European Commission

Does European Union Really Matter for Long-Run Growth and Development?

In Search of the Missing Counterfactual

ANNUAL RESEARCH CONFERENCE

EUROPEAN INTEGRATION INSTITUTIONS AND DEVELOPMENT

13-15 NOVEMBER 2023
BRUSSELS

European Commission | euobserver

Directorate-General for Economic and Financial Affairs and the Joint Research Centre

Does European Union Really Matter for Long-Run Growth and Development? In Search of the Missing Counterfactual

GAROUPA Nuno (George Mason University)

SPRUK Rok (University of Ljubljana, University of Western Australia)

Abstract

In the European political debate there is a growing number of statements about the negative and positive effects of EU integration, and most of them are taken for granted and not supported by sound evidence. In the academic debate, these economic benefits, even if measured in terms of GDP per capita growth, are much less consensual. There are severe methodological limitations to estimating the economic impacts of the European Union, namely the lack of a sound counterfactual. Making use of synthetic control methodology, we construct estimate the counterfactual growth scenarios in response to joining the EU for the period 1870-2015. By matching the EU member states' growth and development dynamics with a balanced sample of non-EU countries prior to the admission, we obtain a plausible representation of the economic growth trajectory in the hypothetical absence of EU membership. Our results suggest that the EU institutional design has disproportionately benefited the economic growth of the founding member states and several additional countries such as Ireland, Sweden and Czech Republic where relatively large gains from joining the EU are perceivable. Elsewhere we detect a pattern of no effect or a weak temporary effect of EU membership that disappears in the long run with large differences in the estimated growth premium of joining the EU across the member states.

JEL Classification: C55, N10, O10, O47, O52
Keywords: European Union, economic growth, long-run development, institutional change

Contact: Garoupa, Nuno; Professor of Law, George Mason University (E: ngaroup@gmu.edu). Spruk, Rok, Associate Professor of Economics, University of Ljubljana (E: rok.spruk@ef.uni-lj.si).

The author(s) were invited to present this work at the Annual Research Conference 2023 on European Integration, Institutions and Development held in Brussels on the 13, 14 and 15 November 2023.

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1. INTRODUCTION

The European Union is the major institutional development in Europe after WWII and one of the most important developments in European history. There are diverse economic and political explanations to account for the emergence and progress of the European Union in the last 65 years. Remarkably, in the European political debate there is a growing number of statements talking about both the negative and positive net effects of EU integration, and most of them are not supported by sound evidence. However, in the academic debate, these economic benefits, even if measured in terms of GDP per capita growth, are much less obvious. To some extent, the lack of strong empirical research is surprising given the policymaking and the political discourse in the last decades.

As recognized by the important article by Campos et al. (2019), there are severe methodological limitations to estimating the economic impacts of the European Union. There have been important studies, including Badinger (2005) and Crespo Cuaresma et al. (2008). These two articles conclude that there is a large and significant effect from European Union membership. For example, Badinger (2005) calculates an average 20 percent increase in GDP per capita (or, alternatively, GDP per capita would be 20 percent lower in the absence of the European Union). Crespo Cuaresma et al. (2008) find that the length of EU membership has a statistically significant positive effect on economic growth while poorer countries do better than wealthier countries. There is also an extensive impact assessment literature in connection with specific economic policy measures. However, these studies are generally not retrospective in their analysis. They mostly focus on a single country, or on a particular change or event such as the introduction of the Single Market.

The main reason for the gap between the economic empirical analysis and the policymaking rhetoric is the lack of a sound solid counterfactual. There is no Europe without European Union to which economic gains can be contrasted and assessed. Campos et al. (2019) develop a framework to address this limitation. They create a synthetic counterfactual and detect large positive effects from European Union membership, an average boost of 10 percent in GDP per capita. At the same time, they find considerable heterogeneity. Greece is the only economy being hurt by European Union membership according to their estimates. The largest winners are Ireland and the Baltic States. On the opposite side, the authors have, apart from Greece, countries like Poland and Slovakia.

In a previous work, Garoupa and Spruk (2018), we explored the need for a counterfactual to test institutional change. It seems to us that the key point in all discussions about how institutional changes explain growth trajectories is to correctly determine the alternative scenario. Natural experiments are inevitably rare. In other words, it is difficult to compare the same economy with and without institutional changes in order to assess the extent to which these institutional shocks can make a significant difference in the long-run horizon. Hence, an alternative methodology to test for the impact of institutional shocks is needed. In particular, we construct a synthetic counterfactual that allows a direct comparison between the same economy with and without a particular shock over the long period of time. We previously applied the methodology to distinguish and confirm standard results from short-term analysis (i.e., how a particular shock affected GDP growth in the following years) but, more importantly, to analyze long-term institutional impacts (i.e., whether or not a particular shock changed growth trajectories for a long period of time).

In this article, we develop a systematic empirical study of how that methodology applies in the context of the European Union. Compared to the previous work, we deploy a large sample covering all EU member states from 1870 onwards to estimate the economic growth impact of joining the EU for all respective countries rather than only for a selected few. To the best of our knowledge, this is one of the first articles trying to estimate the growth effect of entering the EU for the founding member states.

Our results show that the benefits of EU membership are multifaceted and do not withstand a "one-size-fits-all" explanation. Our synthetic control estimates suggest that some countries have reaped substantial benefits from EU membership, especially among the founding member states, where Italy and France have a sizeable growth premium from EU membership. Subsequent rounds of enlargement do not seem to be associated with widespread growth and development improvements. In most cases, the EU membership effect on growth and development is captured by pre-EU trends. For the 1981 and 1986 rounds of enlargement, we find that EU posited an effect more similar to a temporary shock. Our estimates imply that Portugal experienced a substantial growth acceleration in response to EU membership that gradually fizzled out while Spain and Greece did not initially react to EU membership but seem to have worse growth performance in the hypothetical absence of the EU, particularly after the 2008. In fact, after 2008, the counterfactual Greece and Spain perform better than their real counterparts. While the countries from 1995 enlargement round appear to be modestly affected by the EU, the 2004 enlargement is associated with widespread and broad-based gains in growth and development in the affected countries, especially Poland and Czech Republic. Taken at face value, the countries with the largest EU growth and development dividend in our analysis are Ireland, France, Sweden and the Netherlands.

We understand our methodology and result as an exploratory analysis. First, we do not fully resolve the identification issues inherent in the empirical work on institutions and long-run development in the following section. However, we are convinced that our methodology is promising and addresses previous concerns, thus mitigating considerably this line of critique. Second, our results can be explained in the context of economic policies across Europe, even when they are somehow surprising or misaligned from previous literature. Third, we see our approach being an exploratory econometric exercise, part of an important scholarly effort, to remedy the inexistence of an obvious natural experiment. We do not suggest that our findings are the last word on the debate, but an important contribution to clarify the growth benefits from European Union membership.

The following section explains the empirical methodology to construct counterfactuals (section 2). The results are discussed on the following section (section 3). Final remarks close the article (section 4).

2. EMPIRICAL METHODS

2.1 PRELIMINARY DISCUSSION

There are several limitations to consider in the context of our exploratory empirical exercise. The key issues revolve around the spillovers of trade, conflict and migration influenced directly by the postulated institutional changes such as EFTA or EU entry. Such spillovers might render the parallel trend assumption questionable since it is nearly impossible to isolate the institutional shock in the quasi-treated country from its control peers, which does not yield a satisfactory inference on the counterfactual outcomes.

We remedy these concerns by excluding the countries entering the EU in the same year as the quasi-treated country, as suggested earlier by Abadie et. al. (2010). The exclusion of simultaneous EU entrants from the donor pool ensures that the countries in the control group do not suffer from the institutional imitation of the shock, which can make counterfactual outcomes comparison inconsistent, both in time and space. This particular key exclusion also partially alleviates the spillovers of donor countries to the EU entrants, which might arise from trade, conflict, migration and other external factors, while simultaneously affecting the donors in response to the EU institutional shock. By restricting the donor pool to the countries without the EU entry in the same year as the quasi-treated country, we are able to match the treated countries with control group on similar pre-EU entry growth and development trends. Thus, we can examine the contribution of EU entry to long-run growth and development. Finally, we might want to interpret the results with caution when the quasi-treated countries are large economies (such as Germany or France) since size-related concerns are particularly less relevant for the small open economies (such as the Benelux, Portugal or the Baltic states).

Even though the limitations of long counterfactual periods are well known in the literature, there are several advantages when opting for a long pre-treatment period. First, to provide a plausible counterfactual scenario in response to any major institutional change, the credibility of the synthetic control estimator is contingent on the ability to track, reproduce, and capture the trajectory of economic growth before the institutional change took place (Abadie 2021). In previous work, Abadie et. al. (2010) have shown that if the assumption of the linear factor model is taken for granted, the bias produced by the synthetic control estimator are inversely proportional to the length of the pre-treatment period. This implies that an overly short pre-treatment period may contaminate the counterfactual with the impulse shocks that may not be related to the EU membership, and may instead capture a short-term inertia. Hence, it is crucially important to consider a larger pre-treatment time period to collect the necessary information on the characteristics of the growth and development process. When the number of pre-intervention periods is low, the quality of the fit may be more easily achievable. Yet, good quality of the fit may come at the expense of being spuriously driven which implies that the synthetic control group may not reproduce the trajectory of economic growth of the affected country in the absence of the institutional change, and may not smooth out the transitory shocks in a sufficient manner. At the same time, sufficiently long post-treatment period is preferable to small post-treatment period. Small post-treatment periods may have the ability to rule out the confounding influence of idiosyncratic shocks from the synthetic counterfactuals. However, the effects of major institutional changes on the trajectory of economic growth are not expected to arise immediately but gradually over the course of many years and possibly decades. It is precisely for this reason that shortening the post-treatment time period does not seem to be plausible in our analysis. Therefore, extensive insight into the intertemporal dynamics of estimated counterfactual scenario provides us a more complete overview of the long-term growth effect of the major institutional changes both across space and time.

Our paper differs from the extant literature in several respects and adds several novelties to the existing literature, in particular Campos et al. (2019). Earlier studies mainly focus on the economic effects of EU entry starting with 1973 enlargement. We use long-run growth data in the period 1870-2015 from Maddison (2007) and Bolt and Van Zanden (2014) which allows us to focus on the economic effects of EU formation among the founding countries as well.

We employ several auxiliary covariates predicting long-run growth and development including rich past GDP dynamics and geography-related time-invariant characteristics to mitigate the standard omitted variable bias and minimize the pre-EU entry error between treatment and control samples. By considering the geography-related characteristics, we are able to capture growth dynamics between quasi-treated countries and the synthetic control group sharing common geographical features such as latitude, longitude, soil quality and mean distance to coast among a few others. We also consider pre-

EU entry institutional characteristics of the quasi-treated countries and control group to better match on the institutional trends before the EU entry. Such approach allows us to build a synthetic control group for each treated country based on similar pre-entry characteristics, thus avoiding misleading comparisons.

Finally, we also examine the long-run effects of EU membership among the set of Central European countries from the 2004 round on enlargement using recent and fresh long-run estimates of GDP per capita for these countries. We partially alleviate the small pre-intervention period inherent in most synthetic control setups which may invoke weak asymptotic inference. In our case, the pre-intervention period exceeds 100 years, which makes it unlikely that the effect of EU entry is confounded by alternative institutional changes and provides a stronger inference on the counterfactual long-run growth and development paths in the absence of EU membership. Given a relatively short post-EU admission time span, for this reason, we only consider the post-1950 period for the countries from 2004 enlargement round.

We should emphasize once again the explanatory nature of this article. Our approach does not eliminate completely the drawbacks already identified in the conventional literature. At the same time, it has benefited considerably from that same literature. In the absence of natural experiments, synthetic counterfactuals are a useful and promising approach. The treatment developed in our analysis is likely to minimize the standard identification shortcomings.

2.2 IDENTIFICATION STRATEGY

We observe a finite set of countries $i = 1, 2, ...J+1$ over the finite time horizon $t = 1, 2, ..., \mathrm{T}$. Suppose the first country in the finite set enters the EU in the period T_0 and is exposed to the EU membership for the entire period. $\mathrm{T}_0 + 1, ...\mathrm{T}$ while the remaining J countries are the potential control units. Our goal is to examine the contribution of the EU membership to the long-run growth and development. The key variable of interest is the log of per capita GDP $\ln y_{i,t}$. Let $\ln y_{i,t}(\text{without EU})$ be the per capita GDP observed for *i*-th country at time *t* in the absence of EU membership and let $\ln y_{i,t}(\text{EU entry})$ be its counterpart if *i*-th country at time *t* is an EU member for the full period $\mathrm{T}_0 + 1, ...\mathrm{T}$. Our aim is to estimate the effect of EU membership on the entrant countries. Suppose the effects of EU membership are captured by the vector of unknown parameters $\{\alpha_{1,\mathrm{T}_0+1}, ..., \alpha_{1T}\}$ for each period after the membership, where the long-run impact of EU is captured by:

$$\alpha_{1t} = \ln y_{i,t}(\text{EU entry}) - \ln y_{i,t}(\text{without EU}) = \ln y_{1t} - \ln y_{1t}(\text{EU entry}) \quad \text{for } t > \mathrm{T}_0 .$$

Suppose the EU institutional shock is described by the simple binary switcher $D \in \{0,1\}$ that takes place without interruption in the full post-membership period $\mathrm{T}_0 + 1, ...\mathrm{T}$. The potential outcomes are given by the following factor model:

$$y_{i,t}^{D\in\{0,1\}} = \begin{cases} \ln y_{i,t}(\text{without EU}) = \phi_t + Z_i\theta_t + \lambda_t\mu_i + \varepsilon_{i,t} \\ \ln y_{i,t}(\text{EU entry}) = \alpha_{i,t} + \ln y_{i,t}(\text{without EU}) \end{cases} \quad (1)$$

where ϕ_t are the unobserved time-varying technology shocks common to all countries, Z_i is an $(1 \times r)$ vector of observed growth and development covariates, θ_t is an $(r \times 1)$ vector of unknown parameters,

λ_t is an $(1 \times F)$ vector of unknown common factors, and μ_i is $(F \times 1)$ vector of unknown factor loadings. The transitory growth and development shocks are given by $\varepsilon_{i,t}$ where $\varepsilon_{i,t} \sim$ i.i.d is assumed so that the shock transitivity restriction $\mathrm{E}(e_{i,t} \mid D(1,T_0)) = \mathrm{E}(\varepsilon_{i,t}) = 0$ holds. The key parameter of interest is $\lambda_t \mu_i$ which allows us to capture the heterogeneous responses of growth and development to the EU membership at time T_0.

Assumption #1 (No Prior Impact): *The EU membership in country i at time* T_0 *is independent of the growth and development outcome before the membership so that for* $t \in \{1, 2, ..., \mathrm{T}_0\}$ *and* $i = 1, 2, ..., J+1$, *we have* $\ln y_{i,t}(\text{with EU entry}) \approx \ln y_{i,t}(\text{without EU})$.

Our basic idea is to reweight the control group such that the synthetic control group for the EU entrant country matches Z_i and a limited set of pre-membership $\ln y_{i,t}$ and auxiliary covariates for the affected country, which ensures that, μ_i is matched between the affected country and its control group from the donor pool. Since EU membership is our form of treatment, we exclude the countries joining the EU at any point in time as the treated country from the donor pool to ensure that Assumption #1 is not violated (Abadie et al. 2015) and to provide a valid evaluation on the effects of EU entry (Athey and Imbens 2017). Since our pre-treatment period is large, the estimated parameters are not likely to suffer from small-T_0 asymptotics (Doudchenko and Imbens 2016, Possebom 2017).

We assume that there is a stable linear combination of the control units that absorbs all time-correlated shocks $\lambda_t \mu_i$. Let $W = (w_2, ..., w_{J+1})'$ denote the vector of weights used to construct a synthetic linear combination of the quasi-treated country in the hypothetical absence of the EU membership where $j = 1, 2, ... J+1$ is a donor pool and where each value W represents a potential synthetic control.

Assumption #2 (Existence of Weights): *There exists a stable linear combination of control units from the adjusted donor pool without an equivalent treatment shock, which implies that we have:*
$\exists \mathbf{w}^* = \{w_1^{*j}\}_{j \neq 1} \mid \mu_1 = \sum_{j \neq 1} w_1^{*j} \mu_j, \sum_{j \neq 1} w_1^{*j} = 1$ and $w_1^{*j} \geq 0$

The vector of weights is used to reconstruct the unobserved factor loadings μ_i and construct the synthetic control group for the EU entrant without the EU membership (Wong 2015, Powell 2016, Firpo and Possebom 2017). Following Ferman and Pinto (2017), we impose ex-ante restriction on the weight vector $W = (w_2, ..., w_{J+1})'$ to ensure that there exists a stable solution to satisfy Assumption #2 for the full pre- and post-membership period. Our vector of covariates predicting growth and development consists of the limited set of pre-membership levels of per capita GDP and the set of confounding non-outcome covariates (Klößner et al. 2017, Ferman et al. 2018). Let $\bar{y}_i^{K_1}, ..., \bar{y}_i^{K_M}$ be M linear functions of the pre-membership outcomes such that $M \geq F$. Considering Assumption #2, the linear combination of the quasi-treated country with the EU entry is such that

$$\sum_{j=2}^{J+1} w_j^* Z_j = Z_1 \qquad \sum_{j=2}^{J+1} w_j^* \bar{y}_j^{K_1} = \bar{y}_1^{K_1} \qquad \sum_{j=2}^{J+1} w_j^* \bar{y}_j^{K_M} = \bar{y}_1^{K_M}$$

so that the synthetic control unit contains the same within-country post-membership variation in growth and development as implied by the covariates in the full period prior to the EU entry. If T_0 is large relative to the scale of $\varepsilon_{i,t}$, an approximately unbiased estimate of EU membership on growth and development is:

$$\hat{\alpha}_{1t} = y_{1t} - \sum_{j=2}^{J+1} w_j^* y_{jt} \quad \text{for } t \in \{T_0 + 1, ..., T\} \tag{2}$$

where y_{jt} is the reweighted per capita GDP based on the pre-membership covariate-implied similarities between the quasi-treated country and its control peers. Let $\mathbf{X} = \left(Z_1, \overline{y}_1^{K_1}, ..., \overline{y}_1^{K_M}\right)'$ be a vector of pre-membership covariates and suppose $\mathbf{X}^{Control}$ is a $(k \times J)$ matrix which contains the variables for the countries without the EU entry at time T_0. The vector W^* is chosen to minimize the covariate-implied distance between the EU entrant and its synthetic control group:

$$\left\| \mathbf{X}^{EU\ Entrant} - \mathbf{X}^{Control} W \right\|_V = \sqrt{\left(\mathbf{X}^{EU\ Entrant} - \mathbf{X}^{Control} W\right)' V \left(\mathbf{X}^{EU\ Entrant} - \mathbf{X}^{Control} W\right)} \tag{3}$$

where $\mathbf{X}^{EU\ Entrant}$ is the fully saturated vector of covariates for the EU entrant and $\mathbf{X}^{Control}$ is its counterpart for the control group subject to our weight constraints $\sum_{i=2}^{J+1} w_1^j = 1$ and $w_i^1 \geq 0$. Note that V is a $K \times K$ positive semi-definite matrix. The choice of matrix used to minimize the discrepancy in the pre-EU membership deviation of the quasi-treated country from its synthetic control is crucial for the validity of the counterfactual scenario (Xu 2017). We choose V via quadratic nested optimization programming route. This is the equivalent of constrained quadratic optimization routine (Delbos and Gilbert 2005) which finds the best fitting weights conditional for the given vector of covariates. We use a full-scaled nested optimization procedure and search among all diagonal positive semi-definite V matrices to find the best fitting convex combination of weights of the control units.

The convex optimization route is computationally intensive. Note that if the synthetic control group consists of 5 countries from the pool of 58 countries in our sample, the number of possible match-ups in the nested optimization is in excess of half billion to minimize the pre-membership prediction error as much as possible. Using the constrained optimization route to find the residual-minimizing set of weights is boils down to the following objective minimization problem:

$$\hat{\mathbf{w}}(V) \in \arg\min_{\mathbf{w} \in W} \left\| \mathbf{X}_{i,t}^{EU\ Entrant} - \mathbf{X}_{j+1,t}^{Control} \mathbf{w} \right\|_V \tag{4}$$

where $W = \left\{ \{w_1^j\}_{j \neq 1} \in \mathbb{R}^J \mid w_1^j \geq 0 \right\}$ and $\sum_{j \neq 1} w_1^j = 1$. Note that the objective function of the minimization problem converges to $\left\| \mathbf{X}_{i,t}^{EU\ Entrant} - \mathbf{X}_{j+1,t}^{Control} \mathbf{w} \right\|_V$ when T_0 is large enough relative to the pre-membership period where the matrix optimization contains all the possible matches between the *i*-th country and $J+1$ control units in the donor pool:

$$\left\|\mathbf{X}_{i,t}^{EU\ Entrant}-\mathbf{X}_{j+1,t}^{Control}\mathbf{w}\right\|_V=\begin{bmatrix} E[\theta_t]\left(Z_1-\sum_{j\neq 1}w_1^j Z_j\right)+\left(\mu_1^1-\sum_{j\neq 1}w_1^j\mu_j^1\right) \\ \left(Z_1^1-\sum_{j\neq 1}w_1^j Z_j^1\right) \\ \vdots \\ \left(Z_1^R-\sum_{j\neq 1}w_1^j Z_j^R\right)\end{bmatrix} \tag{5}$$

where the countries from the same round of enlargement as the quasi-treated entrant country are excluded from the donor pool to ensure a valid counterfactual scenario. The set of weights $\{\hat{w}_1^j\}_{j\neq 1}$ to construct the counterfactual scenario without the EU entry satisfies $\mu_1^1=\sum_{j\neq 1}\hat{w}_1^j\mu_j^1$ and $Z_1=\sum_{j\neq 1}\hat{w}_1^j Z_j$ where $\mu_1^k\simeq\sum_{j\neq 1}\hat{w}_1^j\mu_j^k$ if $k>1$. The key question about the internal validity of the counterfactual scenario to the EU membership arises from the discrepancy in the pre-membership path of growth and development between the affected countries and their synthetic control group. Our goal is to minimize the pre-EU entry prediction error by performing an extensive diagonal matrix search between $\mathbf{X}^{EU\ Entrant}$ and $\mathbf{X}^{Control}$ up to the point where the error ratio is minimized inside the convex hull of $\left\{\left(\ln y_{21},...,\ln y_{2,T_0},\mathbf{Z}_2'\right),...\left(\ln y_{J+11,T_0},...,\ln y_{J+1,T_0},\mathbf{Z}_{J+1}'\right)\right\}$. Error-minimizing weight vector is computed via the following minimization problem:

$$\hat{\mathbf{w}}=\arg\min_{w\in\bar{W}}\left[\frac{1}{T_0}\sum_{t=1}^{T_0}\left(y_{1t}-\sum_{j\neq 1}w_1^j y_{jt}\right)\right]^2 \tag{6}$$

where $\hat{\mathbf{w}}$ is a nuisance parameter containing the set of weights minimizing the pre-entry prediction error using constrained quadratic programming routine $\hat{\mathbf{w}}(V)$, $\bar{W}\subseteq W$ is the set of weights such that it provides the interior solution to the problem in Eq. (4) for some positive semi-definite matrix. Under the standard conditions for valid counterfactual, the synthetic control for each EU entrant is constructed as a weighted combination of unaffected countries growth and development without the EU entry as implied by $k>1$ covariates. This enables us to match the pre-entry covariate characteristics of the quasi-treated countries with the unaffected from the data-generating process of the finite-sample realization of $\{\ln y_{1t},...,\ln y_{J+1,t}\}$ for $t=1,2,...\mathrm{T}$ conditional on $D(1,T_0\in\mathrm{T})=1$ as our key quasi-treatment related shock variable, which produces the counterfactual scenario (Gobillon and Magnac 2016).

The fit of the counterfactual outcomes implied by the synthetic control group for the EU entrant may be relatively poor if the interpolation biases in the constant linear model in Eq.(1) are large regardless of whether $\mathrm{T}_0\to\infty$. As a remedy, Abadie et al. (2010) and Cavallo et al. (2013) advocate the adjustment of the key model specification with additional covariates to partially avoid poor fit, or to remove the observations with the pre-shock root prediction error greater than $\sqrt{3}$ multiplied by average pre-shock prediction error (Acemoglu et al. 2016). By relying on quadratic nested optimization route, we employ a Newton-Rhapson iteration procedure to eliminate the imbalance in covariates and pre-membership outcomes between EU entrants and non-EU countries inasmuch as possible although without a specific target RMSE ratio. By cross-validating the obtained RMSE with the established metrics of Adhikari and Alm (2016) and Dube and Zipperer (2015), we are able to assess the relative performance of our specifications in removing the pre-membership covariate imbalance.

Finally, we also assume that the country-level EU entry is independent of the past outcomes, which implies that $\ln y_{i,t<T_0}^{without\ EU\ entry} \perp \left(X_{i,t}, \ln y_{i,t>T_0}^{with\ EU\ entry} \right)$ which allows us to fully examine the contribution of EU entry to long-run growth and development. If the assumption of EU entry independence conditional on past growth and development is violated, pre-/post-entry prediction error should be large and incapable of producing a plausible counterfactual scenario.

3. DATA AND SAMPLES

To capture long-term growth and development, our dependent variable is real per capita GDP adjusted for purchasing power parities (PPP) using Geary-Khamis conversion at 1990 constant prices. The data on per capita GDP is from Bolt and Van Zanden (2014) First Update of the Maddison (2010) database for the period 1850-2015. Wherever possible, discontinuous series is decomposed into a continuous per capita series using the aggregate region-level per capita GDP series to approximate the growth rates and per capita income levels in the between-benchmark years. Using the PPP conversion for the 1990 benchmark year, we compute real per capita GDP for the period 2012-2015 using the revised real per capita GDP growth rates from World Economic Outlook, April 2017 Edition. Per capita GDP estimates are thus comparable both across and within countries with the common benchmark year and the usual PPP adjustment for international comparison, and reflect the long-term development trends, tendencies, and trajectories in space and time.

3.1 AUXILLIARY COVARIATES

Using full outcome path in the pre-membership training and validation period, our goal is to match the growth and development trajectories of EU member states with the rest of the world by construct synthetic control groups that best reproduce and approximate the real growth and development paths of the affected countries by minimizing the predictive discrepancy between the real and counterfactual trajectories that could arise either from the lack of fit or from omitted variable bias. Our control sample consists of 36 non-EU countries,[1] for which a compact per capita GDP time series is availible for the period 1870-2015, which yields a strongly balanced panel with 5,976 country-year observation pairs. For the 2004 Central and Eastern European enlargement, given a relatively short post-EU admission time span, we consider the period 1950-2016 to estimate the treatment effect of joining the European Union.

The auxiliary covariates used to balance the growth trajectories of EU member states with the rest of world consists of (i) pre-EU GDP per capita dynamics, (ii) physical geography covariates, (iii) political institutions covariates, (iv) deep determinants covariates, (v) legal history covariates, and (vi) demographic covariates. First, pre-EU per capita GDP dynamics consists of the level of per capita GDP before EU membership in selected benchmark years such as 1850, 1900, 1950, 1970, 1980, 1990 and 2000. The choice of benchmark years depends on the round of EU enlargement considered in the empirical analysis whilst the greater number of past per capita GDP level covariates is prevalent in future rounds of enlargement. Second, the data on physical geography is from Nunn and Puga (2012),

[1] Algeria, Argentina, Australia, Brazil, Burma, Canada, Chile, China, Colombia, Egypt, Hong Kong, India, Indonesia, Iran, Iraq, Jamaica, Japan, Jordan, Lebanon, Malaysia, Mexico, Morocco, Nepal, New Zealand, Philippines, South Africa, South Korea, Sri Lanka, Syria, Thailand, Tunisia, Turkey, United States, Uruguay, Venezuela, Vietnam.

and comprises geography-related covariates such as binary variables indicating whether the country is an island, and whether or not the country is landlocked, and additional non-binary variables such as soil quality, fraction of the desert area, size of the area (in km2), fraction of the area in the tropical zone, the fraction of the area within 100km of ice-free coast, geo-centric terrain ruggedness proxy, size of land area, latitude and longitude coordinates. Given a relatively large number of physical geography covariates, we extract the principal component yielding single latent physical geography covariates with a maximum possible variation in the full set of components. Third, political institutions covariates comprises V-DEM high-level indicators of electoral and liberal democracy from Teorell et al. (2019) and the traditional Polity2 index (Marshall et al. 2016) to capture the effect of political institutions on long-run growth and development. In a similar vein, we extract the first principal component from the three indices yielding a more compact latent covariate capturing the contrasts in the political institutions across and within countries more fully compared to individual indicators. Fourth, and in the similar vein, the deep determinants covariates consist of the first principal component of the predicted genetic diversity and its squared term (Galor and Ashraf 2014), and the historical share of the population of European descend (Easterly and Levine 2015). This allows us to capture the independent effect of deep historical roots on long-term development. Fifth, the data on country-level legal history is from La Porta et al. (2008). We proxy the country-level legal history by distinguishing between different legal families broadly aligned between the civil law and common law tradition. More specifically, we construct a dummy variable if the national legal system belongs to common-law tradition, and a dummy variable if the legal systems belong to civil law tradition regardless of whether they fall into French, German or Scandinavian civil law tradition. And sixth, the The set of demographic consists of population size and population density from Maddison (2007). Population density is expressed as the number of inhabitants within a country-level territory per square km. The data on population density is from International Data Base of U.S. Census Bureau for the period 1950-2015. For the period 1820-1950, we calculate population density by dividing the number of inhabitants with the size of the country area (in km2) for each individual year using the data on historical boundaries from Klein Goldwijk et al. (2011).

Using twelve untransformed covariates and three latent covariates, our goal is to match the growth and development trajectories of EU member states with the rest of the world by construct synthetic control groups that best reproduce and approximate the real growth and development paths of the affected countries by minimizing the predictive discrepancy between the real and counterfactual trajectories that could arise either from the lack of fit or from omitted variable bias. Our control sample consists of 36 non-EU countries[23] for which a compact per capita GDP time series is availible for the period 1870-2015, which yields a strongly balanced panel with 5,976 country-year observation pairs. For the 2004 Central and Eastern European enlargement, given a relatively short post-EU admission time span, we consider the period 1950-2016 to estimate the treatment effect of joining the European Union.

3.2 BALANCING SAMPLES

Table 1 reports the pre-EU covariate balance between the affected countries and the non-EU control sample for the selected countries. The evidence indicates a high degree of covariate-level similarity of long-term growth trajectory between the actual EU member states and its synthetic counterparts. A reasonably strong similarity of growth trajectories of EU member states and their synthetic peers is particularly informative. It suggests that our control sample is able to reproduce the growth trajectories that would evolve in the hypothetical absence of the EU membership. Covariate-level similarity is prevalent not only in terms of pre-EU per capita GDP dynamics but also across binary, non-binary and latent covariates.

[2] Algeria, Argentina, Australia, Brazil, Burma, Canada, Chile, China, Colombia, Egypt, Hong Kong, India, Indonesia, Iran, Iraq, Jamaica, Japan, Jordan, Lebanon, Malaysia, Mexico, Morocco, Nepal, New Zealand, Philippines, South Africa, South Korea, Sri Lanka, Syria, Thailand, Tunisia, Turkey, United States, Uruguay, Venezuela, Vietnam.

[3] Since the common economic area might confound the treatment effect of EU membership, countries such as Switzerland and Norway that are formally not part of the EU are excluded from the control sample.

Table 1: Treatment vs. Control Covariate Balance Before EU Enlargement

	Germany (1952)		Italy (1952)		Ireland (1973)		Greece (1981)		Spain (1986)		Sweden (2004)	
	Actual	Synthetic	Actual	Synthetic	Actual	Synthetic	Actual	Synthetic	Actual	Synthetic	Actual	Synthetic
Panel A: Pre-EU GDP per capita dynamics												
Log GDP Per Capita in 1870	7.52	7.42	7.34	7.26	7.48	7.43	7.10	6.93	7.10	7.03	7.20	7.21
Log GDP per capita in 1900	8.00	7.96	7.53	7.54	7.80	7.81	7.12	7.22	7.49	7.49	7.64	7.64
Log GDP per capita in 1950	8.20	8.13	7.74	7.75	7.91	7.93	7.07	7.43	7.63	7.63	7.96	7.90
Log GDP per capita in 1970					8.02	8.07	7.88	7.88	7.56	7.85	8.57	8.51
Log GDP per capita in 1980							7.56	7.76	7.69	7.85	8.82	8.76
Log GDP per capita in 1990											9.45	9.37
Panel B: Physical geography covariates												
Latitude	51.11	43.30	42.79	17.46	53.18	-2.59	39.04	18.73	40.231	32.42	62.78	45.08
Longitude	10.39	21.34	12.08	25.42	-8.15	92.36	22.99	54.72	-3.644	49.26475	16.76	-19.10
Island	0	0.18	0	0.12	1	0.70	0	0.42	0.00	0.23	0.00	0.07
Landlocked	0	0.46	0.00	0.27	0	0.20	0	0	0.00	0.20	0.00	0.14
Terrain ruggedness	0.60	3.01	2.46	2.29	0.51	2.14	3.10	1.82	1.69	1.83	0.72	1.88
Soil quality	61.34	42.15	51.78	47.64	59.10	47.40	48.59	55.18	64.13	33.27	15.85	20.84
Distance to coast	19.74	24.76	80.92	27.54	95.86	70.05	96.21	62.39	42.91	35.85	21.24	46.03
Log land area	12.76	12.70	12.59	12.73	11.14	11.85	11.78	12.88	13.12	13.12	12.92	13.23
Panel C: Demographic covariates												
Population size	17.85	16.67	17.41	16.15	15.12	15.13	15.62	16.53	16.98	16.95	15.65	15.95
Population growth	0.01	0.01	0.01	0.01	-0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01

Population density	5.10	4.00	4.82	3.49	4.00	3.38	3.87	3.71	3.88	3.87	2.79	2.82
Panel D: Institutional quality and legal history covariates												
V-DEM Polyarchy	0.30	0.40	0.23	0.34	0.60	0.54	0.33	0.33	0.22	0.35	0.60	0.54
V-DEM Liberal democracy	0.25	0.36	0.19	0.29	0.52	0.47	0.24	0.29	0.19	0.32	0.58	0.49
British common law	0	0.17	0	0	1	0.81	0	0	0.00	0.20	0	0.20
Civil law	1	0.83	1	1	0	0.20	1	1.00	1.00	0.42	1	0.66

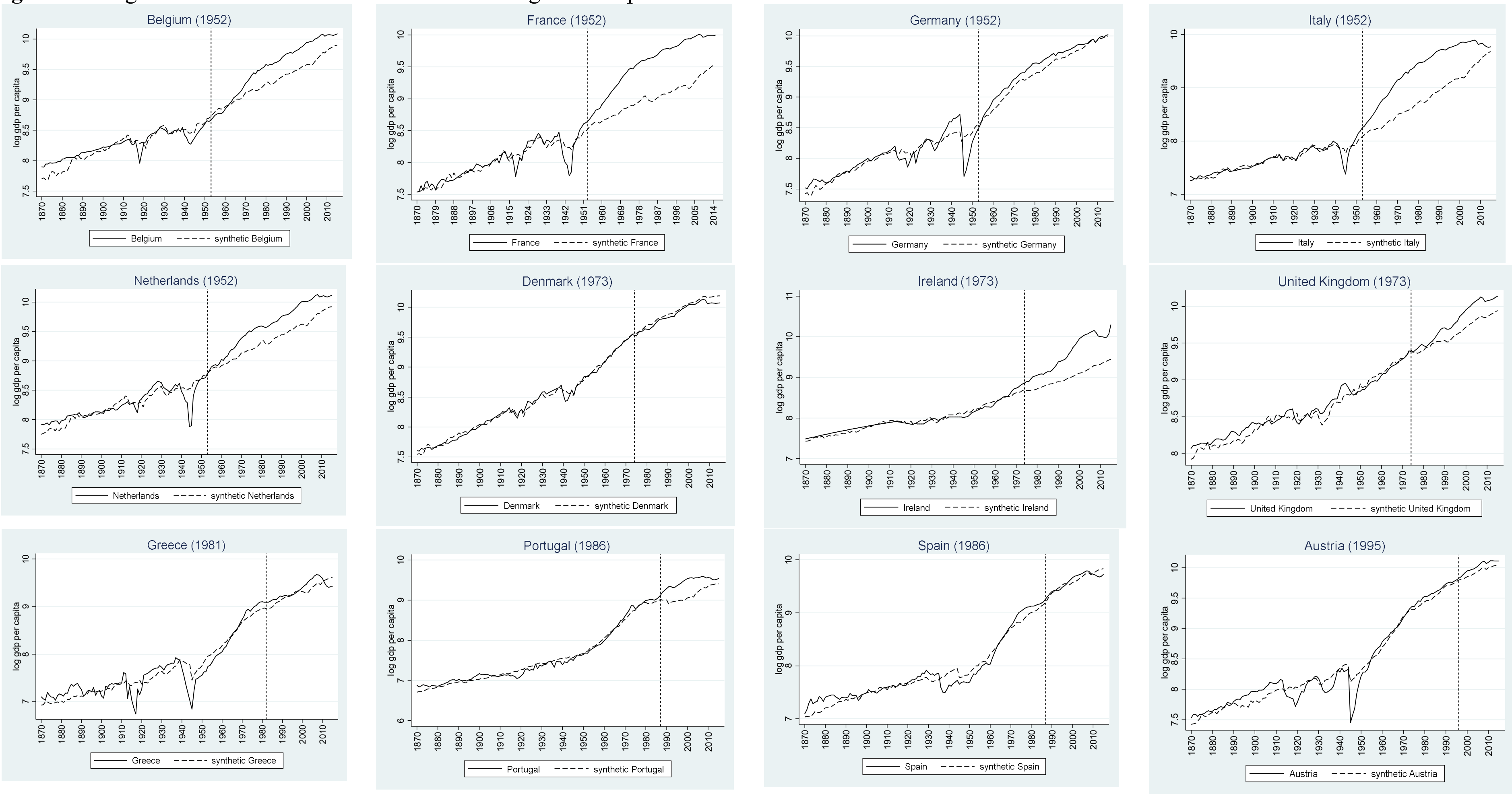
4. RESULTS

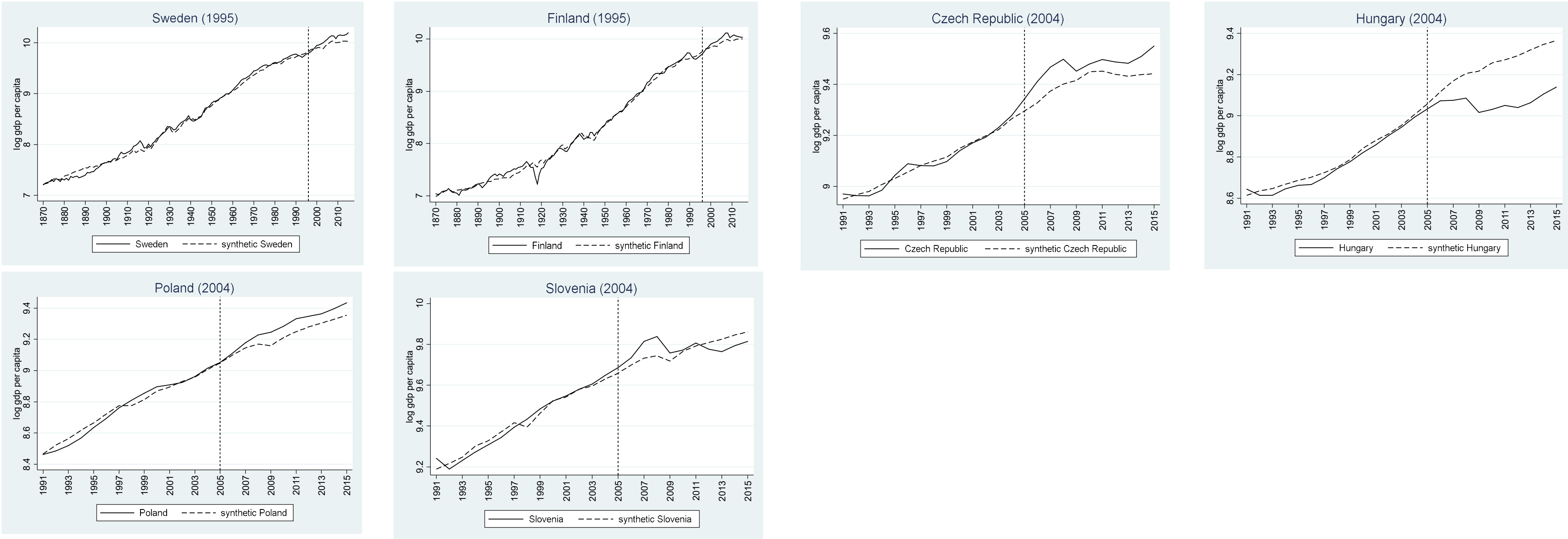
4.1 LONG-TERM GROWTH IMPACT OF FOUNDING MEMBER STATES

Figure 1 presents the estimated long-term growth effect of joining the EU for all founding and non-founding member states except Luxembourg, Baltic states, Malta, and Cyprus. Our baseline estimates suggest that EU membership is associated with about 12 percent improvement in per capita GDP, ceteris paribus, relative to the synthetic counterfactuals. The evidence unequivocally indicates the positive growth effects of being part of the EU with some notable heterogeneities among the founding member states. Our estimates put forward the notion that the actual growth trajectories implied by the hypothetical absence of the EU membership consistently outperform the counterfactuals with two contrasts. The estimated per capita GDP gap induced by the EU membership appears to be a positive structural breakup with long-lasting growth premium that does not disappear down to the present day. Permanent long-run growth impact of joining the EU among founding member states is found for Belgium, France and the Netherlands. The estimated end-of-sample per capita GDP gaps for each of these cases is 20 percent for Belgium and the Netherlands and 58 percent for France relative to the counterfactuals. By contrast, the estimated growth premium for Italy uncovers the EU membership as a long-lasting but temporary institutional shocks. In the initial years after joining the European Union, Italy's growth trajectory departs upward from the counterfactual scenario substantially. The actual growth trajectory appears to be solidly above the counterfactual until the early 1990s. Afterwards, the growth premium associated with the EU membership begins to narrow down whilst almost entirely disappearing down to the present day. This appears to be a stark contrast to the estimated gap for France where the long-run growth takeoff from the pre-EU equilibrium appears to be permanent instead of temporary. Similar evidence is found for Germany. Compared to Italy and France, Germany's growth trajectory in response to the EU membership exhibits a much smaller positive gap from the initial years of joining that gradually disappears. The disappearance of the premium tends to accelerate markedly after 1990s and coincides with the beginning of the German unification whose fiscal and growth cost has been discussed substantially in the literature (Abadie et. al. 2015). The end-of-sample difference between Germany's actual per capita GDP and its synthetic counterpart is +2 percent. On balance, our estimates uncover a reasonably stark contrast between Belgium, France and the Netherlands on one hand and Germany and Italy on the other hand in terms of the long-term evolution of the EU growth premium. The former tend to have gained disproportionately from EU membership in the long run whilst the latter are characterized by temporary gains that appear to be strong in the case of Italy and weak in the case of Germany.

A noticeable feature of our estimates is a relatively low pre-EU prediction error for all founding member states. In all respective cases, we find that the root mean square prediction error is less than 0.15 of the basis log point, which implies that the estimated counterfactual growth trajectories have an innate tendency to reflect the effect of joining the EU on economic growth rather than a lack of fit. On the general note, our results confirm sizeable economic growth benefits of joining the EU documented by Campos et. al. (2019) and several others among the founding member states.

Figure 1: Long-Term Economic Growth Effect of Joining the European Union




Sweden (1995)
Sweden
synthetic Sweden
Finland (1995)
Finland
synthetic Finland
Czech Republic (2004)
Czech Republic
synthetic Czech Republic
Hungary (2004)
Hungary
synthetic Hungary
Poland (2004)
Poland
synthetic Poland
Slovenia (2004)
Slovenia
synthetic Slovenia
log gdp per capita

4.2 LONG-TERM GROWTH IMPACT IN NON-FOUNDING MEMBER STATES

The evidence for non-founding member states uncovers substantial contrasts in both the magnitude and pattern of the growth effect. In general, long-term growth benefits of joining the EU appears to be markedly lower in comparison with the founding member states. The estimated per capita GDP gaps for the countries from the first northern enlargement round in 1973 contrasts marked and sizeable positive effects of joining the European Union for United Kingdom and Ireland opposed to almost zero effect in Denmark. The estimated long-term growth impact of the EU membership for the United Kingdom and Ireland features the characteristics of the permanent structural breakup given that both respective growth trajectories exhibit a strong upward departure from the synthetic counterfactuals. The end-of-sample difference between the actual per capita GDP and its synthetic peer is particularly large for Ireland and amounts to a factor of 1.1 whereas the respective end-of-sample gap for the United Kingdom is +11 percent which is comparable the gains found for Belgium and Netherlands. Given that the respective prediction error is low in both cases, it is unlikely that discernible pre-EU trends are the main drivers of the estimated counterfactuals. By contrast, the estimated impact of joining the EU in Denmark appears to be almost non-existing. Unlike in cases of Ireland and United Kingdom, the actual growth trajectory does not seem to break away from the pre-EU long-run growth equilibrium nor does it contains the characteristics of a temporary growth shock induced by the EU membership.

The southern enlargement round in the years 1981 and 1986 does not seem to be associated with significantly improved growth trajectories in response to the admission to the European Union. However, two contrasts emerge. First, the growth trajectories of Greece and Spain tend to be unaffected by the EU membership from the initial years of joining onwards given that their actual growth trajectories and their synthetic counterparts do not seem to diverge neither upward nor downward after integration into the EU. In both cases, the divergence between the actual and synthetic growth trajectories appears to be perceptible around the years of the democratic transition in 1975 and 1978, respectively instead of the admission to the European Union which implies that domestic institutional changes unrelated to the European Union membership seem to be somewhat more pivotal for long-term growth trajectories of Spain and Greece. By contrast, the estimated per capita GDP gaps for Portugal indicate a rather strong upward structural break which seem to widen considerably until the early 2000s. For instance, by the year 2000, Portugal's actual per capita GDP appears to be 52 percent higher than the implied synthetic counterfactual. However, the substantial growth premium of joining the EU tends to narrow substantially down to the present day and renders the structural breakup into a temporary institutional shock. For instance, Portugal's end-of-sample per capita GDP premium of joining the EU is about 7 percent which uncovers a rather rapid disappearance of EU-related growth premium.

The growth impact of joining the EU in the 1995 enlargement appears to be heterogeneous. Our evidence confronts the absence of discernible growth effect for Austria where the structural break in the per capita GDP gap is not perceivable around the years of EU membership, with Finland and Sweden where the positive growth impact of joining the EU is clearly perceivable. The impact difference between Finland and Sweden is substantial. For the former, the growth impact of being part of the EU is consistent with the notion of positive but temporary impact. In the early post-membership years, Finland's growth trajectory outperformed its synthetic counterpart but down to the present day both curves tend to converge, indicating a short-lived growth effect of joining the EU. By contrast, the counterfactual growth trajectory for Sweden in response to EU membership is consistently below the actual trajectory uninterruptedly in the post-membership period, indicating a permanent improvement of economic growth that emanates from being part of the EU. Pointwise, the per capita GDP gap for Sweden in response to EU membership is +23 percent which appears to be relatively large given a reasonably short post-treatment period. For Austria, the estimated end-of-sample per capita GDP gap is about +11 percent, respectively, which confirms the notion of modest but permanent economic growth gains of EU membership. By contrast, neither positive nor negative growth impact of joining the EU is found for Finland. Similar to the case of Denmark, the actual growth trajectory does not seem to react substantially to EU membership. In spite of the modest initial growth gains, the premium related to the EU membership gradually disappears over time render the EU a short-run temporary institutional shock with respect to its importance for the path of economic growth

Our evidence on the growth impact of 2004 Central and Eastern European enlargement confronts three different types of effects. Notice that the pre-EU training and validation period considers only the years after 1990. Unlike the other member states, Central and Eastern European countries had spent significant amount of time under the institutional regimes promulgating non-market economy which implies that considering pre-treatment span beyond 1990 would render the counterfactuals unreliable given that the effect of the transition to market economy and EU membership recovered from the synthetic counterfactuals would be mixed. Considering the post-1990 time span, firstly, Poland and Czech Republic tend to have modest growth premium of joining the European Union. The growth gain appears to be particularly large in the case of Czech Republic where the gap between the actual growth trajectory and its synthetic counterpart keeps increasing over time. The end-of-sample difference between the actual per capita GDP and its synthetic peer is about +11 percent which is comparable with the evidence. The estimated growth gain for Poland is about +8 percent and appears to be reasonably stable over time, and does not seem to widen substantially at the degree comparable with Czech Republic. The relative difference between Poland's actual GDP per capita and its synthetic counterpart arises immediately in the year of joining the EU and appears to be reasonably constant which implies that the EU posits a modest structural growth breakup considering the path of Poland's economic growth, and is consistent with prior findings by Campos et. al. (2019). Secondly, in stark contrast to the other states from the 2004 enlargement round, our estimates of EU growth impact on Hungary uncover the evidence of structural growth breakdown. The growth trajectory of Hungary after joining the European Union appears to be persistently worse than the estimated synthetic counterfactual. The departure of the growth trajectory from pre-EU equilibrium appears to be both immediate and considerable. The estimated end-of-sample per capita GDP difference is about -20 percent. One possible source of the breakdown might be related to the contested domestic political changes that promulgated weak socialist-led government coalition cabinets and eventually led to the rise of the right-wing parties in 2010. Relatively large difference between Hungary's actual per capita GDP and its synthetic counterpart in favour of the latter seems to indicate a permanent growth breakdown rather than a temporary institutional shock after joining the EU. And thirdly, the estimated growth impact of joining the EU for Slovenia is distinctive from Central and Eastern European enlargement round. In particular, the estimates indicate a positive and temporary impact of EU membership which seems to be very similar to Portugal. The initial years of EU membership emphasize some growth improvement with a widening of the gap that gradually disappears and thus indicates the EU as a short-run temporary institutional shock rather than a permanent structural growth breakup.

4.3 COMPOSITION OF SYNTHETIC CONTROL GROUPS

Table 2 summarizes the composition of synthetic control groups used to approximate the growth trajectory of EU member states in the hypothetical absence of joining the EU. Notice that the countries in the control group comprise non-EU countries both inside and outside Europe to isolate the treatment effect of EU membership more fully. For instance, growth trajectory of Italy without EU membership is best reproduced by a linear combination of growth and development characteristics of Uruguay (32 percent), Switzerland (27 percent), China (22 percent), Japan (12 percent), and Turkey (8 percent). A similar set of countries is prevalent in the synthetic control group for France, namely, Switzerland (44 percent), Uruguay (34 percent), Philippines (18 percent), Norway (2 percent), and India (2 percent), respectively, while the control group for Belgium and Netherlands is dominated by Switzerland and Uruguay since in both cases, they represent more than two thirds of the overall synthetic control group. By contrast, the long-run economic growth trajectory of Germany is best reproduced as a linear combination of the growth and development characteristics and dynamics of Switzerland (46 percent), Japan (18 percent), United States (17 percent), Turkey (12 percent), and China (8 percent). Given that the synthetic control groups comprise the non-EU countries reasonably unaffected by World War 2 such as Uruguay as well as those strongly affected by the war such as Japan, and those strongly indirectly affected by war such as Switzerland, it the estimated counterfactuals unlikely posit a source of implausibly large or small effects associated with the EU membership.

The synthetic control groups for the EU entrants from the 1973 enlargement round tend to be somewhat more diverse. For instance, the synthetic control group for Denmark comprises Norway (48 percent) and Switzerland (44 percent) as well as Venezuela (7 percent), Japan (5 percent), and New Zealand (3 percent). As the only country in our sample with a very large growth improvement in response to EU membership, the synthetic control group for Ireland is particularly informative. It consists of the weighted growth and development characteristics of New Zealand (41 percent), Sri Lanka (22 percent), Switzerland (20 percent), India (11 percent) and Jamaica (7 percent). Notice that the synthetic control group loads strongly on the common-law jurisdictions unaffected by EU membership or comparable forms of integration which implies. Such diverse synthetic control group also precludes individual countries from exhibiting a disproportionately large leverage in interpreting the growth effects associated with the EU membership. Similarly, the synthetic control group for the United Kingdom is dominated by New Zealand (69 percent) together with Switzerland (14 percent), United States (11 percent) and Sri Lanka (6 percent) which clearly reflects several institutional and historical commonalities that can be drawn between these donor countries and United Kingdom.

The synthetic control groups for the countries from the 1981 and 1986 southern enlargement round are reasonably diverse. Whereas the synthetic control group for Greece is dominated by Japan (47 percent), the respective synthetic control group for Portugal comprises Hong Kong and Brazil as the two dominant donors in the synthetic control group followed by several others with reasonably minor weight share such as Iran. By contrast, the synthetic control group for Spain is fairly uniformly distributed between four countries dominated by Thailand (38 percent) and followed by Japan (23 percent), Switzerland and United States with each of the two having 20 percent weight share. The main donors in the 1995 enlargement round are Australia, United States, Switzerland, Venezuela and Japan whereas several more contrasts can be found the composition of synthetic control groups for the 2004 enlargement round. For example, the synthetic control group for Czech Republic appears to be quite diverse featuring Switzerland as the major donor having 42 percent weight share followed by Lebanon and a few others. The growth trajectory of Poland prior to EU membership is best reproduced by a convex combination of growth and development characteristics of East Asian high-growth countries such as South Korea (32 percent) and Vietnam (24 percent) as well as a few Latin American countries such as Mexico (24 percent), and Chile (21 percent), respectively. By contrast, the growth trajectory of Slovenia prior to EU membership is best synthesized by a convex combination of growth and development features of South Korea (55 percent), Mexico (24 percent), and Canada (21 percent).

The general thrust of the synthetic control groups contrasts Switzerland and Uruguay as powerful donor countries for the old and wealthy EU states with South Korea as a dominant donor country for the emerging new EU states. United States appears to be an important donor for Germany, United Kingdom, Spain and Sweden, all of which share the characteristics of either rich countries or large domestic markets. By contrast, the influence of the Middle Eastern and Latin American countries in the pre-EU growth similarities is clearly perceptible, especially for peripheral countries like Portugal and Slovenia.

Table 2: Composition of Synthetic Control Groups

	Founding Member States (1952)					Northern enlargement (1973)			Southern enlargement (1981, 1986)			Austrian and Scandinavian enlargement (1995)			Central and Eastern European enlargement (2004)			
	Belgium	France	Germany	Italy	Netherlands	Denmark	Ireland	UK	Greece	Portugal	Spain	Austria	Finland	Sweden	Czechia	Hungary	Poland	Slovenia
End-of-sample delta	+20%	+59%	+2%	+9%	+21%	-9%	+112%	+11%	-25%	+7%	-10%	+11%	+3%	+23%	+11%	-20%	+8%	-3%
Pre-EU RMSE	0.112	0.109	0.151	0.081	0.137	0.048	0.065	0.088	0.201	0.078	0.134	0.143	0.071	0.059	0.021	0.021	0.028	0.024
Algeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australia	0	0	0	0	0.12	0	0	0	0	0	0	0.38	0	0	0	0	0	0
Brazil	0	0	0	0	0	0	0	0	0	0.20	0	0	0.03	0	0	0	0	0
Burma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0.35	0	0
Canada	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.03	0	0	0.21
Chile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.23	0
China	0.10	0	0.08	0.22	0.05	0	0	0	0	0.02	0	0	0	0	0	0	0	0
Colombia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hong Kong	0	0	0	0	0	0	0	0	0	0.35	0	0	0	0	0	0	0	0
India	0	0.02	0	0	0	0	0.11	0	0	0	0	0	0	0	0	0	0	0
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iran	0	0	0	0	0	0	0	0	0	0.15	0	0	0	0	0.13	0	0	0
Iraq	0	0	0	0	0	0	0	0	0.04	0.13	0	0	0.03	0	0	0	0	0
Jamaica	0	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0.10	0	0
Japan	0	0	0.18	0.12	0	0.05	0	0	0.42	0.04	0.23	0.33	0.13	0.06	0	0	0	0
Jordan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebanon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.22	0.01	0	0
Malaysia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0.24
Morocco	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nepal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	0	0	0	0	0	0.03	0.41	0.69	0	0	0	0	0	0	0	0	0	0
Norway	0	0.02	0	0	0.08	0.48	0	0	0	0	0	0	0.67	0.40	0.09	0	0	0
Philippines	0	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Korea	0	0	0	0	0	0	0	0	0	0	0	0	0.03	0	0.06	0	0.32	0.55
Sri Lanka	0.01	0	0	0	0	0	0.22	0.06	0	0	0	0	0	0	0	0	0	0
Switzerland	0.65	0.44	0.46	0.27	0.43	0.44	0.20	0.14	0	0.11	0.20	0.20	0	0.14	0.42	0.54	0	0
Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	0	0	0	0	0	0	0	0.38	0.09	0	0	0	0	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Turkey	0	0	0.12	0.08	0	0	0	0	0.27	0	0	0	0	0	0	0	0	0
United States	0.01	0	0.17	0	0.01	0	0	0.11	0	0	0.20	0	0	0.20	0	0	0	0
Uruguay	0.23	0.34	0	0.32	0.32	0	0	0	0.27	0	0	0	0	0	0	0	0	0
Venezuela	0	0	0	0	0	0.07	0	0	0	0	0	0	0.07	0.20	0	0	0	0
Vietnam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.24	0

4.4 SUSCEPTIBILITY TO PRE-MEMBERSHIP WINDOW LENGTH

One of the major caveats about the estimated economic growth impacts of EU membership concerns the length of the pre-EU time window. The validity of the counterfactuals may be questionable if the weights used to construct them are computed from country-level characteristics that extend far in the past and may contain different political and institutional regimes, technology, distribution of resources and human capital among several other long-run growth mechanisms. One possible, albeit imperfect, remedy is to determine whether the estimated counterfactuals are susceptible to the length of the training and validation period prior to the EU membership. Such approach may allow us to see whether the length of the pre-treatment period used to smooth transitory shocks shapes the counterfactual growth trajectories against our theoretical expectations. To this end, we shorten the training and validation period, and consider the post-1900 period to construct the weights from the country-level growth and development characteristics, and determine whether the estimated long-term growth impact of joining the European Union is susceptible to the choice of pre-membership window length.

Figure 2 exhibits the long-term growth impact of the EU membership using the shortened pre-membership time window. On average, joining the European Union is associated with 18 percent improvement in per capita GDP in the long run, which is very close to our baseline estimate. The estimated impacts appear to be consistent with our prior estimates. Among the founding member states, the estimated per capita GDP premium is particularly high for Belgium and the Netherlands where the end-of-sample per capita GDP gap in response to EU membership are +35 percent and +19 percent, respectively. The economic growth impact of joining the EU in France and Italy is consistent with the notion of the long-lasting but temporary positive institutional shock since, in both cases, the actual long-term growth trajectories gradually converge with the estimated counterfactuals. In subsequent rounds of enlargement, the re-estimated per capita GDP gaps are consistent with our prior estimates. For instance, the growth impacts of joining the EU in the 1973 enlargement round contrasts no discernible effect in Denmark against a very strong and positive effect in Ireland and a more moderate but positive impact in the United Kingdom. For Ireland, the end-of-sample per capita GDP gap is about +95 percent and indicates a very large and beneficial effect of the EU membership on its respective growth trajectory and clearly implies that joining the EU may have been a source of permanent upward structural break. The re-estimated long-term growth impact of the southern enlargement rounds in 1981 and 1986 shows that unlike in the case of Ireland, the growth impact of joining the EU resembles the characteristics of a temporary positive shock with strong short-run effect but reasonably weaker long-run effect given that down to the present day, the actual growth trajectories of these countries are gradually moving back to the implied counterfactual. Whilst Greece and Spain seem to have downgraded the economic growth impact of joining the EU almost entirely by the end of our sample, the temporary growth premium appears to be somewhat stronger for Portugal although the temporary growth impact can seldom be neglected given the gradual disappearance of the gap over time. By contrast, the re-estimated economic growth effect of joining the EU on the entrant countries in the 1995 enlargement round appears to be somewhat different. Compared to the southern enlargement round, strong and positive short-run effect of EU membership is not perceivable. Yet, the estimated growth premium of being part of the EU is somewhat more stable and does not seem to disappear down to the present day, especially in cases of Sweden and Austria, where the end-of-sample difference between the actual per capita GDP and its synthetic counterpart is +16 percent and +8 percent, respectively. Across the full set of synthetic control specifications, no major discrepancies are found in the size of the RMSE compared to the original specifications which confirms our theoretical expectations. Country-level synthetic control groups for the estimates based on post-1900 training and validation period are reported in Table 3.

Figure 2: Economic Growth Effect of Joining the European Union Using Post-1900 Time Span

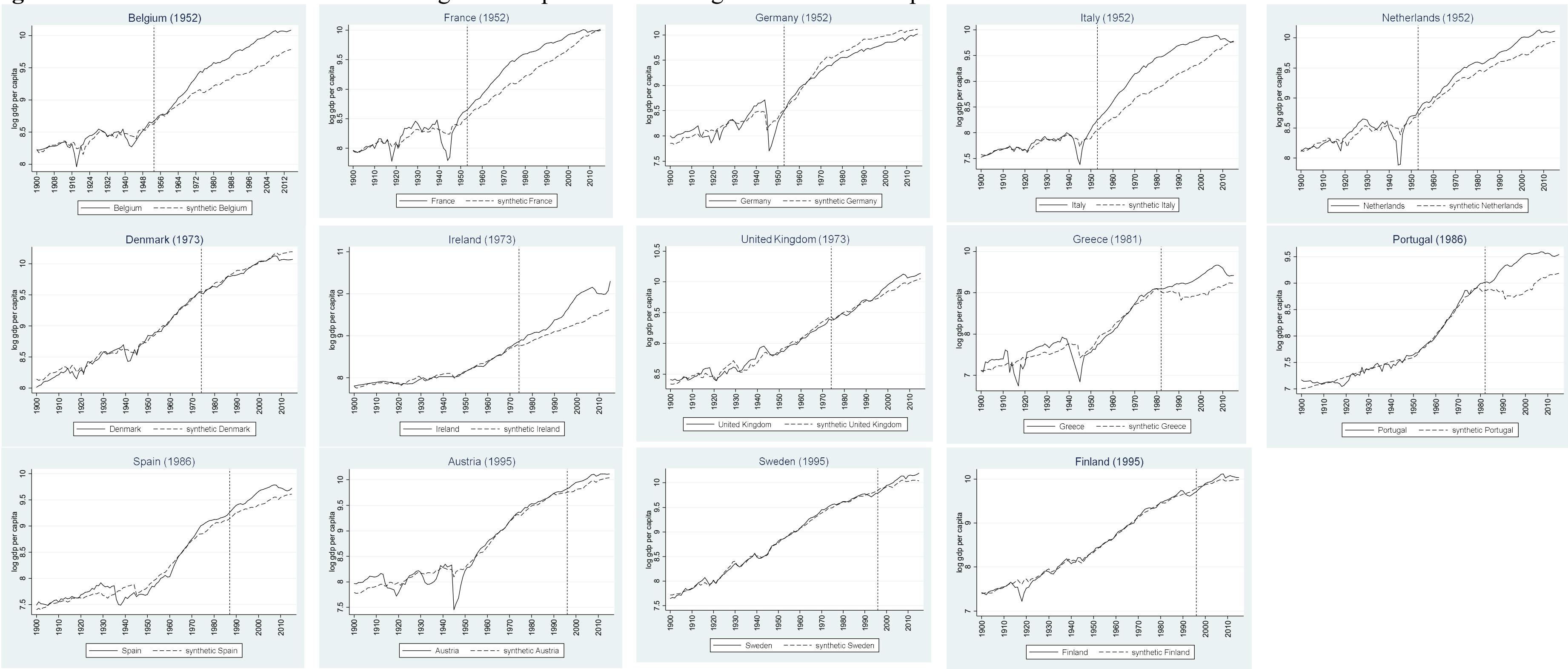


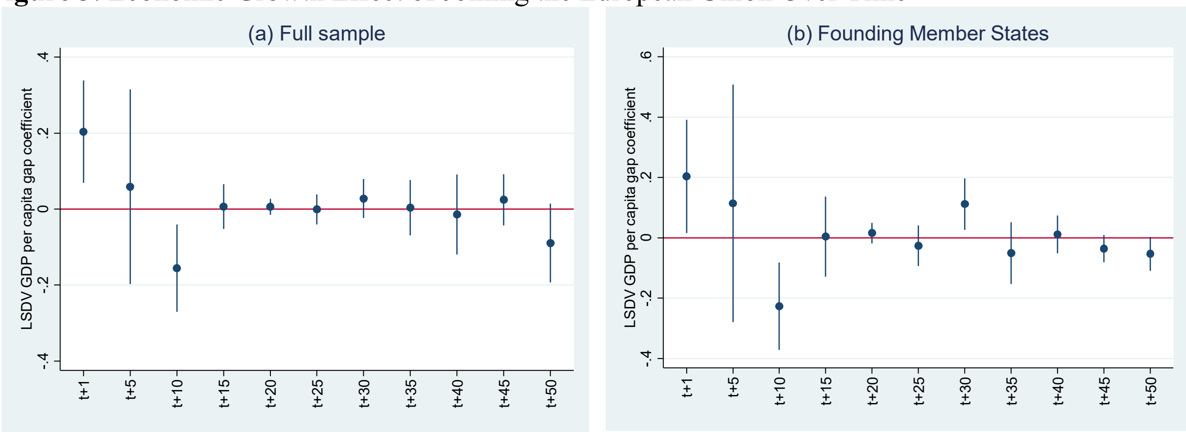
Table 3: Composition of Synthetic Control Groups Using Post-1900 Time Span

	Founding Member States (1952)					Northern enlargement (1973)			Southern enlargement (1981, 1986)			Austrian and Scandinavian enlargement (1995)		
	Belgium	France	Germany	Italy	Netherlands	Denmark	Ireland	UK	Greece	Portugal	Spain	Austria	Finland	Sweden
End-of-sample delta	+35%	-2%	-9%	-1%	+19%	-9%	+95%	+8%	+19%	+43%	+12%	+8%	+5%	+16%
Pre-EU RMSE	0.077	0.133	0.164	0.094	0.141	0.063	0.044	0.068	0.213	0.066	0.119	0.154	0.077	0.037
Algeria	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Argentina	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Burma	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada	0	0	0	0	0	0	0	0	0	0	0	0	0.09	0
Chile	0	0	0	0	0	0	0	0	0	0	0	0	0	0
China	0	0.20	0	0.24	0	0	0	0	0	0	0	0	0	0
Colombia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hong Kong	0.01	0	0	0	0	0.13	0.06	0	0.05	0.31	0	0.24	0	0
India	0.04	0	0	0.02	0	0	0	0	0	0	0	0	0	0
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iran	0	0	0	0	0	0	0	0	0	0.28	0	0	0	0
Iraq	0	0	0	0	0	0	0	0	0.24	0.20	0.02	0.04	0.01	0
Jamaica	0.02	0	0	0	0	0	0.04	0	0	0.05	0	0	0.10	0
Japan	0.01	0	0.49	0.18	0.14	0.02	0.10	0	0.47	0.08	0.27	0.20	0.14	0.05
Jordan	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lebanon	0	0	0	0	0	0	0	0	0.07	0	0	0	0	0
Malaysia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mexico	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0
Morocco	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nepal	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Zealand	0	0	0	0	0	0.01	0.19	0	0	0	0	0	0	0
Norway	0	0.22	0	0	0.05	0.24	0	0	0	0	0	0	0.66	0.44
Philippines	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0
South Korea	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sri Lanka	0.21	0	0	0	0.10	0	0.33	0.14	0	0	0	0	0	0
Switzerland	0.73	0.58	0.42	0.45	0.60	0.60	0.29	0.50	0	0.08	0.19	0.47	0	0.23
Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thailand	0	0	0	0	0	0	0	0	0	0	0.21	0.05	0	0
Tunisia	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turkey	0	0	0	0.10	0	0	0	0	0	0	0	0	0	0

United States	0	0	0.09	0	0	0	0	0.36	0	0	0.08	0	0	0.10
Uruguay	0	0	0	0	0.11	0	0	0	0.16	0	0	0	0	0
Venezuela	0	0	0	0.02	0	0	0	0	0	0	0	0	0	0.17
Vietnam	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Our empirical evidence so far uncovers 12 percent average impact of EU membership on long-run growth that appears to be heterogeneous both across member states and rounds of enlargement, and at the same time does not seem to be susceptible to the length of the pre-treatment period. The question that remains somewhat unclear concerns the evolution of the growth impact of EU over time. Figure 3 reports the economic growth effect of joining the EU over time decimated across five-year intervals. Notice that the vertical axis exhibits the average change in the per capita GDP at each interval after the EU membership that is delineated on the horizontal axis. The evidence suggests that the growth impact appears to be particularly strong in the initial five years. Afterwards, the impact tends to moderate substantially. Our estimates imply that after the tenth year of the EU membership, the effect tends to accelerate substantially, reaching its peak in the thirtieth year after the membership. After the thirtieth year, the magnitude of the impact does not seem to be either strong or statistically significant at conventional levels. Our evidence thus puts forward the notion that the positive growth impact of EU membership is perceivable for about thirty years after the admission to the EU which appears to be reasonably long period in which the growth benefits of the institutional integration materialize.

Figure 3: Economic Growth Effect of Joining the European Union Over Time



One notable feature of our estimates is a marked heterogeneity in the long-term growth impact of joining the EU across the member states that can be detected across the synthetic control specifications. For instance, some countries such as Ireland, appear to have a large estimated growth premium of joining the EU whereas others such as Denmark tend to be unaffected by EU membership. On the contrary, some countries such as Italy are characterized by a strong but temporary deviation of the growth trajectory from its long-run equilibrium in response to joining the EU. The heterogeneity of the impact seems to be indicative of the new member states where some of them such as Czech Republic and Poland tend to enjoy modest growth benefits of joining the EU whilst others like Hungary appear to have incurred a structural growth breakdown relative to the synthetic counterfactuals.

A traditional approach to assess the statistical significance of the EU membership relies on the calculation of probabilities that the underlying impact happened at random (Cavallo et. al. 2013) by calculating the set of placebo effects from the permutation of the EU membership to the unaffected countries to determine whether unit-specific post-treatment effects can be detected relative to the donor pool (Abadie et. al. 2010, Barone and Mocetti 2014, Campos et. al. 2018). Given the length of the training and validation period in our setup, the notion of whether it is correct to assess such probabilities upon very long post-treatment period is questionable. When the post-treatment period spans thirty years or more, it becomes both clear that the countries in the donor pool experience a series of idiosyncratic shocks which can be even larger than the institutional shock of joining the EU. Acknowledging these limitations, our approach to assess the statistical significance of the growth impact of joining the EU is based on comparing the distribution of t-statistics associated with the growth effect from synthetic control specifications. The general thrust of such comparison is that it may allow us to see whether positive, negative or zero effect prevails instead of imposing arbitrary thresholds on certain probabilities to gauge the significance of the impact. Since any generalization of the effect from country-specific evidence is seldom plausible, we build the distribution of t-statistics for each entrant country, each post-treatment year, and each round of enlargement and founding member states. We compare the distribution of t-statistics against a threshold which indicates the conventional significance at 10% and a zero threshold to determine whether any substantive claims can be made with respect to the long-term impact of EU membership.

Figure 6: Distribution of t-statistics on the growth effect of EU membership across enlargement rounds

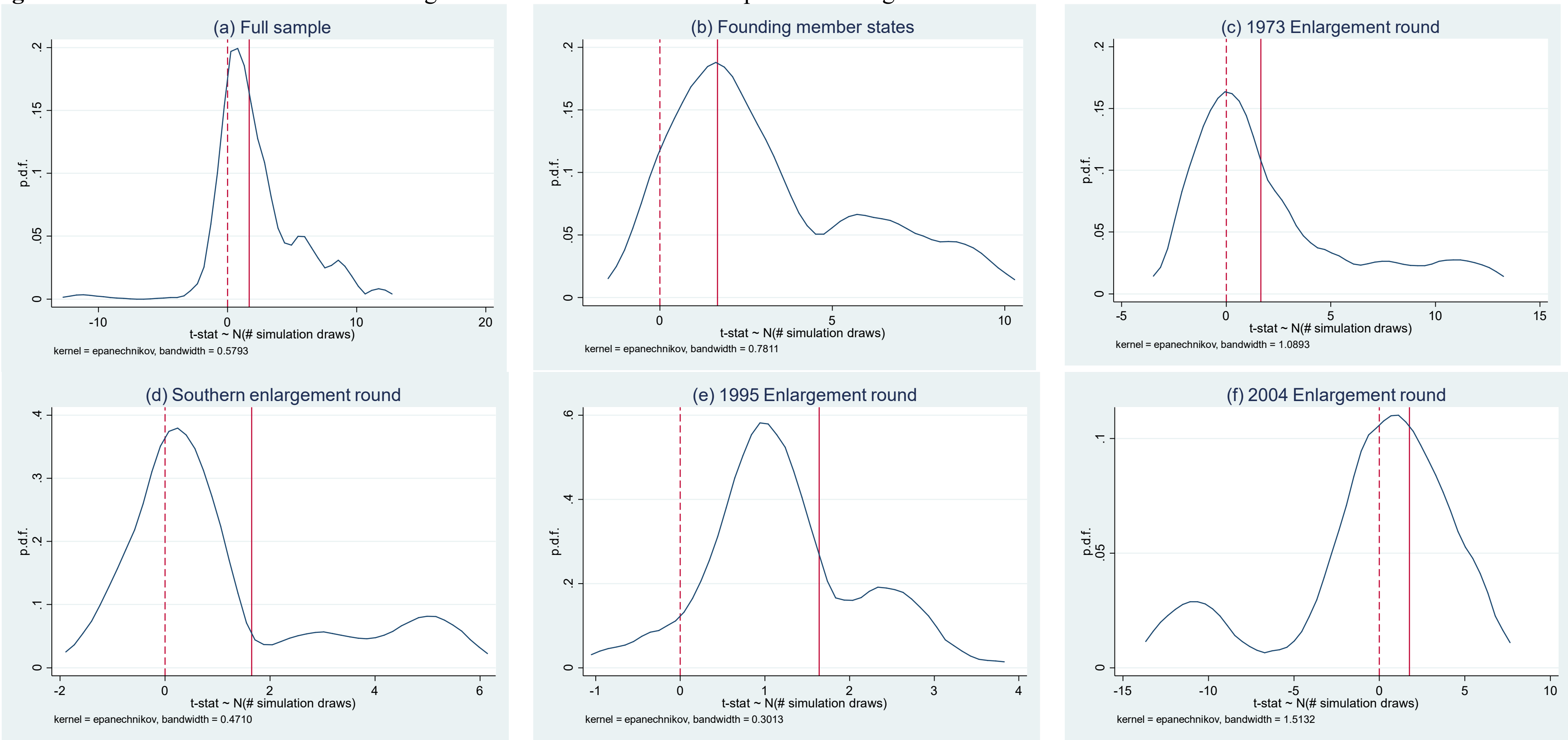
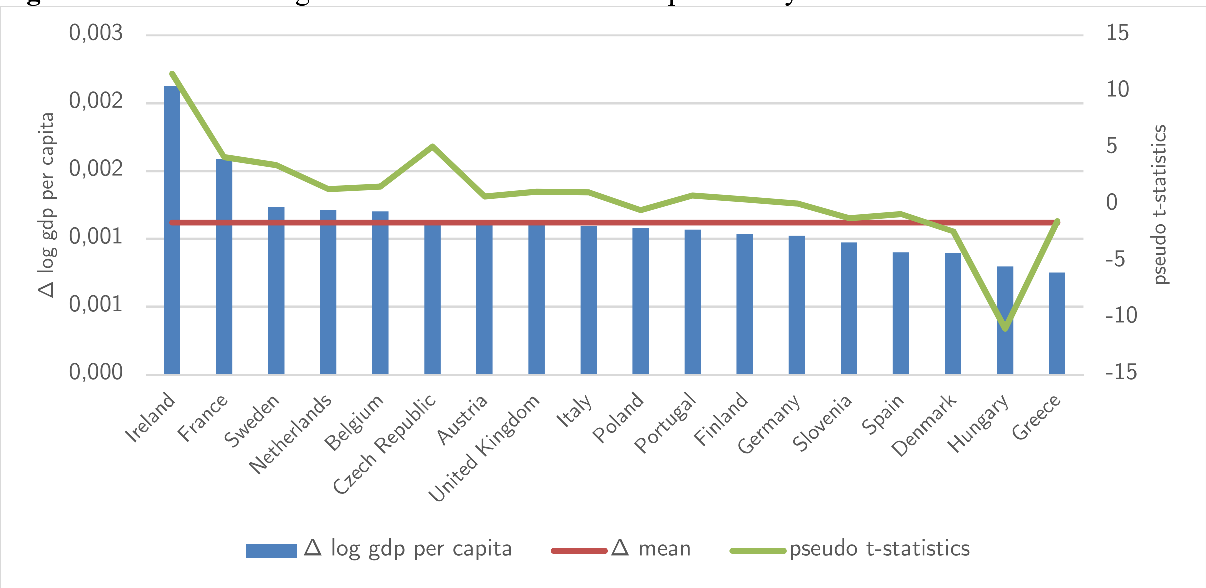


Figure 4 reports the distribution of t-statistics on the post-treatment growth effect of joining the EU for each enlargement round as well as for founding member states using the baseline 1870-2015 time period. Notice that negative values of the t-statistics are indicative of the negative effect of EU membership whilst the positive values indicate the positive effect of EU membership. Several insights can be drawn from these comparisons. It should be noted that the dashed line represents the zero threshold whereas the solid line captures the 10% significance threshold First, long-term growth improvements in the full sample of countries appear to be quite broadly distributed given the distribution of t-statistics is both narrow and a large density of the effect is concentrate on the positive interval without any a large negative tail. This implies that the 12 percent average increase in per capita GDP that can possibly be attributed to the EU membership is quite broadly distributed and does not seem to indicate disproportionate concentration of growth gains among the few countries. Second, the growth impact among the founding member states is somewhat larger than the impact in subsequent enlargement rounds given that the distribution of t-statistics is substantially right-skewed whilst the density of the negative effect is low. At the same time, the distribution of t-statistics in the 1973 enlargement round is comparable with the corresponding distribution for the founding member states. Third, the growth impact of joining the European Union in the southern enlargement round is considerably different. In particular, the negative t-statistics is perceptible and occupies about one third of the overall distribution which provides some evidence on the uneven growth impact of EU membership between the founding member states and the countries from the southern enlargement round. Fourth, the growth impact of joining the EU in the 1995 enlargement round is generally positive but somewhat more modest than perceived for the founding member states and countries from 1973 enlargement round. And fifth, the growth impact of the EU membership in the 2004 enlargement round is mixed without any uniform pattern and can be explained by the joint presence of the negative effect in Hungary and either positive or zero effect elsewhere. Given that the baseline estimates provide evidence in support of the notion that joining the EU is associated with about 12 percent increase in per capita GDP, marked heterogeneity should not be neglected in interpreting the estimates of the long-term effect of EU membership. Figure 5 compares the distribution of growth impact of joining the EU against the average 12 percent increase together with the pseudo t-statistics on the growth effect.

Figure 5: The economic growth effect of EU membership summary



5. CONCLUSION

In this article, an application of the synthetic control method to study the growth impact of the EU membership, over the very long term, is considered. Compared to earlier studies, we estimate the growth effect of joining the European Union for the founding member states and compare them against the EU growth effects of countries in the subsequent rounds of enlargement. Our estimates imply that joining the EU is associated with an average increase in per capita GDP by about 12 percent with notable heterogeneity. For instance, our estimates indicate that the founding EU member states' per capita GDP improved by 22 percent, respectively. By contrast, the estimates for subsequent rounds of enlargement do not indicate pervasive growth gains for all involved countries except Ireland where a substantial EU growth premium is perceivable. At best, subsequent rounds of enlargement are associated either with no effect of entering the EU on growth, or with positive but temporary effect that disappeared after the lapse of the initial post-enlargement years. By contrast, the 1995 enlargement round and especially the 2004 Central and Eastern European enlargement appears to have been an episode of markedly accelerated growth in response to EU membership, particularly in cases of Poland and Czech Republic where our estimates indicate per capita GDP increases of 8 percent and 11 percent in 11 years after the membership. By contrast, peripheral countries in southern Europe such as Slovenia, Portugal and Spain appear to have gained the least from joining the EU as our estimates suggest that the growth gains for these countries are statistically indistinguishable from zero. Our estimates imply that Greece appears to be the only country that lost significantly from EU membership. At the general level, our evidence suggests that the EU institutional design seems to have benefitted disproportionately the founding membership states and a handful of other countries such as Ireland, Poland and Czech Republic which might have benefitted from the economic advantages the geographic conditions that seemed friendly to the expansion of the EU and the associated market access.

The exploratory nature of our methodology implies that we do not take our results as the last word on the matter. We do not fully resolve the identification issues even if we adjusted the estimations to address the overall concerns in the literature. Still, we argue that our methodology is promising, and the results add important insights. Putting in context of current scholarly debates, our exercise looks like a step forward in assessing the long-term economic benefits from the most important institutional changes in Europe since WWII.

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