UNIVERSITY OF GOTHENBURG

The Grit of the Swedish Krona

An Artificial Implementation of the Euro in Sweden

Jonas Becker & Philip Pettersson

Abstract:

We estimate what would have happened to GDP per capita had Sweden joined the European Monetary Union in 1999, using the Synthetic Control Method. The donor pool for our analysis consists of eleven early adopters of the Euro that implemented the Euro in 1999.

Our results suggest that joining the Euro would have had no immediate effects. Yet by having an independent monetary policy Sweden manage to handle the financial crisis in 2007-2008 and the following Euro-crisis in 2009 better than the counterfactual Synthetic Sweden which implemented the Euro in 1999.

Our results suggest that the per capita GDP (in PPP) is on average 7% higher for the period 2001-2022 in Sweden still using the Krona relative to the doppelganger Synthetic Sweden using the Euro as currency. For the period 2009-2022, GDP per capita is on average 5% higher for Sweden than for Synthetic Sweden.

This thesis suggests that Sweden would not have benefited economically from adopting the Euro when it was introduced in 1999.

Bachelor's thesis in Economics, 15 credits

Spring Semester 2024

Supervisor: Johan Stennek

Department of Economics

School of Business, Economics and Law

University of Gothenburg

Table of contents

I. Introduction

In recent years, as the Krona has become relatively weaker compared to other currencies, the debate about adopting the Euro in Sweden has come to life again. In this thesis we ask: would Sweden have benefited economically from implementing the Euro as its currency?

The purpose of this thesis is to estimate how the Swedish GDP per capita would have been affected by joining the Euro when it was launched in 1999. To do so, we need to compare how the Swedish economy actually evolved, with how it would have evolved if we had joined the Euro in 1999. More precisely, we use the so-called synthetic control method (or SCM for short). We use the eleven countries that joined the Euro in 1999. Each country is given a weight so that the weighted average of these countries, which we call "Synthetic Sweden", is similar to the real Sweden in the pre-treatment period, i.e. the period before 1999.

In the next step, we compare how GDP per capita in Synthetic Sweden and real Sweden evolve after 1999. The idea is of course that since real Sweden evolved in a similar way to Synthetic Sweden before 1999, it would also have evolved in a similar way to Synthetic Sweden after 1999, had we adopted the Euro.

Our main results suggest that by keeping the Krona, Sweden outperforms Synthetic Sweden in terms of GDP per capita, both in terms of PPP and market exchange rates. It seems that joining the Euro would not have had any immediate effect. Instead, the benefit for Sweden seems to have come from its ability to handle economic shocks. This can be seen after the events of the financial crisis in 2007-2008 and the following Euro-crisis in 2009, where Sweden seems to have benefited by having an independent monetary policy as compared to Synthetic Sweden in times of shocks. This is in line with the optimum currency area theory, where the loss of independent monetary policy is viewed as the main drawback of joining a common currency area. After the Euro-crisis in 2009, which significantly impacted the whole European Union, Sweden managed to recover faster than Synthetic Sweden, and the gap between the two shows no sign of decreasing per the latest recorded observation in our data.

According to economic theory, there are both pros and cons with a single common currency such as the Euro. The pros are lower transaction costs, reduced currency risk, greater transparency, and greater competition. Since transaction costs, which are the extra expenses that people and companies face when they for example search for information or negotiate deals are lower, theory suggests that trade within the currency area should increase as well. Reduced *currency risk*, meaning that companies working in different countries with different currencies face lower risks from unexpected changes in currency values which might affect the return of an investment, is another pro of a single common currency. Further, having a single common currency can allow for greater *transparency*, i.e. consumers can easily compare prices of products across various European markets, choosing where from to purchase, which according to economic theory also can increase competition between firms.

The main cost of the common currency area is that a country loses its ability to manage economic shocks independently. Normally, having its own currency allows a country's central bank to adjust the exchange rate or nominal interest rate to respond to economic challenges, serving as a first-best shock-absorber tool. What this means is that the central bank can make its currency cheaper relative to others, which increases net exports, since domestically produced goods become relatively cheaper to foreign buyers. A lower nominal interest rate can also help the economy by boosting domestic consumption and investments levels.

Adopting the Euro may also offer political benefits and increased political influence, e.g. as Ingves points out (Forsberg 2024). Furthermore, as European politicians aim to achieve a more integrated capital market, Sweden's position outside the European Monetary Union (EMU for short) could come with risks of not attracting enough foreign capital from other European Union members (Rising 2024). However, based on our analysis, throughout the period of time for which we have data it does not seem as if being outside the EMU has negatively impacted Sweden's GDP per capita. Foreign direct investments, i.e. the amount of foreign capital invested in a country, is a component of the GDP identity. Our results suggest that Sweden has outperformed Synthetic Sweden in terms of GDP per capita during this period, despite Sweden not being a member of the EMU.

To our knowledge, this paper is the first to look at the economic impact of the Euro, had Sweden joined the Euro in 1999, using the Synthetic Control Method. However, Lin & Chen (2017) uses the SCM to assess the economic impact for the eleven countries joining the Euro in 1999, had they not joined the Euro in terms of GDP per capita. They also conduct, what they call, an inverse SCM analysis for Sweden, U.K. and Denmark, i.e. they estimate what would have happened to these countries had they joined the Euro. Where their study differs from ours is that Lin & Chen (2017) first off uses more variables relevant for the growth rate of the GDP identity. They include human capital in terms of secondary school enrolment, openness in terms of imports and exports, investments and population growth to predict the trajectory of the growth rate for GDP per capita in the post-treatment period i.e. after 1999. Secondly, they convert the values of the variables of interest into the natural logarithm, i.e. they estimate the growth rate of GDP per capita rather than the value of GDP per capita in absolute numbers, as done in our study. However, they found that by not adopting the Euro, Sweden might have benefited economically from this policy decision following the Euro-crisis, meaning that our findings are similar to theirs.

Our thesis has two main strengths when compared to the study that Lin & Chen (2017) did. First off, we focus solely on Sweden. Secondly, and most importantly, our analysis contains more years of post-treatment data. Since we have more observations, we are able to capture yet another economic shock, namely the Covid-19 pandemic. As seen in the results, both Sweden and Synthetic Sweden experience a drop in GDP per capita around the time of the pandemic. Yet, as also can be seen after the financial crisis and the Euro-crisis, Sweden manages to recover better than Synthetic Sweden, and while the slope for GDP per capita is positive in both cases it is steeper for Sweden relative to Synthetic Sweden. Since, hypothetically, the only difference between Sweden and the doppelganger is the currency, which in turn provides Sweden with the ability to independently conduct monetary policy, it seems as if this is a potent tool that can be used to handle the negative effects of economic shocks.

The remainder of this thesis is structured in such a way that section *II* describes relevant economic theory, section *III* outlines the data used for the empirical analysis, section *IV* describes the empirical method and how the Synthetic Control Model is constructed, section *V* presents the results of the empirical analysis, in section *VI* we present the results of the robustness tests used to give credibility to the Synthetic Control Model. And finally, in section *VII*, we present our conclusions.

II. Theory

Economic theory provides various reasons why countries might receive net benefits or costs from joining a common currency. The most well-known contribution in this area is Mundell's (1961) optimum currency area (OCA) theory, which presents potential benefits and costs from adopting a common currency such as the Euro. The theory defines an optimal geographical area where two or more sovereign countries agree to use a common currency instead of their own separate ones. For example, the Franc and the Mark became just denominated in Euro in early 1999. France and Germany thereafter share the same central bank, hence abandoning independent monetary policy. The common currency, in this instance the Euro, then fluctuates only to the rest of the world for its member states.

The designation *optimum* is defined from a handful of key OCA criteria, which are mostly referred to as the mobility of *labour* and *capital*, *price* and *wage* flexibility, degree of *economic openness*, *diversification* in production and consumption, and *fiscal*- and *political* integration. The OCA theory suggest that if these criteria are fulfilled, any arbitrary European Union member country would likely receive future net benefits from adopting the Euro as their currency. Intuitively, the net benefits will deliver full employment while maintaining balanced international payment levels and stable price levels.

First off, before explaining the OCA criteria, we will review the most common cited benefits and costs arising from a common currency from an economic perspective, focusing on the European Monetary Union (the EMU) and Sweden. Then, we will briefly explain the OCA criteria, and lastly present some conclusions derived from the theory.

II.I. Benefits of a Common Currency

Benefits arising from a common currency are:

1. *Lower transaction costs and increased price transparency:*

The currency exchange rate fees between domestic currencies and the Euro would be eliminated. The costs related to translation of prices from domestic currencies, e.g. the Krona to the Euro is also eliminated. The greater the trade with other union members, the greater the benefits. This would also incentivize positive competition, benefiting consumers and corporations since lower costs associated with uncertainties and resources allocated to compare prices and information searching. Lower risks of exchange rate fluctuations since countries joining the common currency are fixing their exchange rates, might benefit risk-averse firms or individuals.

2. *Investments and economic convergence:*

Lower trading costs reduce the risks associated with exchange rate fluctuations and reduced costs of hedging. This lowers investment risks and increases further integration of financial and capital markets within the currency area. Further integration in turn fosters greater competition and economic growth. A more unified market might help with smoothing out economic differences in Europe, aligning business cycles more closely among member states. A stronger economic convergence like this means that, more often, the common monetary policy will suit most of the individual countries in the EMU.

These benefits together, will lead to net positive efficiency gains for the society, enhancing overall economic stability and growth according to the OCA theory. Had Sweden joined the Euro in 1999, from a theoretical point of view, it would lead to an increase in trade between Euro members and Sweden.

II.II. Costs of a Common Currency

The main *cost* arising from a common currency, according to Mundell (1961), is mostly referred to as the *loss of independent monetary policy.*

The loss of independent monetary policy means that countries like Sweden lose the flexibility to adjust their monetary policy independently. Being able to adjust the nominal interest rate is no longer possible and does no longer work as the first-best shock-absorber. Future macroeconomic shocks are likely to occur, and without the option to affect the economy via an independent monetary policy, the costs might be high. If the shocks are idiosyncratic and asymmetric, the independent monetary policy tool is regarded as relatively more important than if the shocks are symmetric across the common currency area.

II.III. The OCA Criteria

By the *labour* and *capital* criteria, Mundell argues that if mobility of factors, specifically if *labour* mobility is high, a common currency area might be more resilient to an asymmetric shock if the integration is relatively high. Meaning that the need for a fall in relative wages can be offset by labour moving freely and somewhat effortless migration to restore full employment and the labour force adapting to the demand for workers in one country respective to another. However, the capital mobility within a currency area is likely to be somewhat mitigated by the pace at which direct investments can be absorbed and moved from one country to another.

Mundell also states in his paper that when nominal *prices* and *wages* are flexible between and within countries using a common currency, these countries can more easily adapt to asymmetric shocks. Meaning that prices or wages can in *real terms* move up or down, such a flexibility might help to prevent long term unemployment or inflation in any member state. On the other hand, if prices and wages are *rigid* and cannot easily adjust, countries first-best policy instrument is the control of the nominal interest rate. In the short term, prices and wages adjust slowly in the event of shocks or disturbances, hence we might assume that they are rigid. Meanwhile, in the long run, it is plausible that real wages and prices are flexible.

However, member states of the Euro lose this first-best instrument using monetary policy tools, and hence makes it very hard to depreciate the currency for a single country if needed due to asymmetric shocks if relative prices and wages are rigid in the short run.

Economic openness measures how much a country's economy is integrated with the global market, i.e. through trade. When a country has a relatively high degree of economic openness, changes in the prices of traded goods with the rest of the world is likely to affect local prices. This means that if international prices fluctuate up or down, domestic costs of living will likely follow the same path for the consumer. Hence, if a country is having a relatively high degree of economic openness, a devaluation under fixed exchange rate regime, or depreciation under flexible exchange rate regime, tends to offset itself. This since, given a rapid increase in costs of living from imported goods, the nominal exchange rate is less useful as an economic instrument to absorb shocks (Mongelli 2002).

Diversification in production and consumption means that any arbitrary potential member of the common currency should have a variety of different industries and types of goods produced in the economy. When a country's economy is relatively high diversified, it is less likely to be severely affected by disruptions in any single industry or sector. This is because economic shocks in one sector does not impact the entire economy as significantly, hence spreading the risk and providing some sort of protection against economic disturbances.

According to Kenen (1969), countries with well diversified economies are better protected from the need to adjust their nominal interest rates or nominal exchange rates to manage macroeconomic shocks. Furthermore, they are therefore more likely to benefit from using a common currency, relying relatively less on monetary policy as a first-best shock absorber. This is due to them being less sensitive to asymmetric shocks, they gain benefits from improved market integration which reduces transaction costs.

Fiscal integration, Kenen (1969) expanded on Mundell's theory with fiscal integration characteristics in the OCA theory. Countries that share a supra-national fiscal policy and transfer system could redistribute funds to a member country affected by asymmetric macroeconomic shocks, potentially reducing the need for nominal interest rate adjustments as first-best shock absorber. In the case of the European Monetary Union, with a supra-national component, any affected country pays less to the rest of the European Union but receives a higher net benefit through transfers. This is some form of "public risk sharing". However, this requires a significant level of political integration and willingness to undertake such risk.

Political integration, there might be additional political incentives for a country like Sweden to join the Euro. Significant economic and political decisions are made by the European Central bank and European Parliament. Sweden's influence in the European Union might be at stake if Sweden does not implement the Euro, as Ingves highlights (Forsberg 2024). There seems to be a political will to integrate, and it is therefore a common context and argument for joining the Euro.

To summarize, and according to theory, if a country can fulfil these criteria stated above there are efficiency gains to obtain for countries in a monetary union utilizing a common currency.

II.IV. Theoretical Conclusions

With respect to the OCA theory, assessing whether Sweden would have benefited from joining the Euro in 1999 is a complex question with no real answer. For example, Krugman (2013) has a more pessimistic view about the European Monetary Union and argues that the costs of a common currency area might be high, especially after economic booms or busts. Krugman (2013) suggest that a floating exchange rate can help against asymmetric shocks. He also argues that Europe does not match e.g. the US in terms of labour flexibility and fiscal integration, which are crucial assumptions for OCA-theory to deliver net benefits.

Furthermore, when joining a common currency, the importance of fiscal policy increases. If a nation has an independent monetary policy, fiscal policy can be used to support monetary policy in stabilizing the economy in the event of idiosyncratic macroeconomic shocks. Without the option to change the nominal interest rate via the central bank and depreciate the currency in real terms, asymmetric shocks instead have to be managed by only using fiscal policy.

Calmfors (2003) discusses the properties of fiscal policy as a countercyclical tool, but also reasons why it might not be enough to rely only on monetary policy. One reason is that during a severe recession or depression, using monetary policy might not work if a country is stuck in a situation where cash is hoarded, also known as a liquidity trap. In this scenario, lowering nominal interest rates might not be a solution solving the problem, since it is not possible to have negative real interest rates when prices are falling. Other pros of fiscal policy stated by Calmfors (2003) is that it is more effective when targeted towards, for example, a specific sector of the economy.

The cons of fiscal policy, such as taxes or VAT changes and increased government spending, is the fact that these policy decisions must go through slower decision-making processes. The lags of fiscal policy are long, as Calmfors (2003) points out. Additionally, the decisions might be more complex because of the many numbers of different instruments that can be used as fiscal policy tools.

Without the ability to conduct independent monetary policy, the need for sound fiscal policy is crucial. However, maintaining strong fiscal discipline is a major challenge. In the EMU, individual countries can't depreciate their currency to improve relative competitiveness. Instead, when the burdens of debt become too significant, they can only achieve relative competitiveness via lower inflation relative to other EMU members. This is achieved via high unemployment rates, resulting in very slow or even negative real wage increases. This approach is highly unpractical because it results in lower living standards and hardships for citizens (Calmfors 2013). Also, some EMU countries have struggled to follow the fiscal rules regarding budget deficits and government debt relative to GDP, issues that led to the Euro-crisis in 2009.

Further, von Hagen and Mundschenk (2001) discuss interactions between the joint monetary policy and the different national fiscal policies in the EMU. Their analysis concludes that even though monetary policy in the long run can be adjusted in such a way that it doesn't affect the individual output of the member countries, in the short run there is potentially a conflict between the joint monetary policy and the different national fiscal policies since both can be used to determine aggregate demand in the EMU. Von Hagen and Mundschenk (2001) also point out that if the interdependencies between the joint monetary policy and the national fiscal policies are ignored, it might have a negative impact on the EMU.

Sweden, as a small open economy, is heavily dependent on trade and net exports and does not match the economic structure and diversification of core European economies like Germany or France. This means that Sweden might need to maintain its ability to adjust monetary policy to handle idiosyncratic and asymmetric macroeconomic shocks. It appears plausible that the higher a country's vulnerability for asymmetric shocks, e.g. the less economically diversified a country is, they might be less likely to benefit from a common currency. Additionally, it is plausible that prices and wages are in fact rigid in the short run, which adds to the arguments for retaining the independent monetary policy instrument.

While maintaining control over its currency allows Sweden to handle economic shocks and its monetary policy more independently, it might also face challenges in attracting foreign capital. Investors might prefer the stability and benefits of larger currencies, hence being outside the EMU might make Sweden less attractive for foreign capital.

In summary and by OCA theory alone, it is hard to draw any conclusions regarding what would've happened to GDP per capita if Sweden had adopted the Euro in 1999. Since the benefits or costs of joining a common currency are a nuanced issue, we will instead try to evaluate this using empirical observations.

III. Data

As of 2024, twenty member states in the European Union have adopted the Euro as their currency. However, our analysis focuses exclusively on the eleven countries that adopted the Euro at its launch in 1999. In this thesis, we will not include the nine countries that joined the Euro post 1999 due to the insufficient data they provide. Therefore, these eleven initial Eurozone countries constitute our donor pool for our Synthetic Control Method Analysis.

Our empirical analysis utilizes time series data. The primary outcome variable, GDP per capita, is measured in thousands of 2015 US dollars. Furthermore, we have a second model with GDP per capita in PPP terms, which is measured in thousands of 2021 international dollars, as the outcome variable. An international dollar is a hypothetical currency that can buy the same amount of goods and services in another country as a US dollar can buy in the United States. Our models specifically include data from 1990 through 2022. All the observations are gathered from the World Bank Databank (2024).

From the gathered data, we derive 9 years of pre-treatment and 24 years of post-treatment observations. While there is no formal test to see whether this is a sufficient number of years of pre-treatment data, we have the same number of years of pre-treatment data as in the study conducted by Lin & Chen (2017). Compared to their study, the group of potential donors in our case is smaller, which could be a limitation. This is not an issue specifically related to our thesis though, since there were in fact only eleven countries that adopted the Euro in the year 1999, which automatically limits the number of potential donors that can be used to construct the synthetic counterfactual.

The reason that we do not start earlier than the 1990s is that the 1980s marked a period of significant economic deregulation and liberalization across many European economies, including Sweden, which experienced several reforms towards greater economic openness. This decade also saw advancements in technology and a shift by numerous countries toward flexible exchange rates, which further facilitated free movement of capital. Moreover, the end of the Cold War had profound impact on Germany for example, given the reunification of East and West Germany in 1990 which was an event that had significant economic impact. Since the 1980s was a period in time where the European economies experienced varying degrees of idiosyncratic shocks which could have unwanted effects on our synthetic control models, for example making them biased, we decided to use the year 1990 as our starting point, given the thought that the European economies of interest are more similar to each other from this time.

IV. Empirical Method

The method of choice for this thesis is the *Synthetic Control Method*, or *SCM* for short. The method requires the creation of a synthetic (i.e. artificial) control unit by using a group of donors that donate various attributes to construct the synthetic control unit. The treated unit and synthetic control unit are then compared at and after the point in time where treatment occurs, trying to establish whether treatment has had an effect or not. Thus, by utilizing the SCM, we strive to be able to estimate the effect implementing Euro as currency in 1999 has on GDP per capita for our control unit, *Synthetic Sweden*, and then comparing this counterfactual outcome to the actual outcome Sweden has had. Further, to try to evaluate the statistical significance of the treatment effect different robustness tests will be used, namely a placebo test “in-time” as well as a “leave-one-out” test.

Lastly, the results from the synthetic control method, as will be shown in the results section, indicate that the estimated development of GDP per capita for Synthetic Sweden is mostly influenced by a few countries. This is anticipated as the variations in economic characteristics among the countries that constitutes the donor pool is quite large. And finally, the donor pool consists of the countries Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

IV.I. Construction of the Synthetic Control Method

Following Abadie (2020), we gather and analyse data from the World Bank for 11 countries, which are untreated, and these untreated countries make up the "donor pool".[1]

The gathered data spans over the years 1990 to 2022. For every nation j and year t, we get an observation of Y_{jt}, the outcome, i.e. GDP per capita or PPP per capita GDP[2].

We then define Y_{jt}^N to be an estimated response without treatment for each j and year t. Thus, for the country $j = 1$ and the post-treatment period, Y_{jt}^I is defined as an estimated response with treatment. The effect of the treatment for the unit of interest in period t where $t > T^0$ is then $\tau_{1t} = Y_{1t}^I - Y_{1t}^N$.

What we're missing, and what we aim to reproduce, is Y_{1t}^N. This is the value for GDP per capita that would have been observed for Sweden without treatment, hence making it possible to make a comparison between Sweden with treatment and Sweden without treatment. To get an estimate for GDP per capita for Sweden without treatment, we need to construct the counterfactual Synthetic Sweden.

Synthetic Sweden is defined as a weighted average of the countries that make up the donor pool and can be represented by a $J \ x \ 1$ vector of weights, $W = (w_2, \dots, w_{J+1})'$. With a given set of weights, the estimators of Y_{1t}^N and τ_{1t} are $\hat{Y}_{1t}^N = \sum_{j=2}^{J+1} w_j Y_{jt}$ and $\hat{\tau}_{1t} = Y_{1t}^I - \hat{Y}_{1t}^N$, respectively (Abadie 2020). That the synthetic control is a weighted average of the countries in the donor pool means that weights are restricted to be non-negative and that they sum to one. Weights are also typically sparse, and only a small number of units contribute to the counterfactual (Abadie 2020).

How are then the weights $w_2, \dots, w_{J+1}$ for the donor countries chosen? Abadie (2020) propose to choose the weights in such a way that the synthetic control resembles the predictors and the outcome variable of the treated unit in the pre-treatment period as closely as possible. I.e. given a set of non-negative constants $v_1, \dots, v_k$ Synthetic Sweden, $W^* = (w_2^*, \dots, w_{J+1}^*)'$, is to be chosen in such a way that it minimizes $||X_1 - X_0 W|| = (\sum_{h=1}^k v_h (X_{h1} - w_2 X_{h2} - \cdots - w_{J+1} X_{hJ+1})^2)^{1/2}$, with the restriction that the weights $w_2, \dots, w_{J+1}$ sum to one and are non-negative. The estimated treatment effect is then $\hat{\tau}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}$. Minimizing $||X_1 - X_0 W|| = (\sum_{h=1}^k v_h (X_{h1} - w_2 X_{h2} - \cdots - w_{J+1} X_{hJ+1})^2)^{1/2}$ is done by using constrained quadratic optimization, which the algorithm in Stata does automatically when using the *synth* command. To determine the so-called fit of the model in the pre-treatment period we use the term *Root Mean Squared Prediction Error* (RMSPE), which is the square root of the squared deviation between GDP per capita for Sweden and Synthetic Sweden in the pre-treatment period, i.e. the distance between observations for the actual outcome and the

---

[1] For us, this is where the method differs a bit. In the case of this thesis, Sweden has not undergone an intervention, while the units in the "donor pool" have undergone an intervention, they changed their respective currencies to the euro. I.e., the treatment in the case of our thesis is to not implement the euro.

[2] Also, for every country, a number of k predictors of the outcome, $X_{1j}, \dots, X_{kj}$, can be utilized. These predictors can include pre-treatment values of the outcome variable if they are unaffected by the treatment. For this thesis, we are only using pre-treatment values of Y_{jt}, the outcome variable, as predictors. I.e., we are only using the untreated values of the outcome variable[2] observed in the pre-treatment period as a predictor for our synthetic control unit.

counterfactual outcome divided by the number of periods, and a lower value for RMSPE indicates a better fit in the pre-treatment period. RMSPE is also provided automatically by the synth command in Stata.

The results for Synthetic Sweden in the pre-treatment period are then used to estimate the trajectory of the counterfactual estimate, Y_{1t}^{N}, in the post-treatment period, making the comparison with Sweden's actual outcome in terms of GDP per capita possible.

IV.II. Choice of Exchange Rate

The results from the Synthetic Control Method are presented below in two sections, based on two slightly different models. In the first model we use GDP per capita (in constant 2015 US $) as a predictor for Synthetic Sweden. In the second model, PPP per capita GDP (in constant 2021 international $) is instead used as the predictor. Given that our two models differ in what currency they utilize, we can't make a direct comparison between them. Yet, despite this, the outcome of the two models is similar, meaning that the results of one model can be viewed as affirmation of the other one. Other than this, the two models are similar, i.e. they both only use data for their respective variable from the year 1990 to the year 1998 to predict the trajectory of Synthetic Sweden in the post-treatment period.

Gross domestic product (GDP) is identified by $Value = price \ \times volume$. GDP is a measurement of the production in the economy of a country. Economies estimate their expenditures on GDP at a national level in terms of prices and in terms of the local currency, e.g. Kronor or Euros. To accurately compare volumes of goods and services between countries and economies, the differences between these countries and economies must be eliminated, and local currencies converted into a common currency. Most often this is converted into the US Dollar, as it is in our dataset.

To accurately compare output and production levels between countries, since the size of countries differ, it is important to measure output and production relative to the population, which is why we use GDP *per capita*. Although GDP per capita primarily measures production rather than income, it is the most widely used measure when comparing income levels between countries over time (World Bank 2020).

By measuring GDP per capita in US Dollars as in *Model One*, we can relatively easily compare the size of economies on a per capita level between countries. In our case, this means that we're able to compare the size of the Swedish economy on a per capita basis with the hypothetical size of the economy on a per capita basis in Synthetic Sweden.

On the other hand, while GDP per capita is a widely used measure when doing comparisons between countries, it overlooks the relative purchasing power of currencies in the home country, i.e. the difference in standards of living between countries. This is the reason why we're also utilizing PPP per capita GDP as in *Model Two*. PPP adjusts for differences in price levels between countries, offering a more accurate measure of what people actually can buy with their income in their home country, which means it also takes into account price differences in non-tradeable goods between countries, for example housing and government services.

To conclude the reasoning above, using market exchange-rate converted estimates of GDP per capita as we do in *Model One* will not only reflect differences in volumes or outputs (which is the most interesting part), but also differences in national price levels. Thus, this way to measure and compare economies to one another might inflate high-income countries, where price levels tend to be higher for non-tradeable goods and deflate lower-income countries where price levels tend to be lower for non-tradable goods. PPP-based comparisons, as in *Model Two*, estimate more effectively these price differences, and hence more accurately reflect economic output or volumes, i.e. relative purchasing power of currencies in the home country (World Bank 2021).

V. Results of the Synthetic Control Method

The results of our empirical analysis are presented below in two sections, first for *Model One* that utilizes GDP per capita in constant 2015 US $, and then for *Model Two* where we have GDP per capita in PPP terms in constant 2021 international $.

V.I. Model One - GDP per capita (Constant 2015 US $)

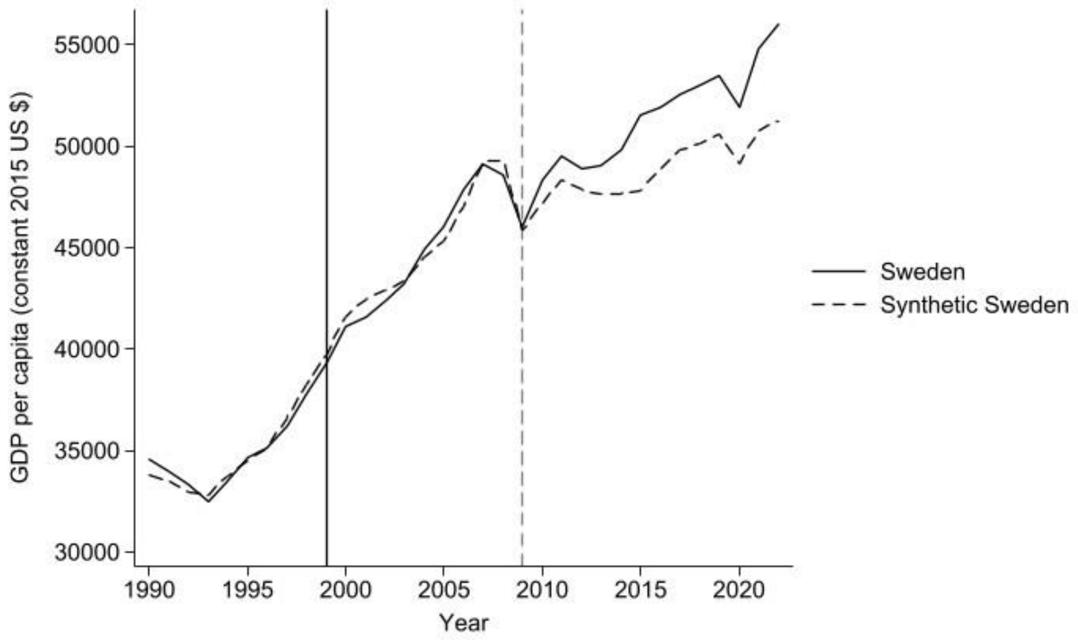

Figure 1: Outcome and counterfactual estimate when GDP per capita (constant 2015 US $) is used as the predictor for Synthetic Sweden. The solid, vertical, black line represents the point of treatment. The dashed, vertical, grey line represents the point where Sweden and Synthetic Sweden start to diverge, by which we mean that they no longer visually seem to track each other.

Figure 1 shows the actual outcome in terms of GDP per capita for Sweden and the estimated outcome for Synthetic Sweden from the year 1990 to the year 2022. Starting from the year 1990 in the pre-treatment period, Sweden and Synthetic Sweden can be seen to converge rather decently from this year. The solid, vertical, black line represents the point where treatment occurs in 1999, i.e. when Sweden doesn't adopt the Euro as its currency, but Synthetic Sweden does. Synthetic Sweden's estimated GDP per capita is at the time of treatment slightly higher than Sweden's and the gap increases around the year 2000, but no dramatic treatment effects are seen visually, and Sweden and Synthetic Sweden also take turns having the highest level of GDP per capita over the following years. Until 2009, where divergence between the two is starting to show.

The financial crisis from 2007-2008 significantly affected the global economy. Yet, Sweden managed the impact better than the doppelganger Synthetic Sweden, given our model. Both saw a drop in GDP per capita, but Sweden's economy, in terms of GDP per capita, recovered relatively better in the following years. This could be due to, as partly explained in section *II* according to the costs of an optimal currency are, Sweden being able to effectively use monetary policy tools like currency depreciation via the control of the nominal interest rate set by the Swedish Riksbank. An option individual member states in the European Monetary Union did not have. This made Swedish goods cheaper relative to foreign goods. As a result, Sweden's economy rebounded quicker than that of Synthetic Sweden. Additionally, a lower nominal interest rate also affects economic activity via a boost in domestic consumption and investment levels.

Furthermore, the Euro-crisis starting in 2009, might also explain the divergence of Sweden and Synthetic Sweden. The Euro-crisis was triggered by a sovereign debt crisis, where markets had worries that internal debt relative to GDP for some European countries got out of hand, and the sustainability of these debts. However, Sweden's debt to GDP-ratio has fallen since 2007, indicating sound fiscal policies relative to many Euro member countries (Collignon 2012).

In terms of an estimated outcome, Synthetic Sweden has close to non-increasing GDP per capita from 2011 until 2015. Meanwhile, Sweden's actual GDP per capita increases at a relatively high pace during the same period. This is in line with the findings of Lin & Chen (2017), that the Euro-crisis had a relatively larger negative impact on many of the economies in the EMU when compared to those outside the EMU. And in 2022, which is the latest recorded observation in our data, Sweden's GDP per capita is around $55000 while Synthetic Sweden's GDP per capita is around $50000, meaning that Sweden's GDP per capita is around $5000 more than the counterfactual estimate.

As described in section *IV*, the Root Mean Square Prediction Error (or *RMSPE* for short) value measures how good of a fit the synthetic control unit is in the pre-treatment period, where the RMSPE value is the square root of the squared deviation between the actual outcome and the estimated counterfactual outcome in the pre-treatment period. In other words, RMSPE measures the "distance" between GDP per capita for Sweden and Synthetic Sweden in the pre-treatment period. For *Model One*, we get an RMSPE value of roughly 421, i.e. GDP per capita for Sweden and Synthetic Sweden differ on average by about $421 in the pre-treatment period.

GDP per capita for Sweden has an average value of around $35000 in the pre-treatment period. The difference between Sweden and Synthetic Sweden, as measured by the RMSPE value, amounts as stated above to about $421. Translating this to a percentage, the average difference between the outcome and the counterfactual estimate in the pre-treatment period is roughly 1.2%. Meaning that on average, Sweden and Synthetic Sweden deviate from each other by about 1.2% in the pre-treatment period. Visually, as we see in *Figure 1*, the solid and dashed lines representing Sweden and Synthetic Sweden respectively also lie rather close to each other during the pre-treatment period.

Which countries contribute to Synthetic Sweden in Model One?

Country name	Donor weight
Austria	0%
Belgium	0%
Germany	34%
Spain	0%
Finland	57%
France	0%
Ireland	0%
Italy	0%
Luxembourg	9%
Netherlands	0%
Portugal	0%

As shown in the table above, out of the eleven countries that make up the donor pool only three are given any weight, meaning that these are the only countries that are included in our synthetic control unit. These three donor countries are Germany, Finland, and Luxembourg which account for 34%, 57%, and 9% of Synthetic Sweden, respectively. The weights for these countries are estimated by an algorithm, so that the pre-treatment estimates for Synthetic Sweden resembles the actual outcome for Sweden as closely as possible (Lin & Chen, 2017). That only three countries make up our synthetic control unit and that Finland is shown to be almost 60% of Synthetic Sweden is not something we are too concerned about either, partly due to the fact of the many similarities between Sweden and Finland and the long-running history of the two countries, but also because few units contribute to the counterfactual (Abadie 2020), as was also briefly explained in section *IV*.

Since we're interested in if there is a difference between Sweden that still has its own currency and Synthetic Sweden that adopted the Euro in terms of GDP per capita, we also want a rather convenient way of comparing the two, which is done by calculating the percentage difference in GDP per capita between them. This is done by summing GDP per capita for the years or the period we're interested in, and then dividing by the number of years to get an average for that period. Then, diving the average for Sweden by the average for Synthetic Sweden for each period of interest and subtracting one shows us the percentage difference between the two. I.e. $\frac{\frac{1}{n} x \sum_{i=1}^{n} Y_{1n}^{I}}{\frac{1}{n} x \sum_{i=1}^{n} Y_{1n}^{N}} - 1$. The results of this are shown in the two tables below.

GDP per capita averaged over the years 1999 to 2009

	Mean GDP per capita
Sweden	44552
Synthetic Sweden	44668
Percentage difference	0%

From the point of treatment and up until around 2009 where Sweden and Synthetic Sweden are starting to show signs of divergence, Sweden has on average a GDP per capita which is roughly the same as that of Synthetic Sweden.

GDP per capita averaged over the years 2009 to 2022

	Mean GDP per capita
Sweden	51220
Synthetic Sweden	48782
Percentage difference	5%

When instead calculating the percentage difference for GDP per capita between Sweden and Synthetic Sweden over the years 2009 and until 2022, Sweden instead has a GDP per capita that is roughly 5% larger than that of Synthetic Sweden, on average.

V.II. Model Two - PPP per capita GDP (constant 2021 international $)

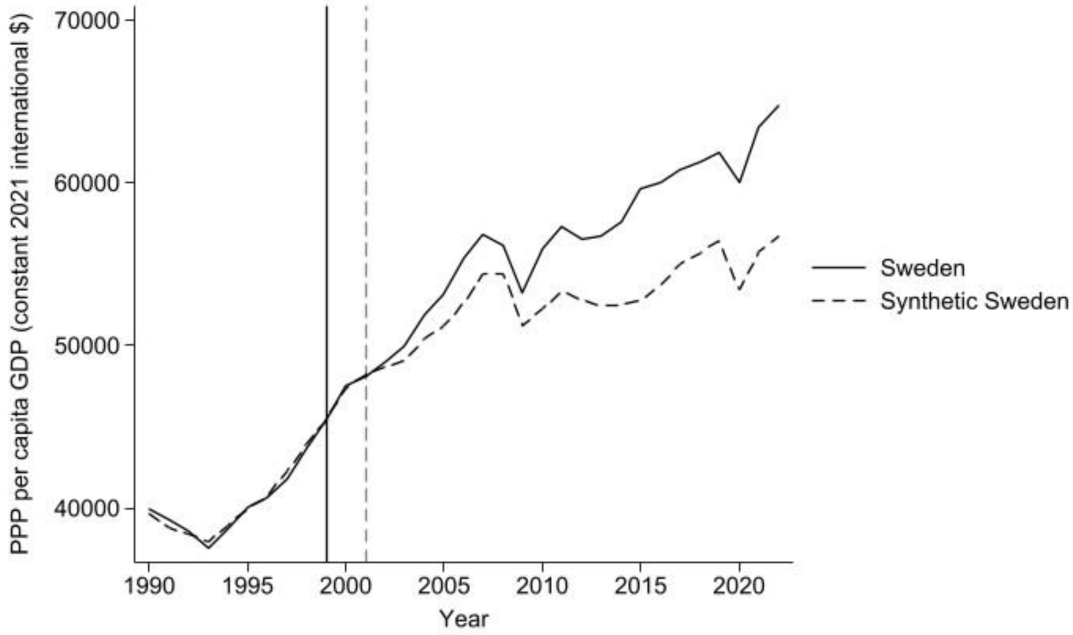

Figure 2: Outcome and counterfactual estimate when PPP per capita GDP (constant 2021 international $) are used as the predictor for Synthetic Sweden. The solid, vertical, black line represents the point of treatment. The dashed, vertical, grey line represents the point where Sweden and Synthetic Sweden start to diverge, by which we mean that they no longer visually seem to track each other.

Like *Figure 1*, *Figure 2* shows the outcome for Sweden and the estimated outcome for Synthetic Sweden from the year 1990 and to the year 2022, with the difference being that this time the outcome is represented by PPP per capita GDP instead of regular GDP per capita. From the starting point in the year 1990, the estimated outcome tracks the actual outcome rather well during the entire pre-treatment period until treatment, which is represented by the solid, vertical, black line. At the time of treatment, Synthetic Sweden and Sweden seem to have basically the same level of PPP per capita GDP. Synthetic Sweden also tracks Sweden for a short while after treatment, until around the year 2001. Hence, by visual observation, which was something also seen in *Figure 1*, the treatment doesn't seem to have had an immediate effect on PPP per capita GDP.

Contrary to *Figure 1*, in *Figure 2* we see Sweden and Synthetic Sweden beginning to diverge earlier in time. Marked by the dashed, vertical, grey line the two are starting to show signs of divergence, which is around the year 2001. After this year, Sweden's PPP per capita GDP trends higher than that of its Synthetic counterpart with a gap that's increasing after the year 2009, following the same pattern as was seen in *Figure 1*. The early 2000's recession seems to have slowed the economic development of Synthetic Sweden in 2001, compared to Sweden not seemingly being negatively affected at all in terms of PPP per capita GDP. However, the 2001 recession was quite mild in comparison with the following financial crisis.

For our latest recorded observation in the data in 2022, Sweden's PPP per capita GDP is roughly $64000 while Synthetic Sweden's PPP per capita GDP is about $57000, which amounts to Sweden having a PPP per capita GDP that is roughly $7000 higher than that of Synthetic Sweden, which is slightly higher than the difference that was seen in *Model One*, yet the difference is still in favor of Sweden.

Again, as we did with *Model One*, we use the RMSPE value as well as a visual observation to determine the fit of the synthetic control unit in the pre-treatment period. For *Model Two*, we get an RMSPE value of about 293, meaning that PPP per capita GDP for Sweden and Synthetic Sweden differ by about $293 in the pre-treatment period. With PPP per capita GDP for Sweden in the pre-treatment period being roughly $34000, the RMSPE value of $293 translates to a percentage difference of roughly 0.9% between the outcome and the counterfactual estimate in the pre-treatment period. I.e. on average, Sweden and Synthetic Sweden deviate from each by about 0.9% in the pre-treatment period in *Model Two*, indicating a better fit in the pre-treatment period than what we saw in *Model One* where the average deviation instead was about 1.2%.

Which countries contribute to Synthetic Sweden in Model Two?

Country name	Donor weight
Austria	0%
Belgium	0%
Germany	6%
Spain	4%
Finland	45%
France	45%
Ireland	0%
Italy	0%
Luxembourg	0%
Netherlands	0%
Portugal	0%

Shown in the table above are the weights given to the different countries in the donor pool that make up Synthetic Sweden, and as was described in *Model One* this is done automatically by an algorithm so that pre-treatment estimates resemble the actual outcomes as close as possible (Lin & Chen, 2017). The four donor countries for *Model Two* are Germany, Spain, Finland, and France and they account for 6%, 4%, 45%, and 45% respectively. Compared to *Model One*, France and Spain are now donors instead of Luxembourg, and the donor weights which Germany and Finland accounted for has been reduced.

Calculating the percentage difference between Sweden and Synthetic Sweden in terms of PPP per capita GDP is done in the same way as in *Model One*, i.e. by the equation $\frac{\frac{1}{n} x \sum_{i=1}^{n} Y_{1n}^{I}}{\frac{1}{n} x \sum_{i=1}^{n} Y_{1n}^{N}} - 1$. Since we're starting to see divergence between Sweden and Synthetic Sweden earlier in *Model Two* than in *Model One*, the periods for which PPP per capita GDP are averaged and thus the periods for which the percentage difference is calculated are not the same in *Model Two* as they were in *Model One*. The results of the calculations are presented in the two tables below.

PPP per capita GDP averaged over the years 1999 to 2001

	Mean PPP per capita GDP
Sweden	47027
Synthetic Sweden	47015
Percentage difference	0%

When averaging PPP per capita GDP for Sweden and Synthetic Sweden from the point of treatment and until the year 2001, the percentage difference is roughly 0% between the two. Which is rather self-explanatory since they seem to track each other very well during this period.

PPP per capita GDP averaged over the years 2001 to 2022

	Mean PPP per capita GDP
Sweden	56792
Synthetic Sweden	52870
Percentage difference	7%

When instead averaging PPP per capita GDP from the point where divergence is beginning to show and until the year 2022, the percentage difference between Sweden and Synthetic Sweden is roughly 7%, i.e. Sweden's PPP per capita GDP is for the period from 2001 to 2022 on average 7% larger than that of Synthetic Sweden.

Even though the difference between the two is larger in *Model Two* than it was in *Model One*, both models still show the same pattern where Sweden seems to be better off than Synthetic Sweden despite which exchange rate we use, a difference which seems to be largely driven by the 2007-2008 financial crisis and the following Euro-crisis starting in 2009.

VI. Robustness Tests

A weakness of the synthetic control method is that it is not possible to evaluate whether the results are statistically significant or not using standard methods (Lin & Chen 2017), where standard methods in this case for example means statistical t-tests. To overcome this weakness and to assess the credibility of the synthetic control unit, Abadie (2020) presents two different sorts of robustness tests, which are the *in-time placebo test* and the *leave-one-out-test*.

The first one of these robustness tests that we employ is the leave-one-out test. This test is a repeated analysis of Synthetic Sweden where we remove the donor countries from the donor pool one at a time. By excluding the donor countries for Synthetic Sweden, the idea is that we can evaluate whether the estimates for our synthetic control are in fact driven by the lack of treatment, and not for example shocks on the outcome of that particular excluded donor.

The second robustness test is the in-time placebo test. Originally, this is done by backdating the treatment by for example ten years, implying a treatment that has not occurred yet at that point in time, hence the use of the term placebo. By changing the time for the inputs and the time of treatment, we're investigating whether factors attributable to time itself has an effect on the estimated outcome for our synthetic control unit, and to provide credibility to our synthetic control unit the new one with the placebo time of treatment should resemble the original one. For us, this backdating turns out to be a bit of an issue since we don't have observations of PPP per capita GDP further back in time than 1990. Hence, we opted to modify the in-time placebo test slightly, and rather than backdating the treatment we pushed the treatment further into the future, i.e. our placebo treatment occurs in 2004 rather than 1999, five years later than it actually did. This may pose a problem for the credibility of the test since treatment in fact actually has occurred when we to the in-time placebo test and change the treatment period to 2004, yet at the same time as was concluded in *V*, treatment does not seem to have had a significant impact on the outcome at the time of treatment.

Lastly, since *Model Two*, which utilized PPP per capita GDP (constant 2021 international $), showed a better pre-treatment fit than *Model One* did, we will only be performing our robustness tests on *Model Two*[3].

[3] We have also included the results from the two robustness tests for *Model One* in the appendix.

VI.I. Leave-one-out

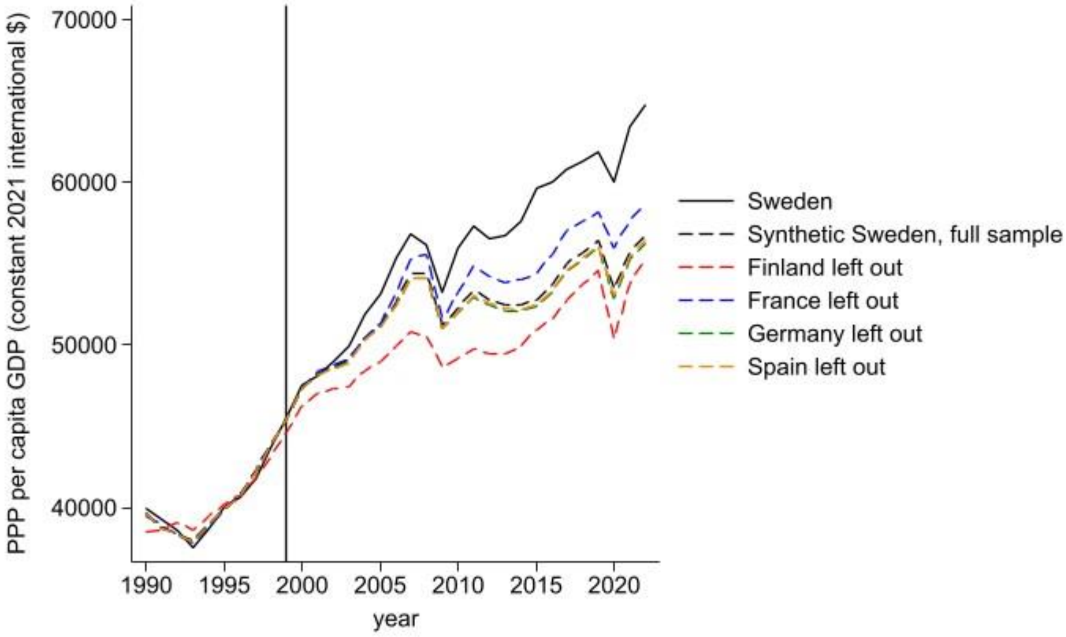

Figure 3: Outcome and the different counterfactual estimates in terms of PPP per capita GDP (constant 2021 international $) when employing the leave-one-out robustness test. The solid, vertical, black line represents the point of treatment.

Figure 3 displays the results of the leave-one-out robustness test, where we have run the synthetic control method five different times for *Model Two*. First with the full sample, then four more times while one at a time removing one of the donors of the original Synthetic Sweden from the donor pool.

Visually, the fit of the different models seems to be able to fit the actual outcome of Sweden in the pre-treatment period rather well, with the Synthetic Sweden where Finland is removed from the donor pool showing the largest deviance. This worse off pre-treatment fit is probably the reason why again in the post-treatment period, the Synthetic Sweden that has Finland removed from the donor pool visually seems to have the largest deviance from the original Synthetic Sweden.

Yet, from 2015, all four versions of Synthetic Sweden that have had a donor removed from the donor pool seem very well centered around the original one. Also, in none of these different versions is there a different outcome, i.e. from the year 2001, which was the point where divergence started to show in the original Synthetic Sweden, and until 2022, Sweden has an average PPP per capita GDP that is larger than that of any of its synthetic counterparts, which can be seen in the table below, with the percentage difference between Sweden and that version of Synthetic Sweden in brackets. Hence, given the leave-one-out test the results in *V.II.* for show robustness.

PPP per capita GDP averaged over the years 2001 to 2022

	Mean PPP per capita GDP
Sweden	56792
Synthetic Sweden, full sample (percentage difference)	52870 (7%)
Finland left out (percentage difference)	50446 (13%)
France left out (percentage difference)	54041 (5%)
Germany left out (percentage difference)	52556 (8%)
Spain left out (percentage difference)	52616 (8%)

VI.II. In-time Placebo Test

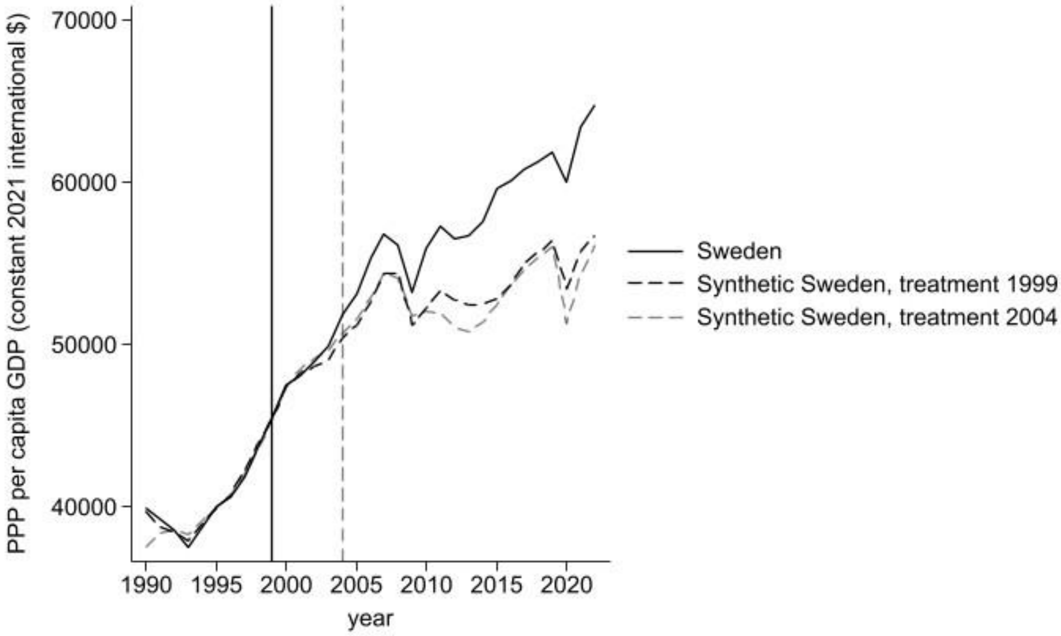

Figure 4: Outcome and the different counterfactual estimates in terms of PPP per capita GDP (constant 2021 international $) when employing the in-time placebo test. Here, the Euro in introduced in 2004, five years post the actual policy change. The solid, vertical, black line marks the point in time where treatment originally occurs. The dashed, vertical, grey line represents the point in time where the placebo treatment occurs.

Figure 4 displays the results of the in-time placebo test. This test is conducted as if treatment had occurred in 2004, clarified by the dashed, vertical, grey line. For the in-time placebo test, the same set of data is used. What we want to find is that this placebo-treatment will not result in a post-placebo-treatment divergence, in terms of the trajectory of Sweden and Synthetic Sweden. As displayed in *Figure 4*, the trajectory is very similar to the original treatment, i.e. it follows Synthetic Sweden rather well. However, if we were to observe a large divergence effect when conducting this test, it would indicate that we need to doubt our claims and results from *Model Two.*

The absence of estimated effects prior to the intervention when backdating the treatment, is that the synthetic control is able to reproduce the trajectory of the outcome variable after the treatment occurs (Abadie 2020). Since our data doesn't stretch further back in time than the year 1990, we're unable to backdate the treatment, hence why we've opted to push the placebo treatment a few years into the future instead. This means that when the placebo treatment occurs, the treatment has in fact already occurred, which itself could affect the results of test. Given this, we are questioning whether we can trust the results of the in-time placebo test, which implies that we are also unsure if this robustness test is successful in providing any credibility to *Model Two*.

VII. Conclusions

The aim of this thesis is to investigate if there would've been an impact on GDP per capita had Sweden joined the European Monetary Union in 1999. This is done by using the Synthetic Control Metod to construct a Synthetic Sweden that implemented the Euro in 1999. By employing the Synthetic Control Method, we compare the actual outcome for Sweden still using the Krona with the counterfactual estimate for Synthetic Sweden that instead adopts the Euro in 1999. We also utilized two slightly different models, one where the outcome and estimate is measured in GDP per capita, and one in which they are measured in PPP per capita GDP.

As seen in *V.I.* and *V.II.* the results of the two models differ a bit. First, they differ in where Sweden and Synthetic Sweden start to diverge, with it happening several years earlier in *Model Two* than in *Model One*. Secondly, they differ a bit in the calculated average percentage difference between Sweden and Synthetic Sweden for their respective periods where we have calculated the average, where *Model Two* has a slightly larger percentage difference than *Model One*. We believe that these differences between the models may be due to a distortion of price levels following the introduction of the Euro, effectively raising the price levels in the countries that joined the EMU, which would affect PPP per capita GDP relatively more than GDP per capita, which could explain why divergence is starting to show earlier in *Model Two* than in *Model One*. It could also be due to the early 2000's recession affecting PPP per capita GDP more than it did affect GDP per capita.

Our primary finding is that there seems to have been no immediate effect of the treatment in terms of each of the two models respective outcome variable. Yet, as seen in *Model One* and *Model Two*, the benefits of Sweden having its own currency when compared to Synthetic Sweden that adopted the Euro, seems to be in Sweden's ability to handle an economic shock like the 2009 Euro-crisis relatively better. According to economic theory, the introduction of a common currency increases trade and financial cooperations that can be derived from reduced transaction costs, higher price stability and less exchange rate risks. However, theory also tells us that the loss of independent monetary policy prevents countries from using the first-best shock-absorber policy tool, which is the ability the country has to control its nominal interest rate through the central bank. The empirical analysis in our thesis seems to validate this theory, that idiosyncratic macroeconomic shocks can be mitigated by the control of the nominal interest rate and an independent monetary policy, aiding an economy going through a crisis.

From our findings, there seems not to be the case that had Sweden joined the Euro in 1999, we would have benefited from this policy decision in terms of GDP per capita. Simply put, we would not have been a richer country than we are today. However, it is plausible that had we joined the European Monetary Union, there would be significant gains in political influence that might offset the cost of a lower GDP per capita. The incentives for adopting the Euro would likely be mostly political. Our empirical findings are also in line with the findings and conclusions of Lin & Chen (2017).

Further, if the Krona continues to weaken relative to the Euro, investments made in the Krona are less attractive compared to investments in the Euro for foreign investors given the risk associated with exchange rate fluctuations. This could mean that in the long run Sweden might attract lower levels of foreign capital compared to other European countries that have adopted the Euro. Assuming that the desired levels of capital stocks in Sweden are higher in the future than they are today, and the fact that investments are a part of the GDP identity, if foreign investments decrease this might negatively affect GDP per capita in Sweden in the future.

Compared to today when the Krona is weak relative to the Euro, a decade ago the sentiment was quite different during the Euro-crisis, and we consider it a possibility that the opinions regarding which currency Sweden should have swing in favour of one or the other depending on the economic events of the future.

VIII. References

Abadie, A. & Vives-i-Bastida, J. (2021). Synthetic Controls in Action. Cambridge, MA: MIT.https://economics.mit.edu/sites/default/files/publications/ESWC_Paper-1.pdf

Abadie, A. (2020). "Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects.", *Journal of Economic Literature*, June. Cambridge, MA: MIT.https://www.aeaweb.org/content/file?id=12409

Abadie, A., Diamond, A. and Hainmueller, J. (2015). Comparative Politics and the Synthetic Control Method. *American Journal of Political Science*, 59: 495-510. https://doi.org/10.1111/ajps.12116

Andrade, P., Breckenfelder, J., De Fiore, F., Karadi, P., Tristani, O. (2016). *The ECB's asset purchase programme: an early assessment.* Working Paper Series (1956). European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1956.en.pdf

Calmfors, L. (2003). *Fiscal policy to stabilise the domestic economy in the EMU: What can we learn from monetary policy?* Institute for International Economic Studies, Stockholm University. http://perseus.iies.su.se/~calmf/cesifojournal4.pdf

Calmfors, L. (2013). *Överlever euron i längden?* Institutet för internationell ekonomi, Stockholms universitet. http://andromeda2.iies.su.se/~calmf/calmsuppsats.pdf

Collignon, S. (2012). *Europe's Debt Crisis, Coordination Failure, and International Effects.* No. 370. Asian Development Bank Institute. https://www.adb.org/sites/default/files/publication/156225/adbi-wp370.pdf

Fleming, J. Marcus. (1971). On Exchange Rate Unification. *The Economic Journal*, vol. 81(323), 1971, pp. 467–88. *JSTOR*. https://doi.org/10.2307/2229844

Forsberg, B. (2024). "Ingves: Svenskarna har valt att gynna sig själva". *Svenska Dagbladet*, 2024-02-18 https://www.svd.se/a/pQ33OX/borantan-stefan-ingves-ger-sina-rad-till-eftertradaren

Kenen, P (1969). The optimum currency area: An electic view. In Mundell, R.A. & Swoboda, A.K. (eds.) *Monetary Problems in the International Economy.* Chicago: University of Chicago Press.

Krugman, P. (2013). Revenge of the Optimum Currency Area. *NBER Macroeconomics Annual*, 27, pp. 439-448. https://doi.org/10.1086/669188

Kudrna, Z., & Wasserfallen, F. (2021). Conflict among member states and the influence of the Commission in EMU politics. *Journal of European Public Policy*, *28*(6), 902–913. https://doi.org/10.1080/13501763.2020.1751681

Lin, P-C. & Chen, L-Y. (2017). Assessing the Growth Effect of Common Currency Adoption: Synthetic Control Approach. *Journal of Finance and Economics*, 2017, Vol. 5, No. 6, 269-280. DOI:10.12691/jfe-5-6-3

McKinnon, R. I. (1963). Optimum Currency Areas. *The American Economic Review*, *53*(4), 717–725. http://www.jstor.org/stable/1811021

Mongelli, P.M. (2002). *"New" views on the optimum currency area theory: What is EMU telling us?* Working Paper No. 138. European Central Bank. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp138.pdf

Mundell, R. A. (1961). A Theory of Optimum Currency Areas. *The American Economic Review*, *51*(4), 657–665. http://www.jstor.org/stable/1812792

Riksbanken (2024). https://www.riksbank.se/sv/statistik/rantor-och-valutakurser/sok-ars--och-manadsgenomsnitt-valutakurser/?a=Y&y=2015&m=V%C3%A4lj+m%C3%A5nad&s=g130-SEKEURPMI&s=g130-SEKUSDPMI&c=Min&c=Max&fs=3#result-section [2024-05-22]

Rising, M. (2024). "Sverige kan hamna i "andra skiktet" utan euron". *Dagens industri*, 2024-05-09 https://www.di.se/nyheter/sverige-kan-hamna-i-andra-skiktet-utan-euron/

Saia, A. (2017). Choosing the open sea: The cost to the UK of staying out of the euro. *"Journal of International Economics"*, 108, pp. 82-98. ISSN 0022-1996. https://doi.org/10.1016/j.jinteco.2017.06.001.

Von Hagen, J & Mundschenk S. (2001). The political economy of policy coordination in the EMU. *SWEDISH ECONOMIC POLICY REVIEW*, (8), s. 107-137 https://www.regeringen.se/contentassets/d35cce9ca5b840abbb7228a3672dd3e7/jurgen-von-hagen--susanne-mundschenk-the-political-economy-of-policy-coordination-in-the-emu/

Wallin, E. (2023). "Vi ska ha samma kurs som danska kronan". *Svenska Dagbladet*, 2023-12-23 https://www.svd.se/a/jlqKqA/christer-gardell-om-svenska-kronan-for-svag-vill-ha-euro

World Bank (2020). *Purchasing Power Parities and the Size of World Economies*: *Results from the 2017 International Comparison Program*. Washington, DC: World Bank. Doi: 10.1596/978-1-4648-1530-0

World Bank (2021). *Purchasing Power Parities for Policy Making: A Visual Guide to Using Data from the International Comparison Program*. Washington, DC: World Bank. URI: http://hdl.handle.net/10986/35736

World Bank (2024). *World Development Indicators* https://databank.worldbank.org/Data/id/1abc53f4 [2024-06-03]

IX. Appendix

IX.I. Leave-one-out robustness test for *Model One*

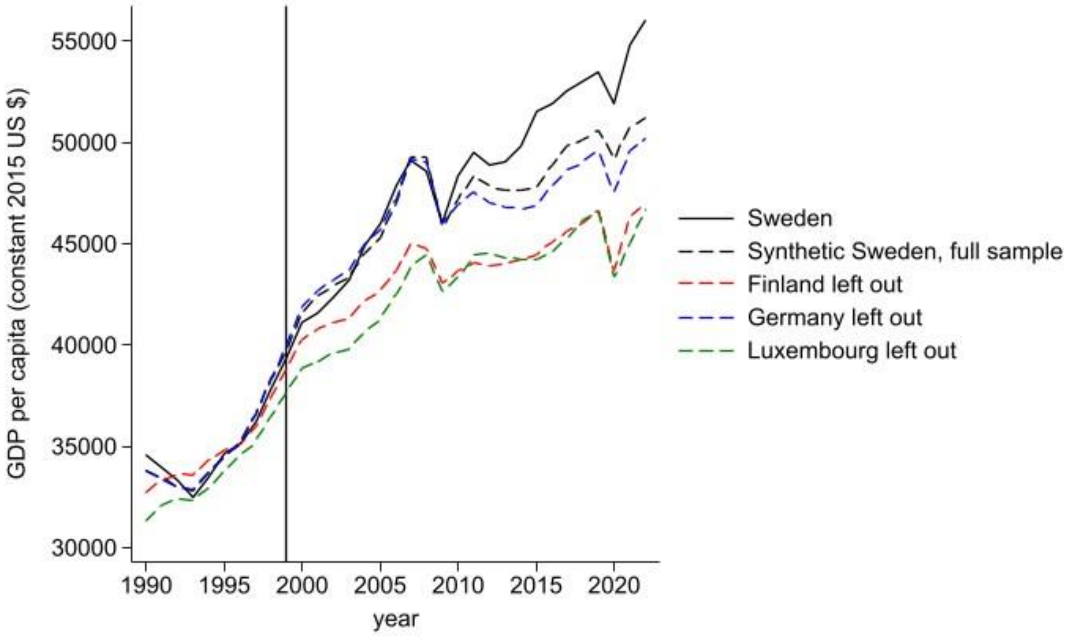

Figure 5: Outcome and the different counterfactual estimates in terms of GDP per capita (constant 2015 US $) when employing the leave-one-out robustness test. The solid, vertical, black line represents the point of treatment.

Following the same methodology for the leave-one-out robustness test as we did for *Model Two* in *V.II.,* only this time removing Finland, Germany, and Luxembourg, which were the three donor countries, one at a time produces the results seen in *Figure 5*. And, as for *Model Two*, given the leave-one-out test the results obtained in *V.I.* show robustness.

IX.II. In-time placebo test for *Model One*

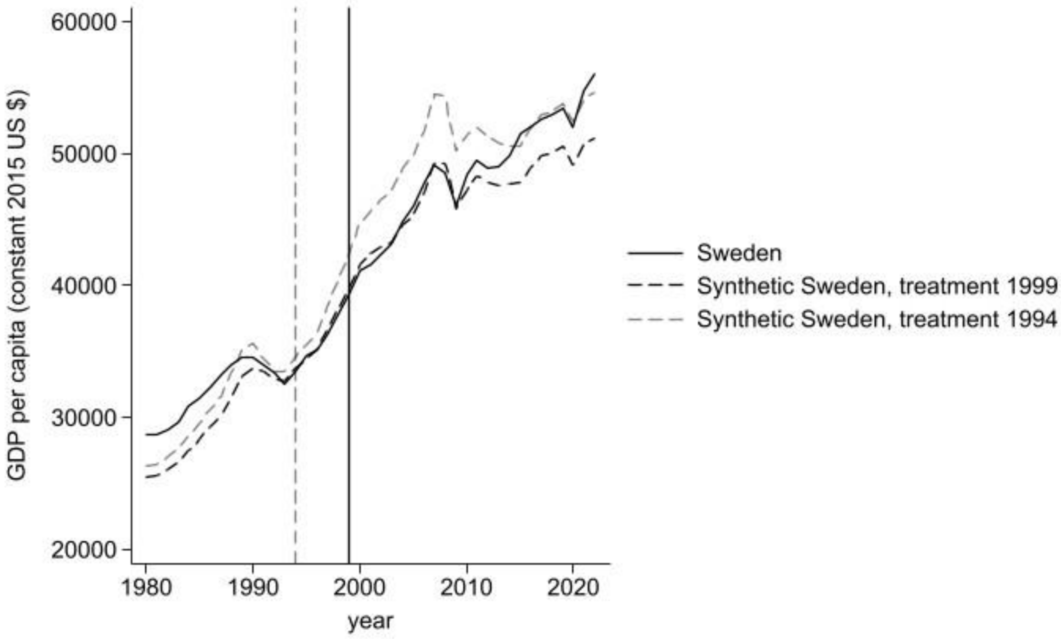

Figure 6: Outcome and the different counterfactual estimates in terms of GDP per capita (constant 2015 US $) when employing the in-time placebo test. Here, the Euro is introduced in 1994, five years prior to the actual policy change. The solid, vertical, black line marks the point in time where treatment originally occurs. The dashed, vertical, grey line represents the point in time where the placebo treatment occurs.

Since data was available further back in time for GDP per capita than it was for PPP per capita GDP, it means that for *Model One* we're able to backdate the treatment and execute the in-time placebo test as it is intended, and the results of this robustness test can be seen in *Figure 6*.

As for *Model Two*, what we want to see is that the placebo-treatment will not result in a post-placebo-treatment divergence, in terms of the trajectory of Sweden and Synthetic Sweden. As seen in *Figure 6*, when the treatment is artificially implemented in 1994 rather than in 1999, what we get is a post-placebo treatment divergence. The pre-treatment fit when compared to the original Synthetic Sweden is also worse. Hence, given the in-time placebo test for *Model One*, we question the credibility of the results obtained in *V.I.*