is less relevant in the context of this case study, but I've chosen to include it to precisely illustrate that it seems highly likely that external circumstances do play a significant effect, especially when using the SCM in this context. The major conflicts associated with the Arab spring resulted in physical- and human capital destruction. Thus it is worth noting that we are not expected to see the same results in our case, given that there was a lack of capital destruction. Though there might be some human capital destruction as a form of brain drain perhaps.

3.2.1. Summary

In short, the above examples of current literature looking at the effect of democracy on GDP growth using SCM indicates that there exists a positive correlation between growth and democracy or democratic transition. Although worth noting is that this is often discussed as being the result of democracy adjacent transmission channels. This furthermore suggests that perhaps economic liberalization and freer markets are more important, than democratization, and perhaps the two tend to occur simultaneously. Ultimately, what is most interesting with these specific SCM papers is that all of them suggest democracy has a positive impact, which goes against the somewhat more nuanced picture painted in the previous section containing non-SCM papers.

4. Research question & purpose

4.1. Purpose

The purpose of the study is to evaluate whether there are any notable effects on GDP growth as a consequence of weakened democracy, and by proxy a weakening of institutions. It aims to build on works of other, similar studies mentioned in the literature review, but in this case apply it to Greece between 1950-1985. Furthermore it is based on the idea developed by Acemoglu and others that high-quality institutions (in the long-term) have a positive impact on economic development. This study uses democracy as a proxy to look at the effects of institutional quality in the relative short-term, with a time horizon of 20 years from the coup, and 10 years after the end of the junta. In short, the purpose of the study is to contribute to the existing body of knowledge that examines the relationship between democracy and economic growth using the SCM.

4.2. Research question

Greece is identified as a good candidate to investigate the pure effects of weakened democratic rule on GDP growth. Given the lack of capital destruction during the coup, it is less likely that a loss of capital would affect the growth of the country, which would affect the growth trajectory in accordance with the Solow-Swan model. Likewise the lack of a major war results in relatively low human capital destruction and labor loss, which are key factors of growth in accordance with the Romer model. Thus we avoid such confounding factors' impact on GDP growth.

Research question: Did the Greek 1967 coup and subsequent military junta affect GDP growth, in both the short- and relative long-term, through the implementation of autocratic governance?

5. Data

5.1. Data requirements

In accordance with what is outlined in a guide to using the SCM by Abadie (2021), there are certain requirements for the data when using the SCM in order to ensure the application of the model is appropriate and credible.

5.1.1. Aggregate Data on predictors and Outcomes

The SCM requires consistent data on the outcome variable of interest and the designated predictors from both the treated unit as well as donor units. This is due to the nature of the model, as it bases its prediction on previous outcomes and then weighs them for post-treatment using post-treatment data.

5.1.2. Sufficient Pre-treatment information

The credibility of the SCM relies heavily on its ability to track the outcome variable in the pre-treatment period for the treated unit through predictor variables. In order to ensure this tracking is bias free, it is of importance to have sufficient data for the treated unit and donor pools for a long pre-intervention period.

5.1.3. Sufficient Post-treatment information

The models need sufficient outcome variable data of the treated unit post-treatment. In order to infer the synthetic outcome the model needs an actual outcome to compare it to. There might be issues if the treatment is expected to affect the outcome variable of interest over a longer time-horizon, requiring for a long wait time until the effect can be recorded and the model can be run.

5.2. Sourcing of data

There is one dataset used for this study, the *Global Macro Database,* a project by Müller, Xu, Lehbib, and Chen (2025). The choice of this dataset in particular had to do with the completeness of the data and the way in which it is presented in an accessible format, as it plainly lays out a plethora of variables across a large number of countries over large time-periods. Most importantly the dataset has a lot of data covering the 1950-1967 period, which is not always represented continuously in other datasets, which allows for the model to get a long enough pre-treatment period to adjust donor and predictor weights to. The dataset is a "*a panel dataset of 46 macroeconomic variables across 243 countries from historical records beginning in the year 1086 to projections through the year 2030*". For this thesis, it is the"real GDP in USD" data that is used.

6. Methodology

6.1 The Synthetic Control Method

The synthetic control method is a method of creating a counterfactual when none is available in order to evaluate the effect of an event. This is done using a set of "donor units" and predictor variables to match against an outcome variable. The donor units are similar entities that have not received treatment, in the case of this thesis other countries similar to Greece, and the predictor variable is the log of lagged real GDP and the outcome variable is the log of real GDP. What is then done is that an algorithm creates a synthetic counterfactual, i.e. a synthetic Greece, that is made up of the donor units. It chooses the size of influence each donor unit has on the model by attempting to match the synthetic counterfactual's outcome variable as close as possible to that of the real entity for the pre-treatment period. When this "best fit" is found, the model provides the weights of influence of each donor entity. What is then done is projection using these weights, i.e. the synthetic counterfactual is projected forward and estimated post the treatment using the already established donor countries and their respective weights. This is then assumed to be representative of the outcome of the real unit should the treatment never have occured.
To truly ensure statistical significance there is additional robustness and placebo testing.

The following notation and formalization of the Synthetic Control Method is heavily based upon the one used in Abadie (2021):

Assume data is obtained for $J + 1$ units, $j = 1, 2, \ldots, J + 1$. Then assume that the first unit,$j = 1$, is the treated unit. In the context of this study unit is Greece, and the treatment is the 1967 military coup. The rest of the units, $j = 2, \ldots, J + 1$ are assigned to constitute what will henceforth be referred to as the "donor pool", i.e the countries used to approximate a synthetic counterfactual to Greece. .The countries making up the donor pool are not subject to the treatment, and must hold up to qualities outlined later under the section *No Interference*. Furthermore, it is assumed that the data spans for T periods, with period T_0 being all periods before the intervention

For each unit of j and t, we observe the outcome variable, Y_{jt}. For each unit, j, we also observe a set of predictor variables, k, to the outcome, X_{1j}, …, X_{kj}. These may include pre-intervention values of the outcome variables, such as lagged variables. Given that these are used in the pre-treatment period, they are unaffected by the intervention.
This results in a series of k vectors, X_1, ..., Y_{J+1}, which contain the values of the predictors for units j = 1, ..., J+1. This can the be arranged into a $K * J$ matrix, which collects the values of the predictors for the J number of untreated units.

For each unit, j, and time period, t, we can set Y_{jt}^{N} to be the response without treatment. For the unit affected by the treatment, $j = 1$ (i.e. Greece) and the post-treatment period, $t > T_0$, we define Y_{1t}^{I} to be the response under treatment.

Thus, we can estimate the effect of the treatment in period $t > T_0$ through the following equation:

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

The equation above estimates the difference between the treated and the synthetic untreated outcome variable for the treated and untreated unit respectively. Given that unit 1 (Greece) is exposed to the treatment after T_0, it follows that in the post-treatment period, $t > T_0$, we have

$$Y_{1t}^{I} = Y_{1t}.$$

As mentioned, the SCM is based on a synthetic counterfactual based on a donor pool consisting of a plethora of other units. The SC is based on the weighted average of the units in the donor pool. It is formally represented by a $J * 1$ vector of weights, $W = (w_2,..., w_{J+1})$. Given a set of weights, W, the SC estimators of Y_{1t}^{N} and τ_{1t} are respectively

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

and

$$\hat{\tau}_{1t} = Y_{1t} - \hat{Y}_{1t}^{N}.$$

To avoid extrapolation beyond the support of the donor pool, the weights are constrained to be non-negative and to sum to one, i.e. each weight lies in the interval [0:1] and together they form a convex combination of the donor units. Usually, only a small number of units in the donor pool meaningfully contribute to the synthetic counterfactual outcome variable, Y_{1t}^{N}. The contribution of each unit is represented by its weight. These weights are reported in the outcome of the algorithm, resulting in a transparent process. The weights should be chosen so that the resulting synthetic control best resembles the pre-intervention values for the treat unit of predictors of the outcome variable.

6.2. Required assumptions

As per Abadie (2021), there are a plethora of contextual requirements, i.e. conditions in which synthetic controls are appropriate tools for evaluating “treatments” (in the words of

Abadie, "*policy evaluation*"). These contextual requirements are not necessarily exclusive to SCM.

6.2.1. Size of the Effect and Volatility of the Outcome

In order for the SCM to be relevant, the theoretical effect of the treatment needs to be large enough that it stands out, lest it will be confused with the effects of other shocks or background noise. I.e. investigating effects that are likely to be small has the risk of drowning in noise. Furthermore, there is a need for relative stability in the outcome variable, as too volatile of an outcome variable means difficulty understanding if the treatment effect is correlated to the changes in the outcome variable.

6.2.2. Availability of a Comparison Group

The model requires an appropriate comparison group in order to construct the donor pool. The donor units themselves need to live up to certain criteria, they mustn't experience similar treatments as the treated unit, in this case coups or breakdown in democratic rule. Furthermore, there needs to exist consistent and sufficient data for the period before and after the intervention.

Besides that, there is no exact rule on what constitutes an appropriate donor. As long as they do not violate key assumptions and provide a good pre-treatment fit, they are eligible candidates. There is however subjective judgement on what makes the country comparable. E.g. they should not differ too much from the country of interest, economically or politically in the context of this paper. The selection process for the major donor is therefore a mix of data-driven fitting and reasoning based on the context of the thesis.

6.2.3. No Anticipation

As the time-series element is crucial in the SCM, outcomes may be skewed if forward-looking economic agents act in advance of the treatment, or if parts of the treatments are implemented before it is formally in place, e.g. a policy package that is enacted in phases over multiple time periods. Such a treatment would complicate the use of the SCM.

In the case of this study, the effect occurs immediately and without anticipation by the larger public, thus it is unlikely that there would be anticipation effects.

6.2.4. No Interference

The assumption of no interference means there is a requirement that the donors included are not subject to any spillover effects of the treatment. Assuming no such spillover effects do not exist is a strong restriction which either must be enforced or accounted for in the analysis of the results. Note that this places quite a constraint on the requirement *Availability of a Comparison Group*. The transparency of the SCM allows for analysis in including/excluding certain units that might be subject to spillover effects, and the model can thus be tuned and adjusted to see how the fit and overall outcome is affected by their inclusion and/or

exclusion. Spillover effects can also be accounted for in the analysis section of the SCM, as there is likely an understanding in how such spillover effects might bias the final results. The problem of spillover effects affecting donor countries will be dealt with on a case-by-case basis for the purpose of this study.

6.2.5. Convex Hull Condition

The convex hull condition is in essence the basis of the model. It is in a simplified way askin "are we able to get a good fit?", "are we able to weigh our donors so that their weighted average predictor variable outcome looks almost identical to Greece's before the treatment date?". This will be illustrated using a graph once we run the model, and will be quite easy to discern visually. The model will also output data which can be analyzed to check the fit on a numerical level.

6.2.6. Time Horizon

In order to compare the treated unit against the synthetic untreated unit, we must have a certain amount of post-treatment data available. In the context of this thesis, given the time-frame we are analysing this is no issue, as data is readily available.

6.3. Constructing the donor pool

6.3.1. Filtering the data - Satisfying the condition of a *Comparison Group*

As previously mentioned there is a need for the countries that make up the donor pool and thus the synthetic counterfactual to be similar to the treated country, on top of other required assumptions and contextual requirements. For this thesis the method for constructing the final donor pool was highly iterative. That is, the model was run with as many donors as possible given the available data in the GMD, in this case 62 donors, with the full list available under Figure A in the Appendix. After each iteration, the most heavily weighted donors were considered with regards to their ability to let the contextual requirements and assumptions hold. If deemed unsatisfactory, the countries were removed. Furthermore outliers with regards to the In-Place placebo test, which will be discussed later, were also excluded as was deemed appropriate. This evaluation was done on a subjective level. The process was repeated until desirable major donors were found.

6.3.2. Filtering the data - Satisfying the condition of *Pre-treatment information sufficiency*

A number of countries that were a part of the GMD were removed from the pool preemptively as they lacked data in the 1950-1985 interval, thus making them insufficient to use in the model.

6.3.3. Filtering the data - Satisfying the condition of *No Interference*

This is, as with the condition of a suitable *Comparison Group*, evaluated on a case-by-case basis.

6.3.4. Final donor pool

After filtering out countries with insufficient data, further filtering was performed in order to ensure the final donors allowed for the previously held assumptions to hold. This was done through an iterative process, where the model was run and the results subsequently evaluated. If the largest donors were deemed to differ too much from Greece geographically, economically or politically, or violated assumptions, they would be removed and the model would be re-run.

7 countries in total were removed from the initial donor pool.
Japan and Nicaragua were the largest initial donors after the first run of the model, with a weight of 0.27 and 0.213 respectively. They were excluded as they were judged to differ too much from Greece. Japan due to the scale of its economy, as well as its cultural and geographical differences in comparison to Greece. Nicaragua was considered a poor donor due to it experiencing political instability and civil war during the relevant time period.

The United States, Venezuela, Germany, the United Kingdom and Iceland were removed as they were considered large outliers after running the in-place placebo test, and thus deemed unsuitable donors. This leaves the model with the remaining donors as the final donor pool, which can be found in its entirety under Figure B in the Appendix.

6.4. Choosing predictor variables

The choice of predictor variables was initially based on economic theory, such as the Solow-Swan model, the Romer model and the national income identity formula. This was done as an attempt to capture broader transmission channels of GDP growth. However this method was abandoned, in part due to the time it took to run the placebo-tests (not an inherent problem of the model, but rather due to the computational power of the device it was run on), in part due to the results, which yielded a poor fit.

Thus, the choice of predictor was simplified. The final predictors used were the log of lagged real GDP and the log of 3-year averages of lagged real GDP. These predictor variables substantially reduced the time to run placebo-tests, and provided a good pre-treatment fit. While it could be argued that using a per capita variable would be reasonable to account for differences in population, given the relatively short observation period this would not have altered the end result significantly. Finally, simplifying the predictor set also reduced the risk of overfitting.

6.6. Placebo and Robustness testing

Placebo and robustness tests must be conducted in order to test the statistical significance of the results.

6.6.1. In-Space Placebo

In-Space Placebo testing in the context of using the SCM means applying the method/model to each and every entity in the donor pool. So for each donor country, the same algorithm is applied to gather pre-treatment and post-treatment fit for all other donors as if they were the country of interest for the study, in order to evaluate the robustness of the result. This can be shown visually through a so-called "spaghetti graph", which is helpful for visually identifying and removing outliers.

The results can also be ranked in a bar graph, where the post- to pre-treatment MSPE (Mean Square Prediction Error) ratio is calculated for each placebo and the initial counterfactual. These are then ranked in descending order. From this, we can infer if the effect of the treatment for the country is abnormally large in comparison to the placebos. If that is the case, it suggests the results are significant.

The test also allows us to calculate a p-value to test for statistical significance. We do this by looking at the rank of our counterfactual of interest, i.e. Greece, in comparison to the placebos which have been visualised using the bar graph. We then take the rank of our counterfactual of interest in descending order and divide it by the total number of counterfactuals created for the placebo test, including our initial counterfactual. To exemplify it, if we generate 19 placebo counterfactuals, the denominator should be 20 as we add the non-placebo counterfactual.

$$p = RANK \div TOTAL$$

This procedure yields our final p-value, which helps us understand if the treatment effect is statistically significant or not. Important to note is that with the p-test used for this method, there is a need for a large enough sample size in order for a p-value under 0.05 to be mathematically possible, which is 20+ observations. With 20 observations we allow for results to reach a p-value = 0.05 if the rank of the synthetic control of interest is 1.

6.6.2. In-Time Placebo

The In-Time placebo test, also referred to as "backdating", uses a fake treatment date that occurs before the real treatment date. The purpose is to see whether treatment effects arise despite the lack of actual treatment occurring. This helps to understand whether the effect is actually a result of the treatment, or whether the model creates a treatment gap as a result of things such as picking up noise, underlying trends or poor model fit. If the gap occurs at the

same time as the placebo date, it suggests the model is not robust. However, if it does not, it strengthens the confidence in the validity of the model.

6.6.3. Leave-one-out test

The leave one out test effectively attempts to see if there is any major divergence in our results should we remove a donor from the donor pool. This allows us to see if our model is heavily dependent on a certain donor, which has implications for robustness.

7. Results

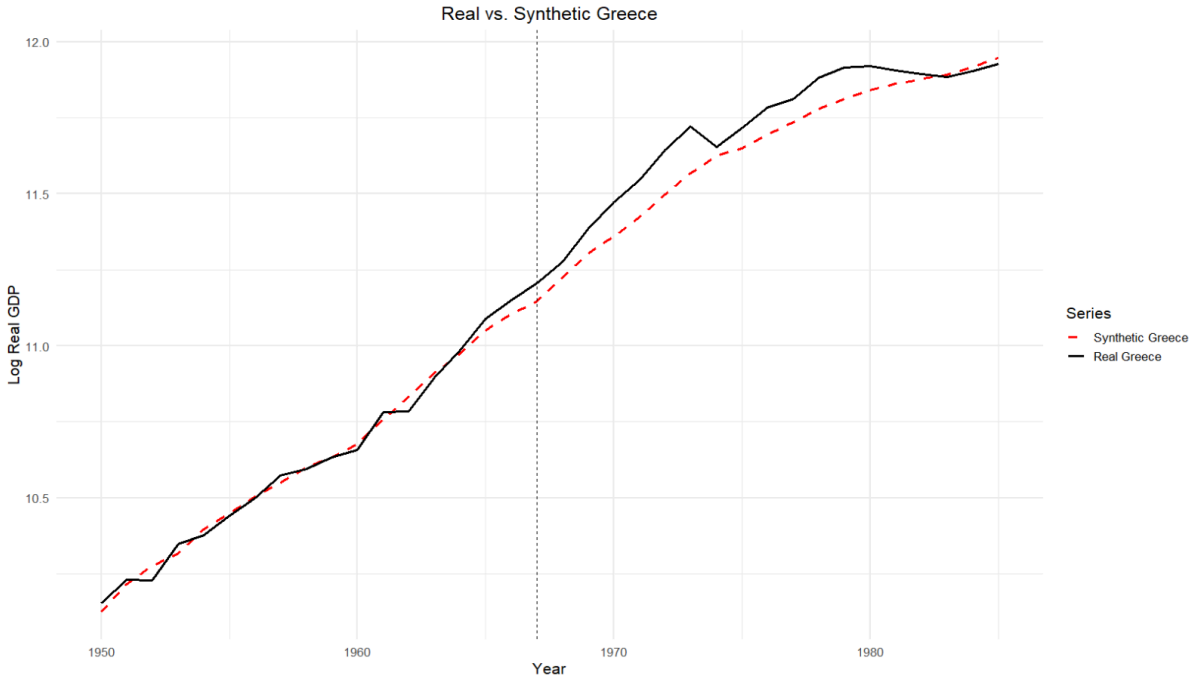

Figure 1 - The graphical output of the SCM showcasing the Log of Real GDP for both real and synthetic Greece.

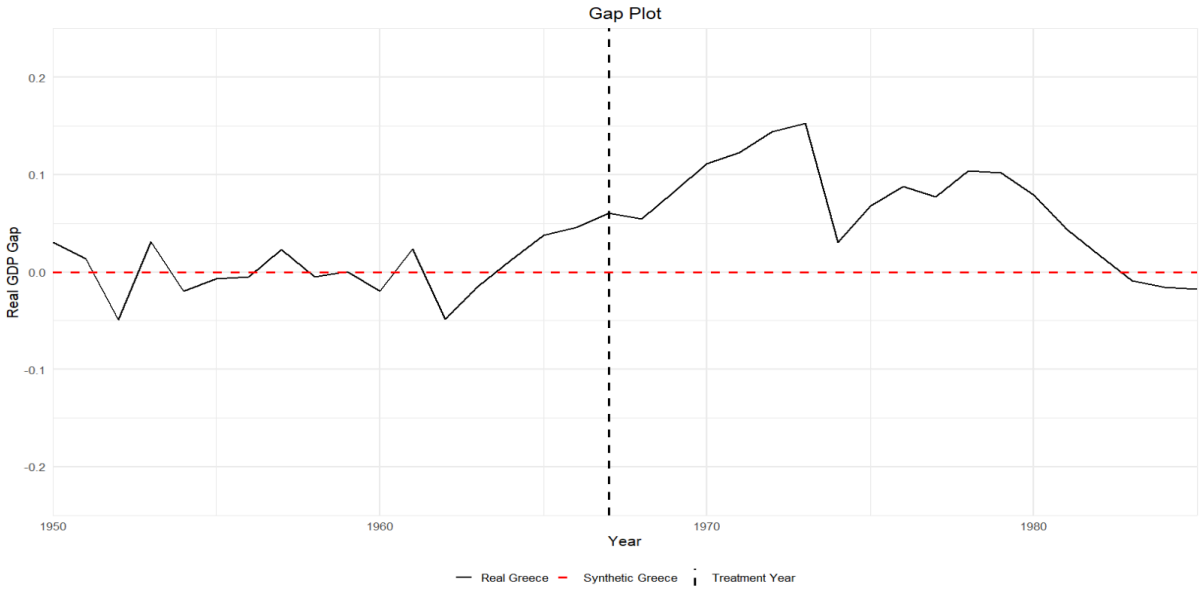

Figure 2 - A gap plot showcasing the difference in GDP between Real and Synthetic Greece.

7.1. The graphic results of the SCM

With regards to the model fit, the model is able to create a decent pre-treatment fit visually, which closely follows the estimated variable, the log of real GDP. The actual numerical fit will be discussed further in *7.2. Predictor outcome*.

Analysing the graphs, Figure 1 and Figure 2, we see that there is a post-treatment divergence, which showcases that the synthetic counterfactual not subject to the military junta, performs worse than real Greece in terms of real growth. Visually this effect is quite clear divergence from the growth path of real Greece. This effect holds until about 1983, and thus it can be said that the effects holds both in the relative short and relative long term, as it is in effect for ca 11-21 years post-treatment. Although worth noting is that there is some nuance to the results, as the treatment was effectively reversed in 1974..

Worth noting with regards to the results is the fact that there is a clear temporary decrease in the gap between real Greece and synthetic Greece in 1974, which is the same year as the military junta ended, which is quite an interesting result. Furthermore, it looks as if there are perhaps anticipation effects. However this is difficult to say from the results alone, and it will require an In-Time placebo test to further understand if this is the case. Given that the data used is yearly, it could just be noise from the year end of 1966 that then gives the impression of anticipation effects as it provides a "ramp" for the quite clear impact of the junta on the economy.

7.2. Predictor outcome

Balance Table: Predictor Means (Treated vs. Synthetic)

Predictor	Treated	Synthetic	Sample Mean
Log Real GDP	10.613	10.610	10.239
Avg. Log GDP (1950–52)	10.205	10.206	9.922
Avg. Log GDP (1953–55)	10.389	10.387	10.064
Avg. Log GDP (1956–58)	10.575	10.572	10.206
Avg. Log GDP (1959–61)	10.741	10.756	10.363
Avg. Log GDP (1962–64)	10.991	10.979	10.523

Figure 3 - A table showcasing the predictor matching between real and synthetic Greece.

As seen in the table of Figure 3, the average values of the synthetic control in the pre-treatment period match well across all values of the synthetic control, further indicating numerically that the fit of the model is decent. This reinforced what is seen in the visual output of the model, which shows a decent visual pre-treatment fit.. Finally it suggests the model follows the assumption of the convex-hull condition, which, as previously mentioned, in essence means that the model is able to generate a decent pre-treatment fit.

7.3. Donor pool weights

Top 5 Donor Countries (Weights)

Spain	Israel	Taiwan	Hungary	Iraq
0.381	0.135	0.048	0.039	0.032

Figure 4 - A table showcasing the 5 most heavily weighted donor countries.

As can be seen in the table, Figure 4, the weights of the synthetic control is mainly dependent on Spain and Israel, with other countries making up relatively smaller weights of the synthetic counterfactual.

Spain does subjectively work as a good donor country. It shares geographical and on a certain level cultural ties with Greece. Both countries are mediterranean, experiencing similar climates and both have considerable mountainous terrain. Both of them fell under the western sphere of influence during the cold war as well, indicating similar overall political ties. So even despite Spain being considerably larger both with regards to total population and GDP, it is for the purpose of this thesis considered an acceptable major donor. Furthermore it is unlikely subject to any forms of spillover effects or the like, which as mentioned earlier is an assumption that needs to hold. While it is under a dictatorship, given that the turn to autocracy didn't occur within the period the paper examines, it should still be considered a valid donor. Lastly, even if the country would be deemed a poor donor, looking at the LOO robustness test we see that dropping the country does not affect the outcome in a major way.

Israel is considered an acceptable donor as well. At the time, its population and economic size were much more similar to Greece's than Spain's, making it a better match both economically and demographically. Israel furthermore shares the same mediterranean climate as Greece and arguably falls on the side of the west during the Cold war, indicating similar political ties.. Something that could arguably make Israel a problematic donor would be its involvement in the 6-day war in 1967, the same year as the military junta took control in Greece. This as well as other conflicts with Israel in the pre- and post-treatment period could make it a problematic donor. But given that these seemingly had limited impact on the country on an aggregate level, Israel is ultimately considered an acceptable major donor. Furthermore it is unlikely subject to any forms of spillover effects or the like.

A full list of each donor country and their weight can be found under Figure B in the Appendix.

7.2. Robustness and placebo testing

7.2.1. In-Space Placebo test

As outlined in *Methodology*, the *In-Space placebo* in essence performs the synthetic control method procedure for each and every donor country in order to gain a sense of the effect is unique to the treated country, i.e. Greece, or if it rather is a result of random chance. This can then be evaluated in two ways, either visually, through a permutation, "spaghetti," graph or through calculating pre-and-post MSPE ratios for each placebo and comparing them by lining them up in a histogram.

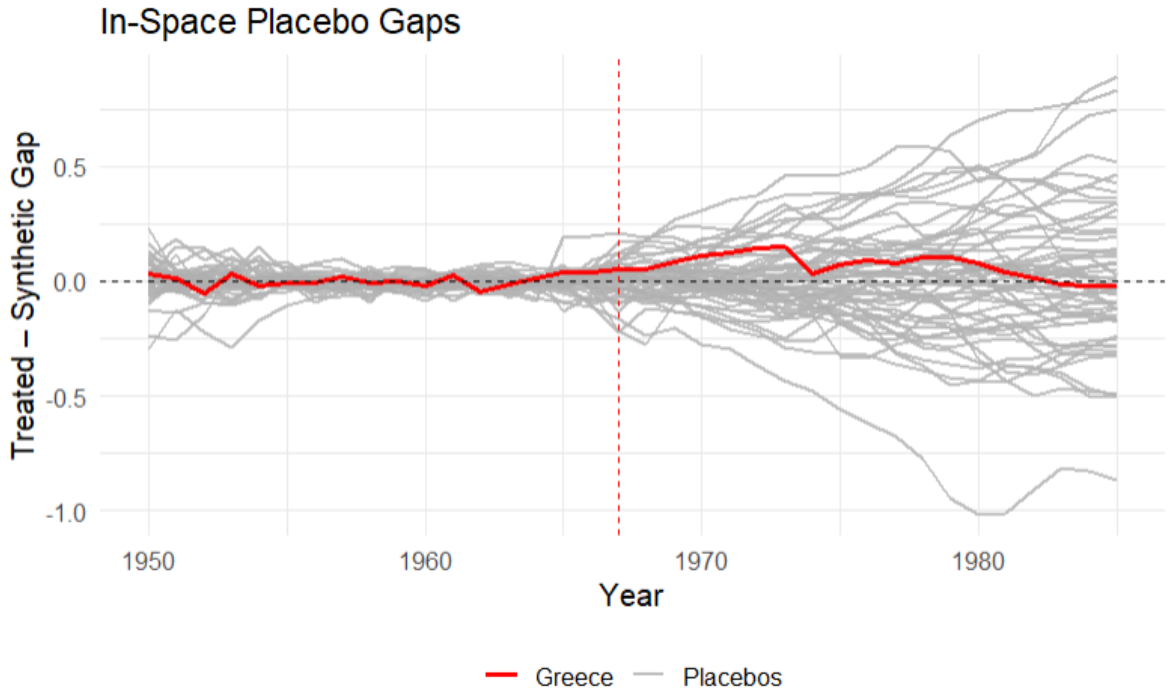

Figure 5 - A permutation graph showcasing the In-Space placebo results, with Greece being highlighted in red.

As we can see in Figure 5, the treatment effect based on the In-Space placebo test does not visually stand out, suggesting that the effect is not statistically significant, and more likely random noise. Worth noting however is that the model provides a decent fit for the pretreatment period.

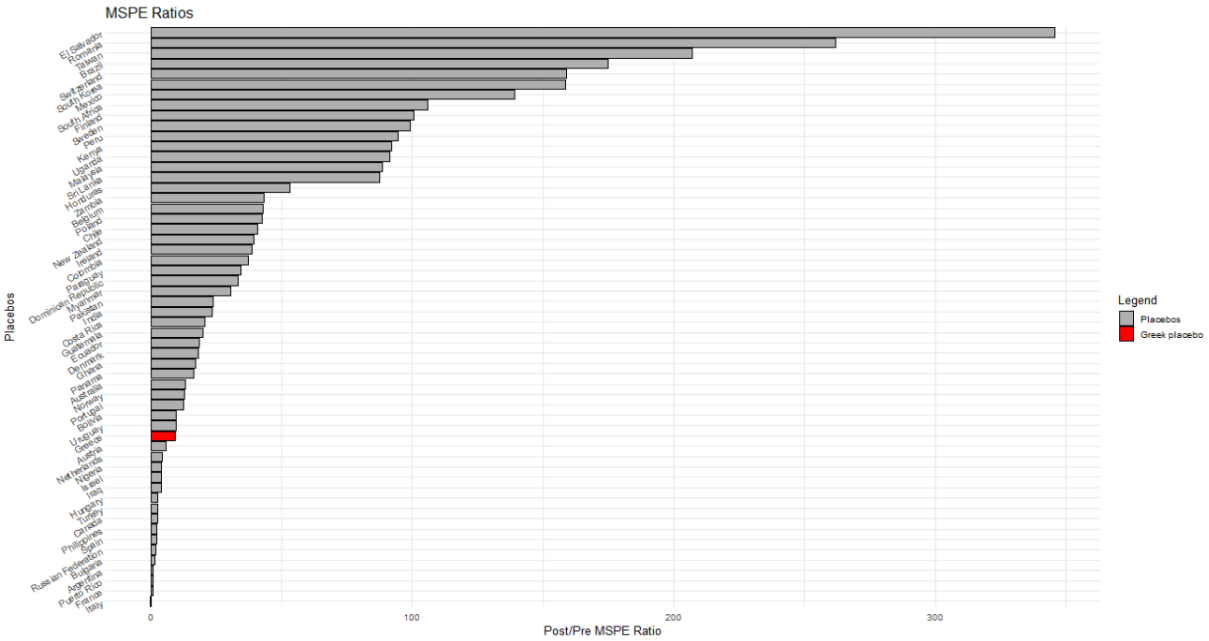

Figure 6 - A bar chart with Post/Pre MSPE ratios ranked in descending order for each placebo counterfactual including the Greek counterfactual ranked as 40th. A higher quality image is available in the Appendix.

Moving on to Figure 6, the outcomes of the placebo counterfactuals are presented in a bar graph format, alongside synthetic Greece. As can be seen, Greece is not standing out amongst the countries, i.e. it is not of substantially higher Post/Pre MSPE ratio compared to the other placebo counterfactuals, which suggests the results from the synthetic control are likely a result of chance, i.e. statistically insignificant, mirroring the results from the "spaghetti" graph.

Left to do is calculating the p-value of the outcome. As mentioned, this is done by taking the rank of synthetic Greece in ascending order and dividing it by the total amount of synthetic counterfactuals generated during placebo testing. With the Greek counterfactual having rank 40 and the amount of placebo counterfactuals being 55, we get a p-value of approximately 0.73 ($40 \div 55 \approx 0.7272$), i.e. > 0.05, thus confirming the result is statistically insignificant.

Worth noting is that we are past the lower limit of required observations for even being able to reach significant results, 20. Thus it would seem that the issue of statistical insignificance is not due to too few observations.

7.2.2. In-Time Placebo test

Figure 7 - A graph showcasing the result of the In-Time placebo test.

The In-Time placebo test provides results which are similar in form to the original counterfactual. While there are some minor deviations with regards to magnitude, the overall form and outcome is highly similar to the counterfactual, thus suggesting the results are robust, and that the model is not simply picking up random noise or underlying trends.

7.2.3. Leave-One-Out test (LOO)

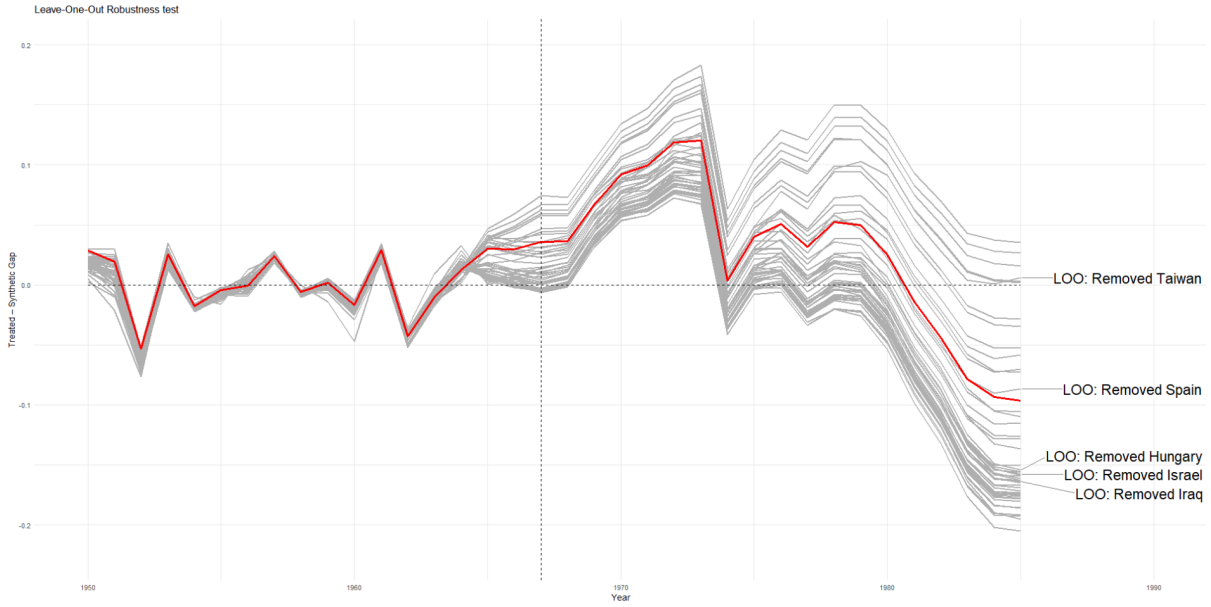

Figure 8 - A graph showcasing the result of the Leave-One-Out Robustness test.

The LOO robustness test as seen above indicates that the results of the model for the 1950-1985 period is highly sensitive to donors being removed. While the overall movements

of GDP growth are consistent over time, the difference in magnitude between each simulation is high. Thus it can be said that the model is highly volatile. The effect of removing the 2 most contributing donors yields quite different results, where removing Spain creates little alteration to the final estimation while removing Israel results in much better performance for Synthetic Greece. As such, the model proves highly unstable and sensitive to donor pool alteration, further weakening the credibility of the initial results.

7.3. Summary of results

In summary, the initial model suggests real Greece fared better than synthetic Greece. The In-Space placebo tests suggest that the results are statistically insignificant, while the In-Time placebo test suggests the model is somewhat robust, and not a result of picking up random noise or underlying trends. Lastly, further robustness testing using the Leave-One-Out test indicates that the model is highly sensitive, as the removal of certain donors can alter the outcome drastically. In the end, the results are to be considered statistically insignificant, and thus no inference can be drawn.

8. Discussion

8.1. Possible reasons for lack of inference

One reason of interest that might contribute to the lack of a statistically significant result is the choice of the predictor variable. As mentioned earlier in the paper, initially there was an attempt at using transmission channels as predictor variables, employing economic models such as the Solow-Swan model and the national income identity formula. However after attempting to do so the method was abandoned due to fit and model run-time issues, and lagged GDP predictor variables were chosen instead. Using other predictors might have resulted in a different growth trajectory post-treatment, and if big enough and resistant to placebo and robustness testing, it could have resulted in a statistically significant result.

It is clear however that the lack of significance did not have to do with too few donors itself i.e. lack of sample size, as the minimum requirement to get a p-value of 0.05 was 20, a number which was more than doubled with the 55 donors used.

8.2. How to iterate and improve upon the model and the thesis

One of the main ways in which the thesis could have built further upon previous research would have been to, as mentioned, to look into variables that are indirectly affected and perhaps often correlate with democracy and democratization. For instance, looking at constituents of economic liberalism as mentioned in the papers regarding Spain and Chile.

Additionally, it would be interesting to pinpoint whether specific aspects of democracy matter more or less through using disaggregated democracy indicators, such as those provided by the V-Dem project.

With regards to donors, it would have been beneficial to create concrete parameters for what makes a country an “appropriate donor”, as this would allow for better reproducibility of the result and allow for iterations and testing of such an assertion, i.e. testing of what makes a country truly comparable. While there was an initial attempt to do so using the V-Dem index to at least account for level of democracy among donors, the method used resulted in too few donors for the result to be mathematically significant, which is why the author proceeded to conduct the filtering of major donors on a case-by-case basis.

9. Conclusion

In conclusion, while the initial results of the SCM produced results which suggested the military junta in Greece actually improved economic performance, due to failed robustness and placebo tests, the results can not be considered statistically significant and thus nothing can be conclusively said about the actual correlation between the junta and Greek growth, and thus about democracy, autocracy and economic growth. Additionally, due to the non-conclusive answer the research question posed cannot be answered. Nonetheless, this thesis has been an attempt at further contributing to the field of economics by applying the SCM on a country in order to see if it is possible to infer any relationship between economic growth and democracy.

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11. Appendix

Initial list of potential donor countries

Argentina	Australia	Austria	Belgium	Bolivia	Brazil
Bulgaria	Canada	Chile	Colombia	Costa Rica	Denmark
Dominican Republic	Ecuador	El Salvador	Finland	France	Germany
Ghana	Guatemala	Honduras	Hungary	Iceland	India
Iraq	Ireland	Israel	Italy	Japan	Kenya
Malaysia	Mexico	Myanmar	Netherlands	New Zealand	Nicaragua
Nigeria	Norway	Pakistan	Panama	Paraguay	Peru
Philippines	Poland	Portugal	Puerto Rico	Romania	Russian Federation
South Africa	South Korea	Spain	Sri Lanka	Sweden	Switzerland
Taiwan	Turkey	Uganda	United Kingdom	United States	Uruguay
Venezuela	Zambia				

Figure A - Initial list of all potential donor countries. Source: Author

Donor Pool Weights (Country (Weight), including zeros)

Spain (0.381)	Israel (0.135)	Taiwan (0.048)	Hungary (0.039)	Iraq (0.032)
South Korea (0.030)	Pakistan (0.023)	Kenya (0.015)	El Salvador (0.015)	Nigeria (0.014)
Panama (0.014)	Puerto Rico (0.014)	Bolivia (0.011)	Malaysia (0.011)	Guatemala (0.010)
South Africa (0.010)	Costa Rica (0.009)	Dominican Republic (0.009)	Honduras (0.009)	Peru (0.009)
Paraguay (0.009)	Romania (0.009)	Turkey (0.009)	Uganda (0.009)	Zambia (0.009)
Myanmar (0.008)	Philippines (0.008)	Portugal (0.008)	Bulgaria (0.007)	Sri Lanka (0.007)
Colombia (0.006)	Ecuador (0.006)	Ghana (0.006)	Chile (0.005)	Ireland (0.005)
New Zealand (0.005)	Belgium (0.004)	Finland (0.004)	Mexico (0.004)	Norway (0.004)
Uruguay (0.004)	Austria (0.003)	Denmark (0.003)	India (0.003)	Poland (0.003)
Sweden (0.003)	Argentina (0.002)	Australia (0.002)	Brazil (0.002)	Switzerland (0.002)
Netherlands (0.002)	Canada (0.001)	France (0.000)	Italy (0.000)	Russian Federation (0.000)

Figure B - List of all final donor countries and their respective weights. Source: Author's calculations/model

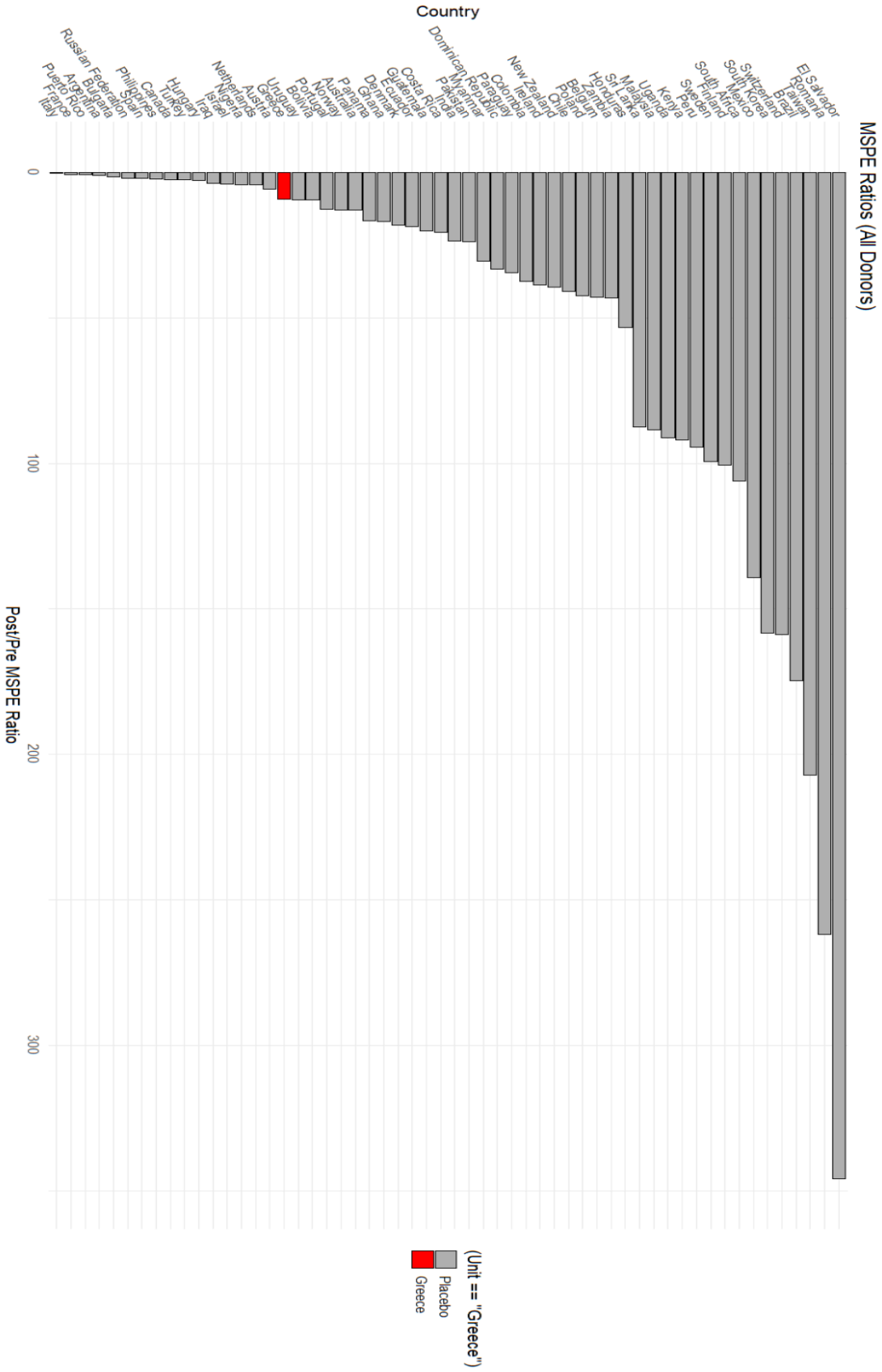

Figure C - The result of the In-Time placebo test's Port/Pre MSPE ratios lined up. Greece is marked in red. Source: Author's calculations/model

12. Use of AI

AI tools have mainly been used for the coding and data cleansing for this thesis, the former in R and the latter in Excel. Additionally, AI has been used as an aid for bouncing ideas and breaking down and explaining difficult concepts through providing concrete examples amongst other things in order to deepen the author's understanding of the subject. No AI generated text has been used within the written component of the thesis itself, nor has anything been rewritten or paraphrased from AI generated text .