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„Has Austria benefited from EU-membership? Estimating
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Control Method“

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Abstract

In a globalized and multilateral world, economic integration is of utmost significance to a country, especially for small economies. To decide the future course of a country's economy, it is important to reflect and analyse the history of its economic integration. This thesis examines the effects of EU-membership, an integral part of European integration, on Austria's real GDP per capita on the basis of a comparative case study. The aim is to create a hypothetical scenario of what it would have been like if Austria had not joined the EU by using the Synthetic Control Method and, in this case, to map the development of real GDP per capita after EU-accession. The results have shown that within the period from 1995 to 2008, Austria's real GDP per capita would have been on average 5% lower in the case of non-EU membership than in the case of EU-membership. Furthermore, real GDP per capita without EU-membership in 2008 is 13% lower than compared to the same year with EU-membership and thus an increase in the difference over the post-intervention period is obtained. In addition, this study offers new insights into the application of the Synthetic Control Method about the country-specific approach regarding the economic effects of EU-membership.

Abstrakt

In einer globalisierten und multilateralen Welt ist die wirtschaftliche Integration für ein Land von großer Bedeutung, insbesondere für kleine Volkswirtschaften. Um über den zukünftigen Kurs einer Volkswirtschaft zu entscheiden, ist es wichtig, die Geschichte der wirtschaftlichen Integration eines Landes zu reflektieren und zu analysieren. Diese Arbeit untersucht den Fall Österreich und die Auswirkungen der EU-Mitgliedschaft auf das reale BIP pro Kopf anhand einer Vergleichenden Fallstudie. Ziel dabei ist es ein hypothetisches Szenario zu erstellen, das zeigt wie es gewesen wäre, wenn Österreich nicht der EU beigetreten wäre und anschließend mittels der synthetischen Kontrollmethode die Entwicklung des realen BIP pro Kopf nach dem EU-Beitritt abzubilden. Die Ergebnisse zeigen, dass innerhalb der untersuchten Zeitperiode von 1995 bis 2008, das österreichische reale BIP pro Kopf im Fall ohne EU-Mitgliedschaft durchschnittlich um 5% niedriger gewesen wäre als im Fall mit EU-Mitgliedschaft. Zusätzlich wurde festgestellt, dass das reale BIP pro Kopf ohne EU-Mitgliedschaft im Jahr 2008 um 13% niedriger ist als im Vergleich zum selben Jahr im Fall mit EU-Mitgliedschaft und somit ein Anstieg der Differenz über den beobachteten Zeitraum nach EU-Beitritt zu erkennen ist. Darüber hinaus bietet die Arbeit neue Erkenntnisse über die Anwendung der synthetischen Kontrollmethode in der länderspezifischen Untersuchung bezogen auf die ökonomischen Auswirkungen der EU-Mitgliedschaft.

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1 Introduction

In today's globalized world, a well-functioning economy is characterized by market integration and the resulting foreign trade, as they are considered the driving force behind economic growth. Adam Smith, who is considered as the founder of modern economics, already argued that the division of labour, free trade and free markets are fundamental prerequisites for economic growth and are important properties which are the results from successful economic integration. An ideal example of a well-integrated market is the European Union, as it offers an optimal economic infrastructure which forms a strong foundation for economic integration, but this economic area and its great single market is also bound by European laws and is regulated by certain market interventions, which do not necessarily conform to Adam Smith's view of free market dynamics.

In the last few decades, advancing globalization with regard to international trade has led to intense competition among each other and at the same time, more reliance on each other. This is true for Austria, a relatively small economy which is strongly reliant on international trade, especially in Europe. Its dependency on a large market without trade restrictions is more than compared to other large countries. Since majority of the trading partners of Austria are located in the European Union, this forms the basis for the importance of EU-membership and is vital for political and economic development of Austria. This view, in favor of the EU-membership, receives many supporters. Nevertheless, the EU-membership repeatedly makes headlines in the Austrian political debate as it is criticized for being too strict or extremely stringent. In the scientific discourse, there are also some opposing views with regard of a common political and economic area. However, it can be noticed, Smith's views are still present and are embedded in today's political and economic discourse.

Nowadays, the process of economic integration in the European Union has a long history and many questions remain about its impact on various economic sectors (especially country-specific). Although attempts are being made at EU-level to create uniform guidelines for a homogeneous market, the effects on the individual countries of the EU can be different. Therefore, it should be of great interest how an event such as EU-accession and the consequent effects of EU-membership has affected Austria's economy.

This comparative case study is focused on how such an event like the EU-accession and the corresponding EU-membership affects the Austrian economy. These effects will be shown in

presenting the scenario of what it would have been like if Austria had not joined the EU, compared to the actual event. This in-depth study specifically to Austria separates this paper from the extend literature by focusing on a single treatment and a single treated unit, which keeps the key econometric and methodological approach in a clear view. This will be done by a newer method of comparative case study - the Synthetic Control Method. The aim of this thesis is to provide a country specific approach by this method and a further scientific basis to answer the question of whether the EU-membership had positive or negative effects on the Austrian economy.

This master's thesis is structured as follows; In chapter 2, a review on market integration, free trade and the examination of the economic effects of EU-membership in Austria, is provided. Chapter 3 describes the European Integration process of Austria and the economic changes due to EU-membership. Chapter 4 includes the methodology of this approach on a theoretical and mathematical basis and the corresponding assumptions. In chapter 5, the results and its interpretation are presented, while in chapter 6 placebo tests and robustness checks are provided. The conclusions of the thesis are presented in chapter 7. Chapter 8 and chapter 9 are including bibliography and appendix respectively.

2 Literature Review

An essential feature of the European Union is the free movement of goods and services. Various empirical studies (e.g., Emery (1967), Syron and Walsh (1968), Ram (1987), Sachs and Warner (1995)) have examined the effects of free trade and found out that it has a positive impact on economic growth. However, knowledge of market liberalisation was weak until the 1980s and the effects or measurements of integration into an ever-larger common free market seemed impossible until then. But the new growth theories (neoclassical growth model) and models (Romer 1986, 1990, or Lucas 1988) from the 80s onwards have enabled more targeted investigations. The paper of Baldwin and Seghezza (1996) surveys a list of famous empirical work on integration and growth at that time and concludes that there is strong evidence that trade liberalization promotes growth through two channels, which they investigated in the context of the EU. These channels are the investment-led growth and the technology-led channel, where the first is promoted by the reduction of trade-barriers and the second by the productivity growth

effectiveness through increasing European knowledge. But as a result they describe the effects as a steady expansion of the social welfare state rather than steadily higher growth rates.

The basis for this master thesis, are the papers by Campos et al. (2014) and (2019), which estimates the effects from economic and political integration in the case of EU-memberships. They examined how GDP per capita and labour productivity of EU-countries would have behaved, if those countries had not joined the EU. They found out, that EU-membership led to large positive growth effects. They calculated that on average approximately 12 percent, per capita incomes would have been lower without the deep economic and political integration of the EU-membership, but also highlighted that these effects differ across countries. In the case of Austria, they found positive effects on real GDP per capita and labour productivity.

Another paper that examines the course of the European economic area and asks the question of what extend this development would have been like without the formation of the European Union and its institutions, without the creation of a common market with a single monetary system, is provided by Boltho and Eichengreen (2008). In doing so, they have taken a very critical approach to the hypothesis that the course would have taken place very differently and apply the methodology applied by Fogel to the railroads, suspecting that the results are small and that the estimators used from other results of the effects are upwards biased. Nevertheless, they conclude that without the EU, European incomes would have been about 5% lower today. In addition, the authors show theoretical analyses of the economic, political and institutional developments and the potential driving forces behind these differences.

A paper by Badinger (2005) which investigates the integration of the European Union and the effects on economic growth, presented similar results, but uses a different approach. Namely an index of economic integration, which takes into account both, the global (GATT) and the regional (European) integration of the EU Member States. Tested this for permanent and temporary growth effects in a growth balance sheet framework using a panel of fifteen EU Member States over the period 1950-2000 and the results showed while the hypothesis of lasting growth effects is rejected, the EU's GDP per capita would be about one-fifth lower today if there had been no integration since 1950.

In the case of Austria, the work of Breuss (2010) and (2020), using the integration model, provides comprehensive results on Austria's economic development in the European Union. Accordingly, Austria has become more modern through EU-membership and has also benefited economically from all stages of integration. Participation in the EU's single market, in the European Economic and Monetary Union (EMU) and further EU-enlargements has contributed to an annual increase in real GDP of 0.8 percentage points. The largest economic impetus came from participation in the single market (+0.4 percentage points), followed by economic benefit caused from the eastern EU-enlargement (+0.3 percentage points), and the introduction of the euro contributed 0.1 percentage points to annual GDP growth. Already with the opening of the East in 1989, Austria moved from the periphery of the EU to its geographical centre. The EU-enlargement in 2004 intensified this development and allowed Austria to participate fully in intra-European globalization. Furthermore, Breuss (2007) also analyses the expansion of the customs union (especially by the Eastern European countries in 2004 and 2007) and its effects on Austrian foreign trade. The results recorded an increase in bilateral trade, as well as a trade diversion from west to east. On the other side, the abolition of tariffs was a loss of government revenue.

Oberhofer and Winner (2015) show by means of an econometric model, the effects of the integration steps on the trade effects in Austria. This study shows that the largest export subsidies of the Austrian export industry could be won by the EU's eastward expansion. The probability of opening up new markets in the new Member States increased by more than 4 percentage points as a result of the EU's eastward enlargement than would have been the case without this integration step. In the existing markets of the new Member States, Austrian companies have been able to increase their market presence through the accession of these countries to the increase by an average of 11% to 13% points. From this perspective, the Austrian economy has been able to appreciate the geographical and the historical proximity.

From the point of view of increasing trade, from and to the accession countries due to the enlarged EU internal market and in relation to the impact of trade effects on imports and exports in Austria a study by John T. Dalton (2016) shows not only the increasing imports and exports of already existing trade goods as a result, but also the trade effects of "new goods", which were little or not at all traded before the accession of those countries in 2004 and which were affected by the EU's eastward enlargement and the associated integration step into the EU internal market. This have become more attractive for Austrian imports and exports. Unlike the results of

the previous study (Oberhofer and Wimmer, 2015), Dalton's studies come to higher results in the area of re-traded goods. According to this, in the following 5 years after the EU's eastward enlargement, the share of "new goods" has 60% of the total growth in imports and exports of Austrian foreign trade to and from the accession countries.

Another important area of analysis of the economic impact of EU-membership is the labour market. The report by Holland et. al. (2011) analyses labour mobility within the EU., the impact of enlargement and the functioning of transitional arrangements. This study focuses on an assessment of the macroeconomic impact of increased labour mobility resulting from the two EU-enlargements in 2004 and 2007. Zaiceva (2014) also examines labour market dynamics within the EU, focusing on the candidate countries. According to this, outmigration can lead to rising wages and falling unemployment in the new EU member states, but also to a shortage of skilled workers. In general, the results show that EU-emigration after enlargement frees sending countries from part of their surplus labour, reduces unemployment and increases wages. However, outmigration can also exacerbate labour and skills shortages and labour market mismatches, which will increase as demand for labour also increases.

3 Austria's Steps towards European Market Integration

Austria's first step towards market expansion and integration after the Second World War, was taken internationally by the GATT (General Agreement on Tariffs and Trade) on 1 January 1948. The main objective of the GATT was the substantial reduction of different trade barriers as well as the safeguarding and shaping of free international trade relations. The concrete design of trade policy took place in the eight rounds of GATT negotiations between 1948 and 1994.

On 4 January 1960, Austria was one of the founding members of EFTA (European Free Trade Association) and thus joined an economic alliance with objectives such as promoting economic growth, full employment, productivity increases, financial stability and ensuring fair trade and competitive conditions. This was its first strong signal towards European integration. Another key feature of EFTA was the abandonment of common external tariffs. In the same year, Austria was also a founding member of the OECD (Organization for Economic Co-operation and Development), which was founded as the successor organization to the OEEC and the Marshall

Plan for the reconstruction of Europe. The OECD supports governments in promoting prosperity and combating poverty through economic growth, financial stability, trade and investment, technology, innovation, entrepreneurship and development cooperation.

The existing literature shows that small economies (see chapter 2) in particular benefit from market expansions and participation in joint economic agreements. However, agreements such as EFTA led to negative economic effects for Austria in different ways (Butschek, 2012), because the following agreements with the EWG (free trade agreement between Austria and the European Community) could not be fully exploited due to the specific conditions of the EFTA agreement, which could only be compensated, when the association with the EWG was concluded on 1 January 1973 and subsequently the application for membership of the European Community was submitted by Austria and the negotiations in 1994 were positively concluded.

3.2 Austria and the EU

After a positive conclusion of the accession negotiations and a referendum within Austria, which resulted in a two-thirds majority in favour of accession, Austria joined the EU in 1995. From this point in time, Austria had unrestricted access to the EU's internal market, which is an economic area without internal borders and is characterized by the free movement of goods, services, people and capital - essential core of European integration.

The customs union prohibits the imposition of import or export duties as well as quantitative restrictions within the European internal market. Customs controls are only provided at the external borders of the internal market. Removal of trade barriers such as dismantling of tariffs has been advantageous for many companies in terms of ease of entering the market and reduced production costs. As a result, the diversity of production in the EU internal market potentially increased. At the same time, there were advantages for consumers. The expanded supply and the increased competition on the market tended to lower prices and increased the quality of products and services. The effect has improved the permanent pressure on prices in favour of consumers' purchasing power. Free movement of workers, a result of the single market, is another reason for significantly reduced production costs. This made it easier for companies to employ qualified personnel.

An important component of the EU's internal market is the free movement of capital. In Butschek (2012), this step is even known as the most consequential one that has contributed to the European integration process. The free movement of capital enabled cross-border financial transactions between Austria and the other EU-countries and opened up the possibility of cross-border financial transactions. Companies got access to a larger capital market. On the one hand, these financial transactions are usually characterized by different currencies, but also by the formation of a common monetary union (Butschek, 2012). Moreover, this led to a significant reduction in transaction costs. Expenses for currency exchange are eliminated, as are expenses for hedging exchange rate risk. There was an increase in the overview of prices, which intensifies competition and facilitates trade, as, in principle, the security of economic activities increased. The member states of the monetary union no longer had to hold currency reserves for the internal trade within the EU. Disadvantages arose from the short-term costs of the currency changeover. In the longer term, the possibility of correcting external imbalances through changes in exchange rates had also disappeared (Butschek, 2012).

On 1 January 1999, the exchange rates of the individual currencies to the euro were finally fixed and the euro was introduced in Austria for the internal trade transactions. From 1 January 2002, euro coins and banknotes were issued, and two months later the currency changeover was completed. At this point the European integration process was completed, but it was also associated with permanent change in the structure of the certain Austrian economic institutions, as their policy agendas were removed and transformed towards European Commission. This included competition policy, which is a key condition for the functioning of single market, the common European agricultural policy, the common commercial policy and structural and regional policy. In order to adapt to the EU-laws, the antitrust act has also been amended. An independent Federal Competition Authority was newly created, which includes a Competition Commission as an advisory body and a Federal Cartel Prosecutor.

The Austrian economy has undergone significant changes after joining the EU in 1995. The advantages in the area of trade on the one side and the regulations and rules at the European level on the other side. Nevertheless, the above-mentioned potential advantages and the literature review suggest, that the accession to the EU and the associated integration process into the European Economic Area has had positive effects on Austrian economic growth. This hypothesis is examined in the following by using the Synthetic Control Method.

4 Synthetic Control Method

The Synthetic Control Method (SCM) is used in statistics and econometrics to investigate causal relationships of a historical public or political event¹. Athey and Imbens (2017) argues "It's the most important innovation in the policy evaluation literature in the last 15 years".

The main idea behind this and in the context of this thesis, is to compare the outcome of an event² (EU-membership), using a treatment group (Austria) and a control group (donor pool) which reflects the synthetic Austria and approximates the characteristics and the outcome for Austria as it would have been without the event (without EU-membership). As in a comparative case study, these two cases of Austria, with and without EU-membership, can be compared and makes it possible to carry out an alternative of qualitative and quantitative inference by applying a wide range of falsification exercises, which Abadie, Diamond and Hainmueller (2015) call "placebo studies".

The SCM was developed and first applied in Alberto Abadie and Javier Gardeazabal (2003), which examined the economic impact of the terrorist conflict in the Basque country. This was followed by and Abadie, Diamond and Hainmueller (2010) and (2015). The former provides a formal discussion of the theoretical properties of the Synthetic Control Method and applied them to investigate the effects of Proposition 99, a large-scale tobacco control program that California implemented in 1988. The second discuss the use of the SCM as a way to bridge the quantitative/qualitative divide in comparative politics and demonstrated this idea, by examine the economic impact of the 1990 German reunification on West Germany.

Two recent papers that discuss the theoretical and technical application of SCM in combination with examples are Gilchrist et al. (2023), which offers a clear and critically review of the properties of SCM and discuss certain conditions for an successful application, based on an example about the long-term effects of the oil discovery in Venezuela. The other, Hollingsworth and Wing (2020), explain assumptions for causal inference by using SCM and show the corresponding consequences if they fail. By doing so, they use Lasso for the implementation of SCM on the example of how recreational marijuana legalization affects sales of alcohol and over-the-counter painkillers.

¹ In context of this thesis, event, treatment and intervention refers to the same.

For the investigation about the economic impact of EU-memberships, the Synthetic Control Method has already been used by Campos, Coricelli and Moretti (2014, 2019). In their study, multiple treatment units of the outcome variable per capita incomes were used to project and investigate the event on all acceded EU-countries. As a result, they estimated on average, that without EU-membership per capita incomes would have been approximately 10% lower for the EU-countries (except Greece) in the first ten years after joining EU (Campos et. al, 2019) compared to the case with EU-membership. In the case of Austria, the results show a positive effect of EU-membership, but were not evaluated in more depth or explicit numbers. A paper by Garoupa and Spruk (2020), examined the long-term economic growth and development effects of the European Union on its accession countries, by using log GDP per capita as the outcome variable for the SCM. The obtained results show disproportionately benefits from EU-membership across the founding members, as well as for additional EU-enlargements. Therefore, for certain countries there are no or weak effects on economic growth which disappear in the long run, or others which got significant gains and benefits from the EU-membership. However, the result does not show any discernible growth effect for Austria, where the structural break in the per capita GDP gap in the years of EU-membership is imperceptible (Garoupa and Spruk, 2020).

4.1 Application and Assumptions

In the application of SCM, time series results of a target outcome variable are observed and categorised in treated and untreated units. For the synthetic control group (synthetic Austria), which reflects the outcome in the absence of the event in the post-intervention period, the pre-intervention untreated units are used to match the units of the treated units in the pre-interventions period as close as possible and are the basis to estimate the synthetic control post-intervention units. The observed post-intervention units are only used in the case of the treated units. The outcome variable is chosen in such a way that it should be influenced by the event and the existing data is available over a long period (some decades) of time³. In addition to the outcome variable, predictor variables are also identified and added to the model, which can highlight and

³ Abadie, Diamond, and Hainmueller (2015) do not recommend SCM, when the pre-intervention fit between treated and untreated units is poor or the pre-intervention time period is too short. In this context the existing literature don't give a precise answer to which extent, the observed time-period or data points are enough, but the corresponding inference tools can help in this regard.

describe the trend of the outcome variable the best and need to be balanced in order to be able to show that the observed differences in the treated outcome and the synthetic outcome can only be due to the treatment.

The units for outcome and predictor variables are observed for the treatment group (Austria) and the untreated group which is the so-called comparison control group, that is used to construct the synthetic Austria. The control group is constructed by a pool of countries (donor pool), which have to be carefully selected and fulfil the following assumptions and requirements based on Abadie (2021), McClelland and Mucciolo (2022) and are implemented in the context of this thesis;

- (1) The donor pool should be unaffected by the event, meaning that no country in the donor pool undergoes the treatment which is the EU-membership or similar policy events.
- (2) No spillover-effects – equivalent to the assumption above, the donor pool should not be affected by the treatment, but also when they not undergo the treatment, there should no effects to the outcome of interest through spillovers of the event. (e.g., Switzerland has bilateral trade agreements with the EU. If the EU expands, then it also results in positive spillover effect on Switzerland. The degree of spillover effects would then depend on the extent to which Switzerland and EU rely on each other.)
- (3) No Anticipation – countries in the donor pool should not anticipate the event and act as if the event already took place in the time before the event occurs (e.g., trade contracts or foreign direct investments tend to increase due to expectations about changes regarding trade barriers or other expected benefits from the EU-membership in Austria).
- (4) Countries should be removed from the donor pool, if they suffer large idiosyncratic shocks which could affect the outcome of interest during the chosen time horizon, especially large positive idiosyncratic shocks in the post-intervention time period like similar policy interventions. Adding such countries could also run the risk of overfitting the donor pool, which may lead to biased results.
- (5) Countries with similar values to the values of Austria should be chosen for the donor pool, because the values of the donor pool and Austria must have an approximate linear

relationship, otherwise the control group do not match the outcome of Austria. Furthermore, this can lead to interpolation bias, if countries with nonlinear relationship between the predictors and the outcome are added to the donor pool.

The synthetic control estimator is constructed as weighted average of the untreated units of the control group. The weights are selected in such a way that discrepancies between the untreated control group units and the treated unit of Austria are minimized in the pre-treatment period. This approach makes it possible to take into account the change of confounders over time. Furthermore, it allows for a systemically and very targeted selection of the countries in the control group, which are in this case, chosen to construct the best comparison to Austria. The subsequent inference is organized by placebo tests and the results between the outcome of Austria and the synthetic Austria can be visualized with different tools, further evaluated and analysed.

4.2 Model Construction

In the following, the Synthetic Control Method is constructed on the basis of mathematical derivation and short theoretical explanation of the model, which is then converted and applied into the software-program R⁴. The corresponding *synth()* package, created and initialized by Abadie, Diamond, and Hainmueller (2011) is used to construct and implement the model in R. Therefore, the mathematical derivation and notation of the model below, follows the definition of Abadie, Diamond, and Hainmueller (2010, 2011, 2015);

Its supposed to obtain data for: $j = 1, 2, \dots, J + 1$ for time periods $t = 1, \dots, T$.

Without loss of generality its assumed:

the first unit ($j = 1$) is the treated unit (Austria: receives EU – membership)

the remaining J units ($j = 2, \dots, J + 1$) are control units which are unaffected by the treatment (donor pool) and contributes to the synthetic control.

Time periods are defined s. t.:

the event / treatment occurs in $T_0 + 1$,

it follows that pre – treatment $1, 2, \dots, T_0$ and post – treatment $T_0 + 1, \dots, T$.

⁴ R is a software program for statistical calculations, graphical representation and professional reporting.

Two potential outcomes are defined:

Y_{it}^I ... refers to the outcome if unit i is exposed to the treatment in $T_0 + 1, \dots, T$

Y_{it}^N ... refers to the outcome if unit i is not exposed to the treatment in time t

The goal is to estimate the difference between two potential outcomes:

$$(1) \quad \alpha_{1t} = Y_{1t}^I - Y_{1t}^N, \quad \text{for } T_0 + 1, \dots, T$$

taking into account, that Y_{it}^N is unobserved for $T_0 + 1, \dots, T$, where SCM is used to construct a synthetic control (synthetic Austria) for the missing Y_{it}^N

To construct the synthetic control, which is defined as a weighted average of the units in the donor pool, the data also includes k predictors for the outcome:

Let \mathbf{X}_1 be a $(k \times 1)$ vector and let \mathbf{X}_0 be a $(k \times J)$ matrix, where

\mathbf{X}_1 includes the pre – treatment characteristics of the treated unit and \mathbf{X}_0 of the untreated units, and let \mathbf{W} be a $(J \times 1)$ vector of weights, where

$$\mathbf{W} = (w_2, \dots, w_{J+1}) \text{ with } w_j \geq 0 \text{ for } j = 2, \dots, J+1 \text{ and } w_2 + \dots + w_{J+1} = 1$$

\mathbf{W} is chosen s. t. the differences between the pre – treatment characteristics of the treatment unit (Austria) and the synthetic control are minimized;

$$\min ||\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W}||$$

Accordingly to the implementation of the synthetic control, it is considered that;

$$(2) \quad \min ||\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W}||_{\mathbf{V}} = \sqrt{(\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})' \mathbf{V} (\mathbf{X}_1 - \mathbf{X}_0 \mathbf{W})}$$

where \mathbf{V} is a $(k \times k)$ matrix, which is positive semidefinite and allows for different weights of the predictors in \mathbf{X}_1 and \mathbf{X}_0 , based on their predictive power for Y_{1t}^I and Y_{1t}^N . \mathbf{V} is chosen in such a way that the mean squared prediction error (MSPE) of the outcome variable is minimized for the pre – treatment periods⁵.

Given the optimal \mathbf{W} and \mathbf{V} , the synthetic outcome become

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

and it follows

$$(3) \quad \hat{\alpha}_{1t} = Y_{1t}^I - \hat{Y}_{1t}^N \quad \text{the synthetic control estimator}^6.$$

⁵ For the optimal choice of \mathbf{V} , Abadie and Gardeazabal (2003) and Abadie et al. (2010) offer a data-driven application, which is also used in this work. This is provided by *synth()* in R. In this process, also equation (2) is minimized and provides results for the given data with the optimal choice of \mathbf{V} and the optimal combination of \mathbf{W} .

⁶ See Abadie, Diamond and Hainmueller (2010) for more details on the synthetic control estimator and the mathematical derivation and proof.

4.3 Model Specification

The panel data set includes annual observations of Austria and 9 countries in the donor pool which are industrialised and transitional economies, and their corresponding outcome and predictor variables⁷.

The selected study period is a total of 38 years, starting in 1970 and ending in 2008. Austria joined the EU on January 1st 1995. Hollingsworth and Wing (2022) point out the threat to validity in synthetic control studies posed by a structural break in the pre- or in the post-period, where the parameters of the interactive model can change significantly due to this structural break and are no longer a solid basis for extrapolation. Due to the Great Recession in 2007/2008, its consequences on the global economy and the different weights of the effects in the respective countries, the observed period ends before the effects of the crisis on the global economy come into force.

The outcome variable Y_{it} and the corresponding predictor variables X_1 and X_0 which should affect and describe the outcome variable before and after the event (see chapter 4.1), are chosen as follows;

Outcome variable (Y_{it}):

- Real GDP per Capita (USD)

Predictor variables (X_1, X_0):

- Trade Openness (Sum of Imports and Exports as % of GDP)
- Inflation (Consumer Price Index annual % change)
- Real GDP per Capita (USD)
- Employment Ratio (Employment to population ratio 15 + years age, total %)
- Industry Share Value Added (% of GDP)
- Gross Capital Formation (% of GDP)
- FDI Inflows (Foreign Direct Investment, net inflows % of GDP)
- FDI Outflows (Foreign Direct Investment, net outflows % of GDP)
- Human Capital Index (Average years of schooling and rate of return to education)

⁷ Data Source: World Bank Data and Penn World Table

The values of each predictor in the treated unit do not have to be the largest or the smallest and are ideally closely surrounded by values from donor units.

The donor pool includes 9 countries which fulfil assumptions 1) - 5) (see chapter 4.1). One particular key exclusion is that the donor pool is restricted to countries which are not in the EU (assumption 2) or entered the EU (assumption 1) in the whole existing history to avoid spillover effects through trade, conflicts, migration and other external factors (Garoupa and Spruk, 2020). In addition, and in respect to assumption 1, to focus on the isolation of the effects on the single event of the Austrian EU-accession, the donor pool is restricted to countries, which experienced no large trade agreements around the year of 1995 when the event of interest occurred.⁸ This restriction is based on the additional assumption, that the most significant effect from the EU-membership is driven through the variable *Trade Openness*. The EU-membership is associated with a greater single market without trade barriers⁹, free movement of labour force, a new strong common currency, whereby all these characteristics are closely in relation with *Trade Openness*. For this reason, large trade agreements can be classified very similar to the event of EU-accession and this would violate assumption 1. In this regard, this paper differs from the extant literature, in particular Campos et al. (2014, 2019) and Böwer & Turrini (2010).

Donor pool countries:

- Australia
- Bahrain
- Chile
- Egypt
- Hongkong
- Japan
- South Korea
- Malaysia
- New Zealand

Furthermore, this work also differs from the existing literature regarding the economic effect of EU-membership on the outcome variable is only investigated in one certain country. Accordingly, the model can be adapted more precisely for a single treated case (Austria), in order to isolate the effect of the EU-membership and fulfil all requirements to get the possible best pre-

⁸ See Appendix 2 for an overview of which major trade agreements were signed around 1995 and which countries were involved.

⁹ See chapter 2 in the literature review for effects of market integration.

intervention fit and unbiased results. The more precise adjustment applies above all to the selected donor pool, which therefore does not have to contain so many countries. This leads to various advantages in contrast to large donor pools, where problems of different forms of overfitting can lead to associated biased results (McCelland & Mucciolo, 2022). The risk of overfitting with smaller donor pools in combination with a long pre-intervention period¹⁰ is greatly reduced. On the other hand, this assumption makes it more difficult to find suitable candidates for the donor pool. Due to the fact that Austria is one of the countries with the highest real GDP per capita, and already in the 70s and 80s Austria recorded a relatively high real GDP per capita compared to other industrialized countries outside Europe. This makes it particularly difficult to find suitable candidates at this time and to satisfy assumption 5.

4.4 Sensitivity Analysis

Regarding the Synthetic Control Method and its transparency and accessibility, another advantage of a smaller donor pool is the possibility to determine whether the result of the composition of the synthetic control group makes sense based on sensitivity analysis. This procedure is clearer and simpler when the sample is not too big. In addition, it will be evaluated which number and combination of countries in the donor pool, the respective predictors and the associated length of the pre-treatment year range used to average predictors and adapt to the synthetic control, will provide the best result with the lowest MSPE¹¹ (Mean Squared Prediction Error). The above-mentioned donor pool of 9 countries is the result after such sensitivity analyses have been applied. Suspicious donors and predictors were selectively and systematically removed¹² and the model was re-evaluated after each removal, as long as the pre-intervention fit between Austria and the synthetic Austria had improved, since the synthetic control estimator's credibility strongly depends on the pre-intervention fit. This procedure was followed to the criteria's in McCelland & Gault (2017), wherein the sensitivity of the fit between Austria and the synthetic Austria in the pre-treatment period, sensitivity of the result of the synthetic

¹⁰ The relation between the number of units in the donor pool and the number of observed units in the pre-intervention period is crucial regarding overfitting bias, see McCelland & Mucciolo (2022) for more details.

¹¹ The MSPE measures the magnitude of the gap in the outcome variable (real GDP per capita) between each country and its synthetic control group.

¹² Started the model with 14 countries in the donor pool and additional predictors (final consumption expenditure in % of GDP, market capitalization of listed domestic companies in % of GDP, stocks traded total % of GDP, stocks traded turnover of domestic firms % of GDP, price level consumption, price level imports, price level exports).

Austria in the treatment period, and the sensitivity of the selection of the donor condition were assessed and subsequently improved in favour of a lower MSPE in the pre-intervention period.

4.5 Interpolation and Extrapolation Bias

An attractive feature of the Synthetic Control Method and the synthetic estimator of Abadie, Diamond and Hainmueller (2010, 2011), which is also used in this approach, is that it protects against extrapolation outside the convex hull of the observed data. This is the case because the weights of all control countries that contribute significantly to the synthetic Austria are chosen in the applied procedure in such a way that they are positive on the one hand and add up to one on the other. It follows that extrapolation can be severely limited by specifying lower and upper bounds, i.e., the donor units used and their predictors for the treated unit are located near or within the convex hull of the values for the donor pool. McClelland & Mucciolo (2022) and Abadie (2021) offer a more detailed explanation with a graphical representation of the convex hull. However, the disadvantage is also shown there, which is the danger of interpolation bias.

Interpolation biases can occur when there is a nonlinear relationship between the predictors and the outcome, thus violating assumption 5. As stated above, assumption 5 means the variables in X_0 of the control countries in the donor pool, which are used to form the weights, have to be similar to those of the treatment variables in X_1 and should reflect an approximate linear relationship. This is especially important to take into account in the case for the chosen donor pool in this approach, because as mentioned above, it has been more difficult to find suitable control countries due to the strict donor pool restrictions. However, Abadie, Diamond and Hainmueller (2010) show that when the outcome and predictors are related by a linear factor model, the bias of synthetic control is limited by a function that goes to zero as the observations of pre-treatment units increases. But if the relationship is not linear, the evidence does not hold, and the interpolation bias increases with the distance between the predictors of the donor pool and those of Austria.

5 Results

Table 1 presents the means of each predictor variable in X_1 for Austria and in X_0 for the synthetic Austria compared to the simple sample mean. The comparison between the predictor values shows that the Synthetic Control Method has done a good job and the estimated values of the synthetic Austria without EU-membership are relatively close to the values of the actual Austria with EU-membership and give very precise results compared with the sample mean. This are important results as the post-intervention outcome trend of the synthetic Austria is based on the predictors estimators in the pre-intervention period.

Table 1 Outcome Predictor Means before EU-membership

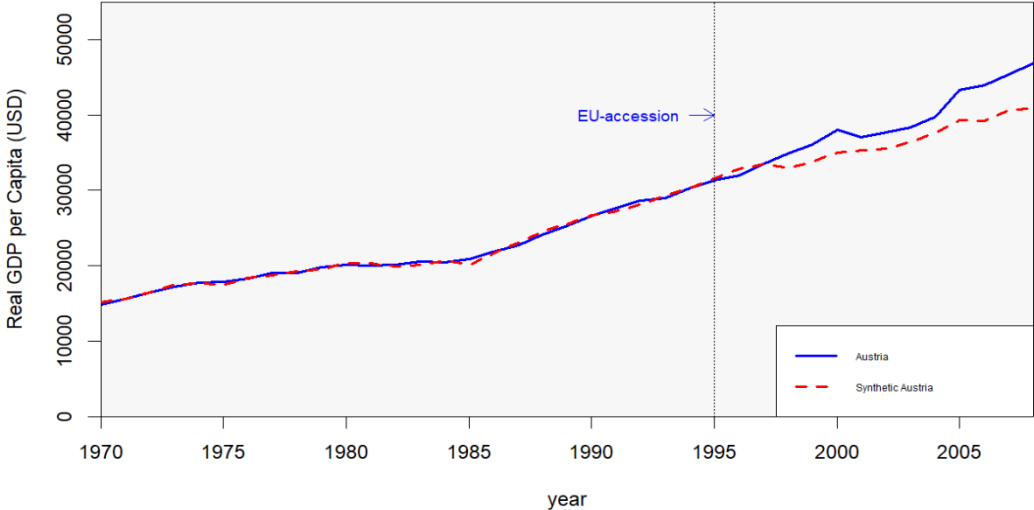
PREDICTORS	AUSTRIA	SYNTH. AUSTRIA	SAMPLE MEAN
TRADE OPENNESS	63.325	61.051	84.433
INFLATION	4.570	7.145	16.141
REAL GDP PER CAPITA	22498.473	22468.562	15779.173
EMPLOYMENT RATE	44.382	47.164	38.884
FDI INFLOWS	0.440	1.661	2.528
INDUSTRY SHARE	28.942	29.107	31.617
CAPITAL FORMATION	25.581	28.650	28.793
FDI OUTFLOWS	0.476	1.627	1.445
HUMAN CAPITAL	2.850	2.984	2.469

5.1 The Effect of EU-membership

Figure 1 shows the real GDP per capita development from 1970 to 2008 for Austria with EU-membership in blue and for synthetic Austria in dashed red without EU-membership. The synthetic Austria almost accurately reproduces the trajectory of actual Austria in the entire pre-intervention period. It can be seen that the predictor estimators of Table 1 represent a combination of X_1 and X_0 , such that a correspondence of economic characteristics exists between Y_{it}^I and Y_{it}^N over the entire pre-intervention period. It follows that the economic characteristics between Austria and synthetic Austria before 1995 can be reproduced without any extrapolating outside of the convex hull. The difference between the outcome variables real GDP per Capita between Austria and synthetic Austria is the synthetic control estimator $\hat{\alpha}_{it}$. In the post-intervention period, a clear effect $\hat{\alpha}_{1t}$ can be obtained. The two lines separates shortly after the event

of the Austrian EU-accession occurred, thereby the trajectory of real GDP per capita in the case without EU-membership is clearly below the trajectory with EU-membership.

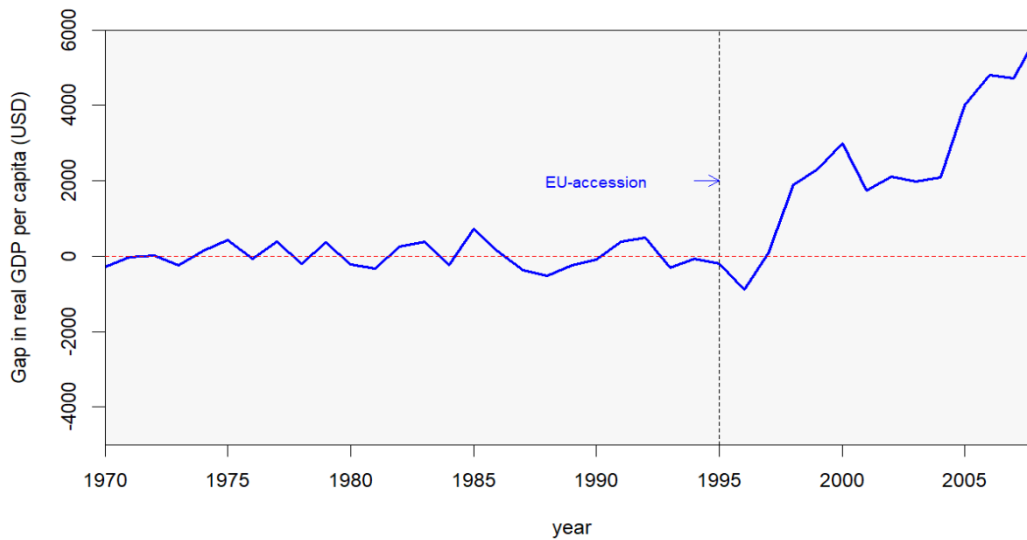
Figure 1 Real GDP per Capita - Austria vs. Synthetic Austria



It can be stated that there is a significant positive effect of the EU-membership on the Austrian real GDP per Capita. This can be better obtained in Figure 2, where the synthetic Austria outcome is set to the horizontal zero line and the blue line of Austria with EU-membership show the gap between the two outcomes of real GDP per capita along the whole observed time path. In 2008, real GDP per Capita in synthetic Austria (without EU-membership) is estimated to be about approx. 13% (5917,14 USD) lower than in actual Austria (with EU-membership) and from 1995 – 2008, real GDP per Capita is **approx. 5%** (2399,86 USD) lower in synthetic Austria than for Austria with EU-membership.

The visualization of the estimator in Figure 1 and Figure 2 and the effect of EU-membership on real GDP per capita shows, that in the first two years after the event of EU-accession occurred, did not much have an effect, moreover it's even slightly lower than the synthetic outcome. This goes in line with the literature (Butschek, 2012). According to the results, Austria had more costs than revenues in the short term as a result of its accession to the EU. This changed in the medium and long run, as the results of Figure 1 and Figure 2 displays. Short-term costs included e.g.; legislative alignment combined with increased administrative burdens, high net payments to the EU as one of the richest countries within the EU which burdened both the budget and the current account, agricultural compensation payments and adjustments to market conditions such as the adoption to the EU's Common Agricultural Policy (Pollan, 1996).

Figure 2 Real GDP per Capita Gap - Austria vs. Synthetic Austria



The synthetic control estimator continues to grow in the post-intervention period, meaning the difference between Austria and synthetic Austria grows towards the end of the sample period and seems to grow even further, but it should be noticed that from the year 2008 on, the Great Recession has hit the global economy and real GDP per capita of Austria declined for a certain time period.

5.2 Weights and Predictive Power

An already mentioned advantage of the Synthetic Control Method is its transparency of the results. The results of the synthetic Austria are a weighted combination of the countries in the donor pool and the predictor variables, which together create the best possible pre-intervention fit, follow the trend of the outcome variable *real GDP per Capita* and create the trend in the post-intervention period for the outcome of the synthetic Austria. In Table 2, the SCM provides a list of the precise proportion to which the respective countries in the donor pool contribute to the synthetic control group, i.e., synthetic Austria, and add up to 1 (100%). Ranked from highest to lowest, these are Japan (0.427), New Zealand (0.361), Hong Kong (0.101), Bahrain (0.056) and Australia (0.055). It has to be noted that the post-intervention outcomes are not used in the calculation of the weights for the synthetic control group.

Table 2 Synthetic Control Group Weights

DONOR POOL	SYNTHETIC CONTROL WEIGHTS (W)
AUSTRALIA	0.055
BAHRAIN	0.056
CHILE	0.000
EGYPT	0.000
HONGKONG	0.101
JAPAN	0.427
SOUTH KOREA	0.000
MALAYSIA	0.000
NEW ZEALAND	0.361

In Table 3, the same principle of the predictor variables and their corresponding predictive power regarding the outcome variable *real GDP per Capita* of the synthetic Austria can be obtained. The highest predictive power of course got the outcome variable as itself as predictor with 0.536, following by *Inflation* (0.235), *Industry Share* (0.113) and *Trade Openness* (0.097). The other predictors like *Employment Rate*, *Capital Formation*, *FDI In- and Outflows* got very low predictive power, *Human Capital* have no predictive power regarding the outcome of the synthetic Austria.

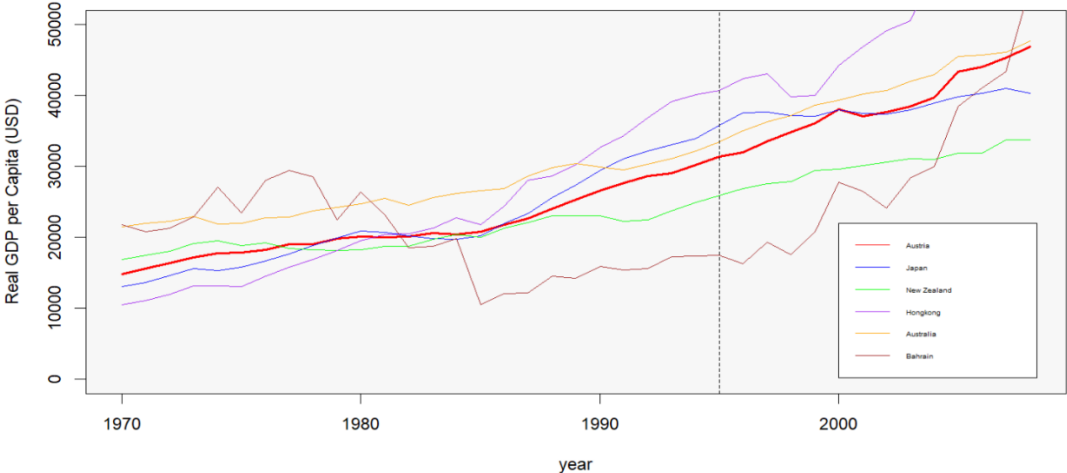
Table 3 Predictors Predictive Power

PREDICTORS	PREDICTIVE POWER (V)
TRADE OPENNESS	0.097
INFLATION	0.235
REAL GDP PER CAPITA	0.536
EMPLOYMENT RATE	0.004
FDI INFLOWS	0.006
INDUSTRY SHARE	0.113
CAPITAL FORMATION	0.005
FDI OUTFLOWS	0.002
HUMAN CAPITAL	0

The countries which contribute to the synthetic control group and form the synthetic Austria can be categorized as industrialized countries (World Bank, 2004). These countries strongly co-move in time across each other and also co-move with Austria in economic terms. Moreover, the outcome variable *real GDP per capita* of Austria and the countries in the synthetic control group co-move across the observed data points in the pre-intervention period from 1970 – 1995 (see Figure 3). This co-movement is an important feature of SCM to construct an accurate synthetic control of the outcome of interest (Abadie, 2021) and go in line with assumption 5 (see chapter 4.1). Furthermore, and this is also stated by Abadie and economic growth theory, cred-

ible synthetic control groups require reproducing not only the trend of the treated outcome variable but also the level because countries with different levels of GDP per Capita will tend to experience different growth rates on average in the absence of an intervention.

Figure 3 Co-Movement Real GDP per Capita: Austria and Countries in the Synthetic Control Group



However, it can also be seen from Figure 3 that there is no linear relationship between real GDP per capita trends between Austria and Bahrain. Bahrain's real GDP per capita shows fluctuations especially for the period between 1973 and 1985. From 1985 onwards a more stable growth process can be obtained in the pre-intervention period till 1995. Therefore, the trends in real GDP per Capita between Austria and Bahrain can be interpreted as curvilinear relationship, as there are opposite trends between Austria and Bahrain, but only up to a certain point around 1985 after which the relationship of both variables tend to an approximately linear relationship till to end of the pre-intervention period.¹³

In order to that the observed units of real GDP per Capita of Austria and Bahrain do not fulfil assumption 5 and to be aware of that this could potentially bias the model, an alternative model is constructed including the same donor pool countries except Bahrain, but South Africa instead, which shows stable growth trends¹⁴. The whole validation method, including sensitivity analysis, to construct the synthetic control group keeps the same, as the predictors and the corresponding chosen lags over which they are averaged also keeps the same to the main model. Based on this alternative model, it can be investigated whether the results differ significantly compared to the main model. Accordingly, a significant change to the main results on the effect

¹³ See Appendix 2 for the relationship of real GDP per capita between Austria and Bahrain.
¹⁴ See Appendix 3 for the results of the alternative model.

of the EU-membership could provide evidence that the results from the main model are biased and Bahrain should be excluded from the model. However, this is not the case and the alternative model show very similar results to the main model regarding the effect on real GDP per capita, unless not that well produced pre-intervention fit as in the main model.¹⁵ For this reason, the outcome of the main model remains the object of interest and inference.

6 Inference

In Economics, the proof of causality of a certain policy event is always challenging. The analysis and the interpretations of such results regarding the difference between correlation and causality have to be taken into account very seriously, even if the corresponding results are significant. An important feature of the SCM is to test whether the results show significant effects, based on placebo studies and robustness tests, as Abadie, Diamond and Hainmueller (2010) suggests. These inferential procedures can help to evaluate the credibility of the results and make causal interpretations of estimates more plausible. In the following, such placebo analysis and additional inferential procedures will be shown.

6.1 Placebo Studies

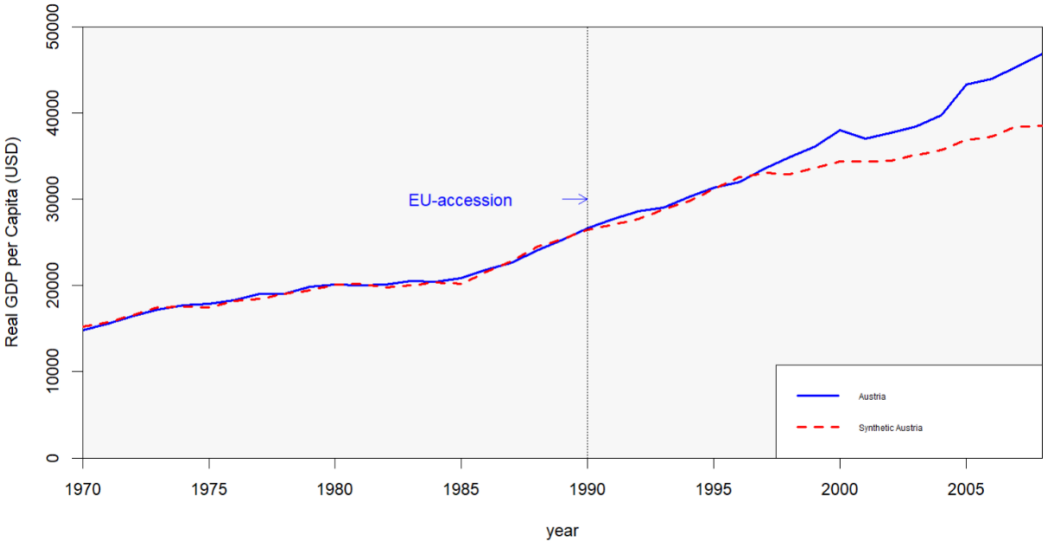
A way to identify anticipation effects (assumption 3 – see chapter 4.1) on the outcome variable *real GDP per Capita* and to check whether the estimates of the synthetic control estimator are credible regarding predictive power, is to redesign the model and reassign the event of the EU-accession to another year in the observed time period before the actual event occurred. This means the event is artificially new produced and implemented to another year in the model construction, such that the optimization process to minimize the MSPE in the pre-intervention period is adapted to the new time of the event. Due to this redesign of the model and the changes of the length regarding the pre-intervention period, the corresponding weights of countries in the donor pool, which contributes to the synthetic control and the predictive power of the predictor variables, as Table 2 and Table 3 presented, can change in the new model, whereas the

¹⁵ See Appendix 3 for the results of the alternative model.

sample and the validation technique keeps the same to compute the synthetic control estimator. This process is called the “in-time placebo test” and follows the idea of Abadie, Diamond and Hainmueller (2010).

Figure 3 presents the results of the new model, where the EU-accession of Austria is reassigned to the year of 1990. This placebo test offers some important information about the results of the main model (chapter 5.1) and can be interpreted based on visual inspection of Figure 3. First, the new artificial EU-membership from year 1990 onwards lead to no sizeable changes on real GDP per capita as compared to the results presented by the main model, and second, the effects from the actual event of the EU-membership from 1995 onwards are still present, separation, shape and direction of the two lines look very similar to the main model, even though the validation procedure uses no information about the timing of the real intervention. This argues for credible synthetic control estimator in the main model.

Figure 4 Placebo Test EU-accession 1990



In the new model of the placebo test 1990, the predictor variable *Employment* disappeared due to lack of pre-intervention datapoints for some countries in the donor pool and the predictive power across predictors changed; *Trade Openness* (0.022), *Inflation* (0.309), *real GDP per Capita* (0.579), *FDI Inflows* (0.009), *Industry Share* (0.033), *Capital Formation* (0.008), *FDI Outflows* (0.039) and *Human Capital* (0.001). The weights of countries which contribute to the synthetic control changed and are from the highest to the lowest; Japan (0.521), New Zealand (0.377), Australia (0.068), Bahrain (0.026) and Egypt (0.008).

The year 1990 is interesting for a placebo test because it was also the time in which the opening of the East and its markets took place, resulting from the collapse of the Soviet Union in 1989. Along with EU-membership, this event is considered one of the most influential for the Austrian economy in the 1990s (Butschek, 2012). It has changed Austria's foreign trade permanently. Austria's former marginal position of the political West changed for Austria in the case of East's opening into a central position in the trading area of Europe. During this period, Austrian foreign trade was able to count itself among the winners after the opening of the East, and Austrian transit trade was able to secure some advantages under the new conditions (Stankovsky, 1998). These changes, which were associated with a boost in Austrian foreign trade, may serve as an explanation for the slightly discernible effect of the placebo test in Figure 3 between 1990 and 1993.

However, the results of the placebo test argue for the credibility of the synthetic control estimator in the main model and reject any anticipation effects based on visual inspection. The effect of EU-membership is not obtained just by chance and the results of the placebo test provide evidence for a significant impact on Austria's real GDP per Capita by joining the EU. Furthermore, the whole results of the placebo test also hold when it is applied to the year 1985 (see Appendix 2).

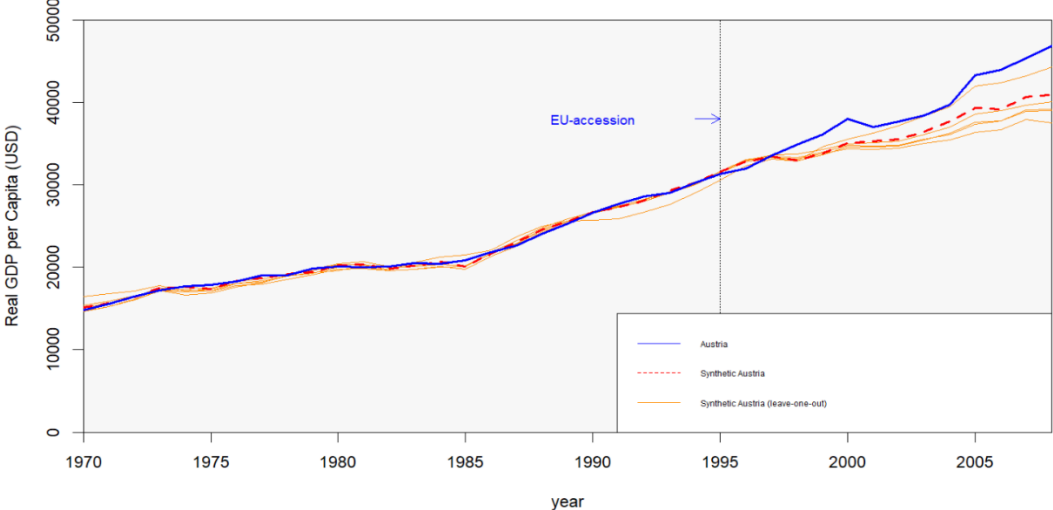
6.2 Robustness Test

In order to investigate the sensitivity of the synthetic control estimator, which can be driven by two important ways as Abadie (2021) noted - first, the choice of units in the donor pool and second, the choice of predictors for the outcome variable. This section provides a robustness test regarding the synthetic control group, that is the weighted average of the units in the donor pool and are linked to both points mentioned above.

In the application in R, a loop is constructed to rerun the model with the synthetic control group of Japan, New Zealand, Hongkong, Bahrain and Australia, but to leave one of them out each round and save the results of the synthetic control estimator. The results are be visualized in Figure 4 and checked for sensitivity whether the results of the synthetic control estimator change significantly or even explode due to the absence of a particular control country, or

whether the results change from negative to positive in comparison to the case of EU membership. The blue and the red dashed line are still for the outcomes real GDP per capita of the main model - with and without EU-membership. The orange lines are the leave-one-out estimates, where one of the countries from the synthetic control group disappeared.

Figure 5 Leave-One-Out Distribution of the Synthetic Control Group



It can be observed that on the one hand all leave-one-out estimates still track the blue line with the outcome variable real GDP per Capita of Austria with EU-membership very closely in the pre-intervention period and on the other hand, all leave-one-out estimates are still negative and centred around the red dashed line in the post-intervention period, which is the synthetic control group constructed using the entire donor pool. In this regard, the results are robust to the exclusion of any particular country which contributes to the synthetic control.

It can be noticed, that one orange line deviates slightly from the actual outcome between 1989 and 1995 and is the closest to the blue line in post-intervention period compared to the other leave-one-out estimates, which are all even more negative than the original synthetic control group represented with the red dashed line. This is the case if Japan is excluded from the synthetic control group. As Abadie (2021) pointed out, if the exclusion of a unit from the donor pool has a major impact on the synthetic control estimator without any discernible change in the pre-intervention fit, it may be justified to investigate whether the change in the magnitude of the estimate is caused by the effects of other interventions or by particularly large idiosyncratic shocks on the outcome of the excluded untreated unit. Japan contributes with a high share of approximately 43% to the synthetic control estimator and is therefore very important to further investigation like Abadie suggests.

Japan's economy underperformed, especially during 1990 and 2000, with regard to its own history and also in comparison to other industrialized countries. The average growth of real GDP in these years was around 1 percent and just one-fourth of the 4 percent annual average growth rate recorded in the 1980s (Callen, Tim and Ostry, 2003). This phase, also known as "Japan's lost decade", can be interpreted as idiosyncratic shock on the outcome variable, which was driven by several reasons (e.g., excessive loan growth quotas, asset price collapse, eroding bank capital etc.¹⁶). This could explain the differences between the actual outcome and the leave-one-out estimate without Japan in the pre-intervention years before 1995 and also the estimated trend in the post-intervention period. However, this interpretation is not in line with the argumentation of Abadie (2020), because idiosyncratic shocks could be identified but the synthetic control estimator do change in the pre-intervention period and at the same time the estimator do not deviate from the synthetic control group to an unusual extent, even still show negative effects in the post-intervention period. Nevertheless, further examination should keep this information in mind.

6.3 RMSE Ratios – An Alternative Placebo Test

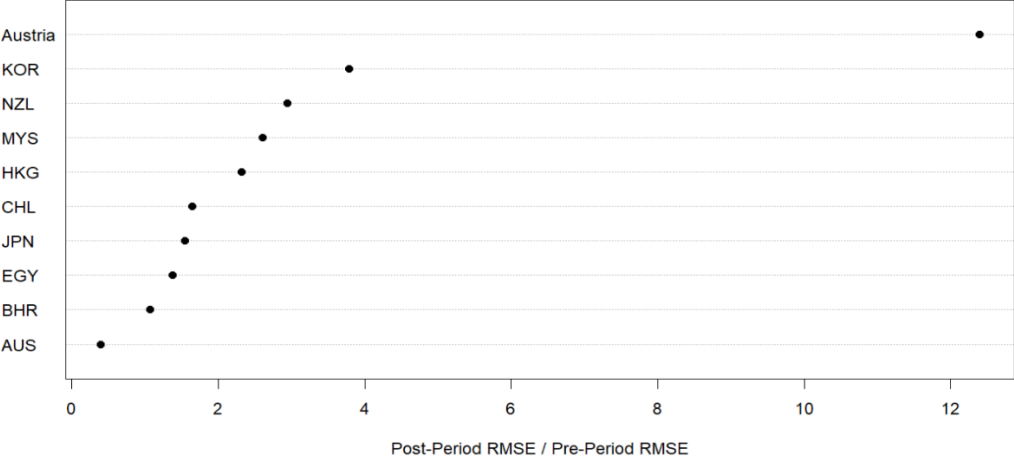
The RMSE (Root Mean Squared Error) measures the magnitude of the gap between the outcome of interest and its synthetic control group. An alternative way to conduct placebo studies is to redesign the model and reassign the event to each country in the donor pool which are actually not affected by the event, but maybe simply the procedure in R produces an effect to the outcome of interest or countries experienced similar events which should not be the case if assumption 1 and 2 are fulfilled. However, the results also provide the possibility to obtain whether the effect of EU-membership is unusually large in Austria compared to the countries in the donor pool.

After the event of EU-accession is reassigned to each country of the donor pool, in the next step of this alternative placebo test procedure, the post-period and the pre-period RMSE for each country are stored and the ratios are calculated by dividing the post-period RMSE by the pre-period RMSE. As a result, a relatively high ratio value, that means the post-period RMSE is unusually high compared to the pre-period RMSE, provides evidence for a significant effect of

¹⁶ See Callen, Tim and Ostry (2003) for more details about "Japan's lost decade".

the EU-membership on real GDP per capita. The final ratios and the corresponding distribution including Austria and all countries in the donor pool are presented by Figure 5 below.

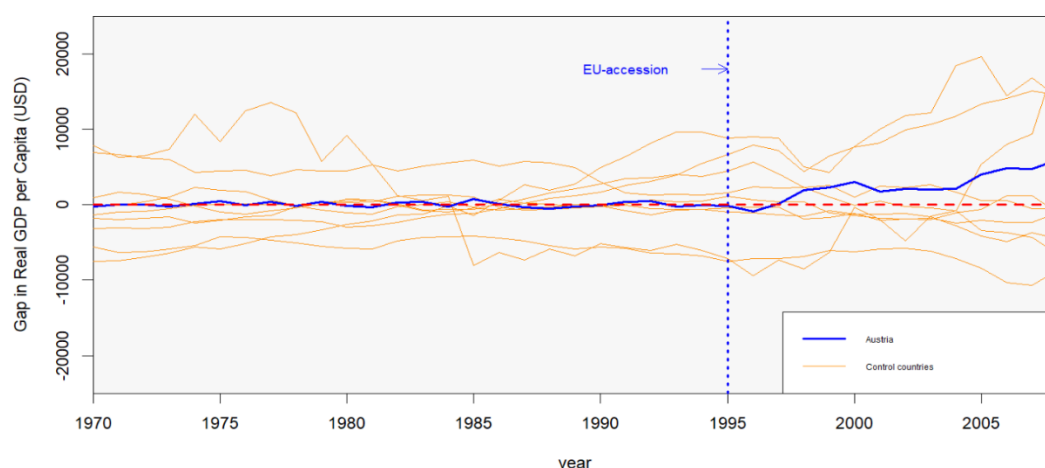
Figure 6 Ratios of Post-RMSE to Pre-RMSE: Austria and Control Countries



The results of the distribution of the RMSE ratios of Austria and all countries in the donor pool, clearly stands out, that Austria have the highest RMSE ratio. It follows, in comparison to the distribution of placebo effects obtained for other countries, the estimated effect of the EU-membership is unusually large in Austria. This provides evidence for a significant effect and supports the results of the effect on real GDP per Capita in Austria (see chapter 4.1)

It should be noted if the procedure above is examined by visually inspection, conclusion of the results loses some kind of interpretation power. This can be seen in Figure 6, which shows the gaps for Austria and all countries in the donor pool compared to its synthetic control group, the pre-intervention fit cannot be reproduced as precisely for the countries in the donor pool as it is the case for Austria and accordingly it's gap RMSE ratios. Due to the donor pool is adjusted to Austria, it comes to a different pre-intervention fit, when the SCM is applied to another country in the donor pool, which could need other countries to construct an adjusted synthetic control group and accurate pre-intervention fit.

Figure 7 Gaps for Austria and all Countries in the Donor Pool



These are consequences of using a small donor pool and could possibly be improved by using more countries in the donor pool, but this means that the overall results also change due to the changed weights for predictors and countries which contributes to the synthetic control group. Nevertheless, the analysis in this section is based on ratios, the key aspect of such analysis is to look at the post-intervention gap compared to the pre-intervention gap. In this regard, Austria got clearly the highest ratio.

7 Conclusion

Accession to the EU and the consequent EU-membership has been regarded as the final step in Austria's European integration process. Especially from an economic perspective, EU-membership can have different effects on the economy of a country that has joined the EU. For this reason, it is important to complement the existing literature with country-specific studies. Not only because the topic of EU-membership is often found in the political debate, but also to provide a scientific basis for the effects on certain countries.

This paper examines the case of Austria and how EU-membership has affected real GDP per capita. For the first time, the Synthetic Control Method was applied to the case of Austria on a country-specific basis and a hypothetical scenario of not joining the EU was created to assess the development of its real GDP per capita in absence of EU-membership.

The results of this comparative case study show that Austria's real GDP per capita without EU-membership between 1995 and 2008 would have been 5% lower than the actual real GDP per Capita in the case with EU-membership. In addition, an increase in the difference between the two cases over the same period has been shown, in 2008 Austria's GDP per capita without EU membership is 13% lower than that with EU-membership compared to the same year. On the basis of these results, a significant positive effect of EU-membership on real GDP per capita in Austria is shown and thus the stated hypothesis is confirmed. The applied Synthetic Control Method and its transparency about estimates offers significant and robust results, but it should be kept in mind, that interpretation about causal relationship in the case of a political event, as the EU-accession, is very complex and limited in general.

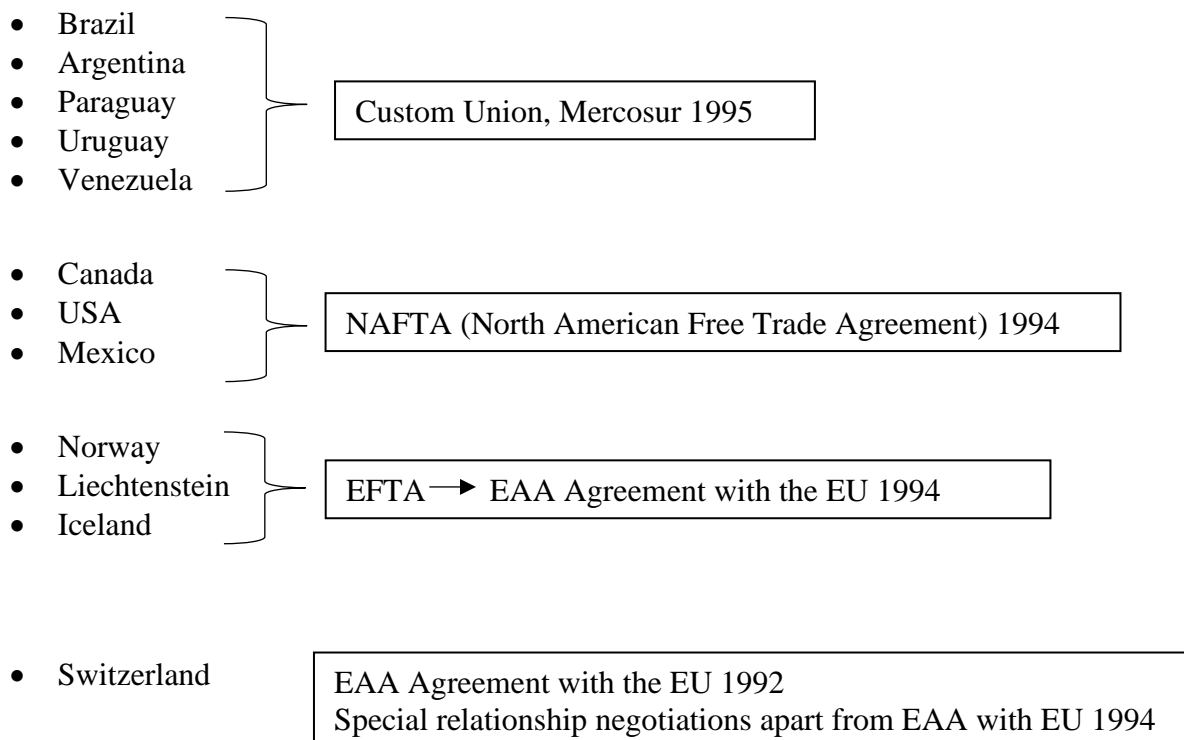
However, the results of this paper are in line with the existing literature, which uses other methods of investigation, but also with the existing literature which has also applied the Synthetic Control Method to all EU-countries, including Austria, and has also found out positive effects for Austria. This could provide evidence that the Synthetic Control Method applied to multiple cases of interest produces similar results as when the application is adapted to one case. Furthermore, this is the true whereas this paper has shown that the assumptions of the Synthetic Control Method can be fulfilled more accurately in a single treated unit case and the corresponding inference techniques provide evidence, that the results are significant and robust, based on a better pre-intervention fit compared to previous studies. Therefore, it supports previous investigations about the effects of EU-membership on economic indicators based on the Synthetic Control Method on the one hand, but it can also be recommended to examine on a country specific level rather than multiple countries of interest on the other hand.

Nevertheless, future country-specific investigations about the economic effects of EU-membership using the Synthetic Control Method can help to confirm this statement or to make a suggestion whether the single-treatment case rather than the multiple-case is recommended in this case of application.

8 Appendix

8.1 Appendix 1 - Trade Agreements

The donor pool is restricted to countries which had not experienced large trade agreements around 1995. This section provides an overview of countries which experienced such trade agreements and therefore, came not into the pool of candidates for the donor pool, even when other assumptions regarding the donor pool were fulfilled.

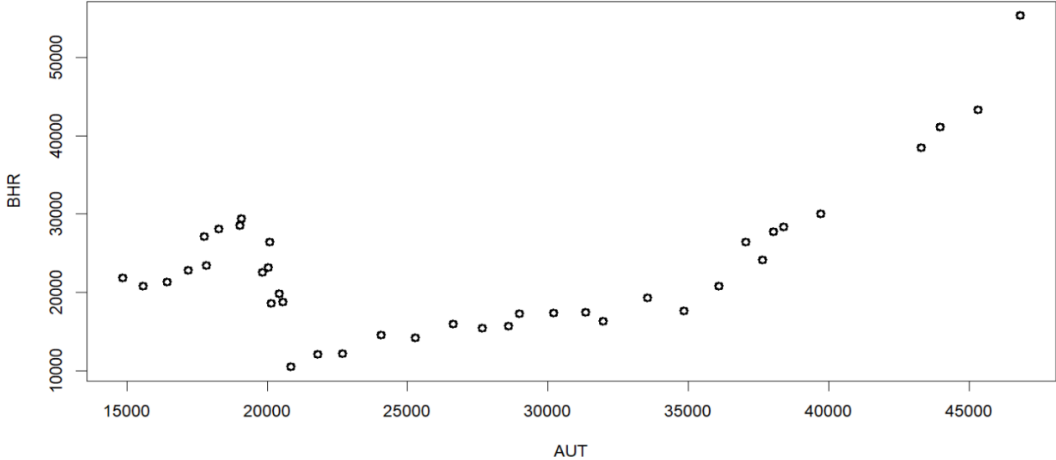


8.2 Appendix 2 – Real GDP per Capita AUT vs. BHR

Obtaining the relationship between the real GDP per Capita of Austria to the real GDP per Capita of Bahrain:

- Real GDP per Capita of Bahrain on the Y-axes
- Real GDP per Capita of Austria on the X-axes
- Observed data points from 1970 – 2008

Figure 8 Curvelinear relationship: Real GDP per Capita - AUT vs. BHR



8.3 Appendix 3 – Alternative Model Results

Table 4 Synthetic Control Group Weights (Alternative Model)

DONOR POOL	SYNTHETIC CONTROL WEIGHTS
AUSTRALIA	0.080
CHILE	0.000
EGYPT	0.000
HONGKONG	0.050
JAPAN	0.443
SOUTH KOREA	0.000
MALAYSIA	0.000
NEW ZEALAND	0.421
SOUTH AFRICA	0.005

Table 5 Predictors Predictive Power (Alternative Model)

PREDICTORS	V WEIGHTS
TRADE OPENNESS	0.015
INFLATION	0.313
REAL GDP PER CAPITA	0.363
EMPLOYMENT RATE	0.000
FDI INFLOWS	0.010
INDUSTRY SHARE	0.275
CAPITAL FORMATION	0.003
FDI OUTFLOWS	0.021
HUMAN CAPITAL	0

Figure 9 Austria vs. Synthetic Austria (Alternative Model)

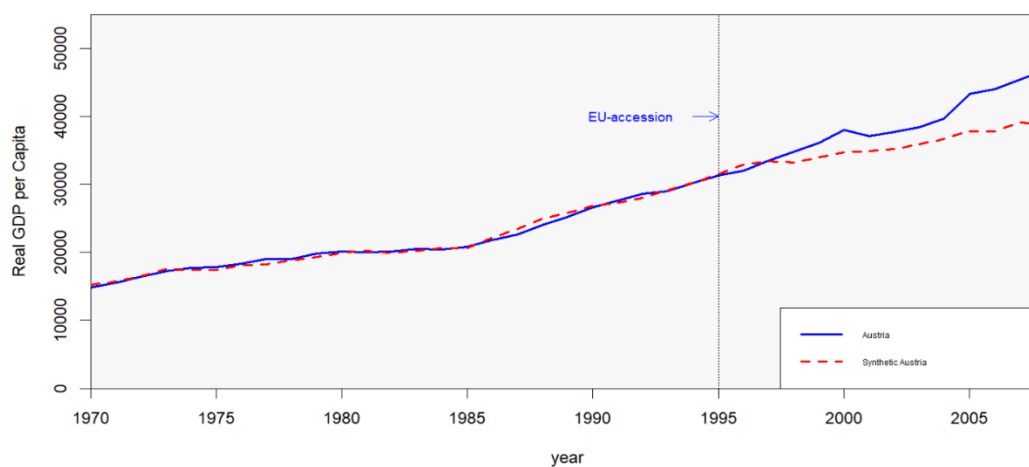
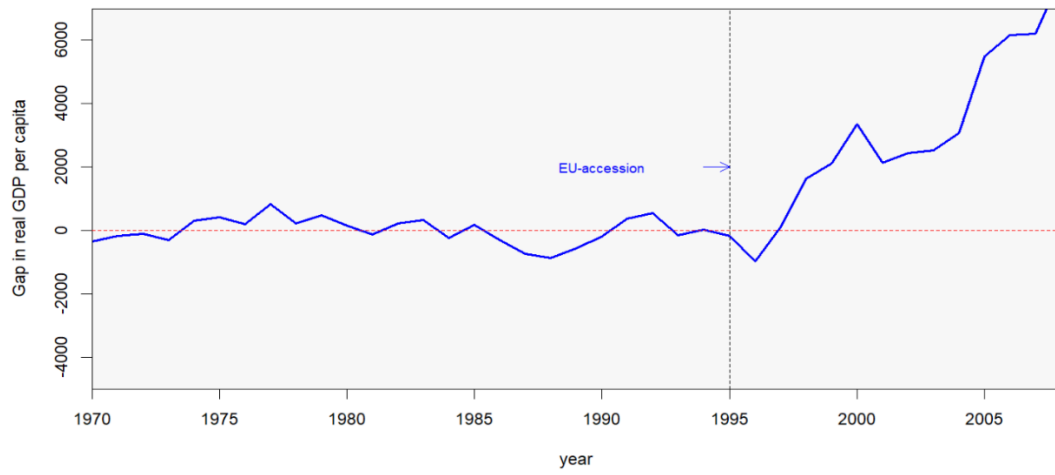


Figure 10 Gap between Austria and Synthetic Austria (Alternative Model)



8.4 Appendix 4 - Placebo Test 1985

Figure 11 Placebo Test 1985

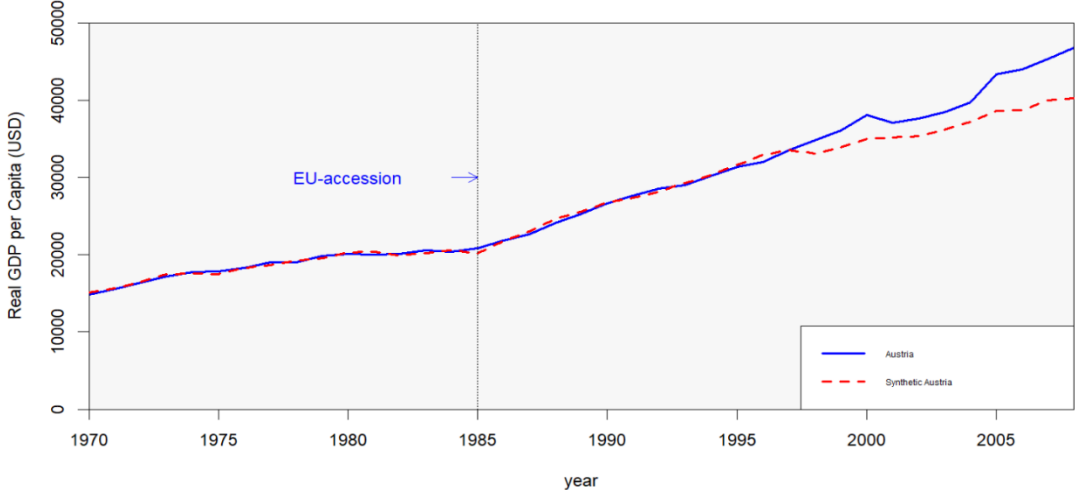


Table 6 Synthetic Control Group Weights 1985

DONOR POOL	SYNTHETIC CONTROL WEIGHTS (W)
AUSTRALIA	0.061
BAHRAIN	0.045
CHILE	0.000
EGYPT	0.000
HONGKONG	0.065
JAPAN	0.472
SOUTH KOREA	0.000
MALAYSIA	0.000
NEW ZEALAND	0.357

Table 7 Predictors Predictive Power 1985

PREDICTORS	PREDICTIVE POWER (V)
TRADE OPENNESS	0.123
INFLATION	0.430
REAL GDP PER CAPITA	0.396
FDI INFLOWS	0.038
CAPITAL FORMATION	0.010
FDI OUTFLOWS	0.004
HUMAN CAPITAL	0

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