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Benefits of EU Membership for The Transition Countries: The Case of Latvia

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Content

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I INTRODUCTION

In 2013 the European Union completed the fifth wave of enlargement. Croatia, the newest member, joined the European family in 2013. In 2007 Bulgaria and Romania joined the union. Eight former communist countries, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, joined in 2004. The wave of enlargement brought together countries of different economic and cultural backgrounds, “making the EU the largest integrated economy of the world with more than 30% of the world’s GDP" (Efstathiou, 2004; European Commission, 2009, p. 2).

At first, the new member states (NMS) grew and performed remarkably. However, due to the recent Great Recession and the Euro Crisis there has been a lot of discussion about the actual economic benefits from EU membership. The economies of Greece, Italy, Spain and Ireland epitomize the increasing concerns. This paper estimates the benefits of EU membership for Latvia, a former communist country and a member of the former USSR. It is widely believed that the EU membership significantly contributes to raising living standards and growth of the economies of new members. In this paper I use counterfactual analysis to answer ***if EU membership improves economic performance and, if so, by how much***.

This paper contributes to the literature of quantitative analysis of benefits from the EU enlargement and integrations, which is relatively limited (Campos et al., 2014). In the most recent paper in literature on the analysis of benefits from EU integration the authors argue that there is disappointingly little literature that tackles the question such as “what would be the level of per capita income in a given country had it not joined the EU?” (Campos et al., 2014, p. 2) The paper also updates the paper by Campos et al. (2014). Whilst Campos et al. use data for Latvia between 1993 and 2008, I expand my analysis to the period 1992 – 2010. The update is important because when the recession in 2008 – 2010 is accounted for the conclusions by Campos et al. (2014) about the *size of benefits* from EU membership in fact become questionable.

The paper is organized as follows. Section II specifies a theoretical framework of economic integration. Section III summarizes the literature on EU integrations. Section IV describes the Counterfactual Model that I use for the analysis. Section V gives description and source of the data used. Section VI offers discussion on analysis and the results thereof. This section consists of five subsections. The reason for such dissection is that Counterfactual Model has an unorthodox method of addressing statistical significance, and hence I offer a special subsection to thoroughly cover deriving p-values. Finally, in the Conclusion section I summarize my results.

The main findings of the paper are as follows. If I treat 2003 as the treatment year Latvia demonstrates stronger economic growth from the EU membership, but only in the early years. Latvia's economic growth is severally compromised as a consequence of financial crisis and the results show that Latvia would have performed better in the financial crisis had it not joined the EU. These results are significant at a 10% significance level. However, bearing in mind the continuum of economic integration, it is quite expected that benefits from EU membership do not start on the official accession date but earlier. When 1999 is treated as the treatment year, the year when Latvia officially opened negotiations with the EU, the results show a much stronger support of EU membership having a strong effect on economic growth. Under this scenario Latvia benefited by about $3218 per citizen per year from EU membership in the period 1999 – 2010.

II THEORY OF ECONOMIC INTEGRATION

In this section I introduce the theoretical framework behind the welfare effects from economic integration, first proposed by Baldwin and Vanables (1995, p. 1600) and updated for EU integration by

Breuss (2008, p. 10). Suppose that welfare of a representative consumer in the new EU member state at a moment in time can be represented by a utility function:

(1) $V(p+t, n, E)$,

where vector p stands for border prices, vector t stands for trade costs, the non-tariff barriers to trade such as border controls for example, vector n is the number of product varieties available in each industry, and the scalar E is total spending on consumption (Breuss, 2008).

According to Baldwin (1995) and Breuss (2008) expenditure of an NMS is defined to be equal to the sum of factor income, profits, rent from trade barriers captured by the domestic agents (including the government), minus investment, and income from EU structural funds transfers, that is:

(2) $E = wL + rK + X[(p+t) - a(w,r,x)] + \alpha tm - I + SF$

Total factor income is $wL + rK$, where L and K are the country's supply of labor and capital and w and r are factor prices. Breuss (2008) identifies total profit through the third term on the right hand side. It represents the product of the economy's production vector X and the difference between domestic prices, $(p+t)$, and average costs, $a(w,r,x)$, where average cost in each sector depends on factor prices (w, r) and production per firm in that sector, x. Trade rents captured domestically amount to αtm, where m is the net import vector (positive elements indicate imports) and α is a diagonal matrix that measures the proportion of the wedge t that creates income for domestic agents; $\alpha = 1$ for a tariff or other barrier with domestically captured rent (DCR) and $\alpha = 0$ for a barrier where no trade rent is captured domestically (nonDCR). Finally, I denotes investment.

Totally differentiating $V(p+t, n, E)$, and dividing through by the marginal utility of expenditure it is true that:

(3) $dV/V_E = \alpha tm - md[t - \alpha t] - mdp$

$$+[p+t-a]dX - xa_x dx + \left(\frac{V_n}{V_E}\right)dn$$

$$+(\tilde{r}/\rho - 1)dI$$

$$+dSF$$

According to Breuss (2008), the identity derived above explains three major effects of regional integration. I here explain them individually:

i) *Trade effects:* The first row of the equation represents the static welfare effects of models with perfect competition. *1)* The first term is the **trade volume** effect. As trade barriers αt fall the trade volume increases. *2)* The second term is the **trade cost** effect. It represents the change in trade costs generated by changes in the non DCR elements of trade barriers, such as border controls, transport infrastructure investment, law enforcement and related property-rights institutions, informational institutions, regulation, language[1]. *3)* The third term is the **terms of trade** effect. This effect we observe only if the acceding country is a large country having the possibility to influence world trade prices. However, since neither of the NMS, the former transition countries, is large enough to influence world trade prices, the last term is equal to zero.[2]

ii) *Scale effects:* The three terms in the second row of the equation above identify theoretical predictions of models with increasing returns to scale and imperfect competition. *1)* The first term shows the **output** effect. Industries that face average costs higher than the price will be forced to abandon the market, and vice versa. In industries where price equals average cost there will be no output effect. *2)* The second term is the **scale** effect. Creation of a common union increases the size of the market. Increasing

[1] See Anderson (2004) for more details on non DCR elements of trade barriers.

[2] The experience with the existing Euro area so far (Breuss, 2008, p. 12) has showed that the introduction of the Euro additionally reduces transaction costs and hence stimulates euro-area trade in the range between 5% and 15%. Therefore, we should also expect that joining a Euro area will help reduce transaction costs and increase intra-euro-area trade in the new EU member states.

the scale of a firm will result in change in average costs. *3)* The third term gives **variety** effects. This effect represents an increase number of differentiated consumer products in the market.

iii) *Accumulation effects:* The term in the third row of the equation identifies what is also called the **growth** effect of regional integration. It implies that a change in investment augments the capital stock with a social rate of return $\tilde{r}$. The accumulation of capital from an increase in investment, in theory, leads to an increase in economic growth.

iv) *"Net EU budget receiver effects":* The term of the fourth row of the equation (3) indicates "the welfare improvement of being a net receiver vis-a-vis the EU budget" (Breuss, 2008, p. 13). As Breuss (2008) points out, former communist countries that joined the EU were initially poor compared to the rest of the EU. They therefore received aid from the EU budget to restructure their economies according to the EU standards.

III LITERATURE REVIEW

Most of the papers that focus on quantitative analysis of EU integration use panel data methods. Henreckson et al. (1997) focus on the EC and EFTA membership. They use panel data on 22 OECD countries between 1976 and 1985 and compare the growth of countries that were members of EC/EFTA to growth of other developed countries that were not. They report that a dummy on EC/EFTA membership was significant and positive and that EC/EFTA membership helped increase growth by 0.6% to 0.8%. Interestingly, the authors report that they find no significant difference between EC and EFTA membership.

Crespo-Cuaresma et al. (2006) also use panel data to study the effect of EU membership on growth, but they also study convergence effects. They claim that poorer countries will grow faster than incumbent countries by entering the EU. Following Romer's endogenous growth model they analyze 15 member states between 1960 and 1998 and they pose a question: "Have per capita income levels in European countries converged towards each other since the 1960s?" (p. 9). Focusing on the β-convergence, a term that "refers to the negative correlation between initial levels of real GDP per capita and its average yearly growth rate" (p. 10), they identify β-convergence impact of the EU membership on long-term growth between 4% and 6%. Bower and Turrini (2009) similarly find that "countries with lower initial income levels, weaker institutional quality and less advanced financial development" benefit more from the EU accession in terms of economic growth. (p. 14)

Breuss (2009) offers a quantitative evaluation of the EU' Fifth Enlargement with special focus on Bulgaria and Romania. Using a Computable General Equilibrium (CGE) Model he analyzes the economy of Bulgaria and Romania in the period 2000-2007 (year of official accession) and 2007-2020 (forecasting). He estimates a 9.2% and 8.9% increase in real GDP for Bulgaria and Romania, respectively, from the accession to the EU for the period 2007-2020. For the same period Breuss finds direct positive effects from integration on other components of the two countries' economies, namely a 0.6 – 0.7 % increase in investments (as a share of GDP), 0.1-0.3 % increase in employment, 0.4-0.5 % increase in labor productivity. Speaking of short- and long-run, however, according to Breuss the EU integration provides a significant but temporary shock to the level of GDP, therefore not leading to a permanent steady-state increase of growth. The results of his CGE model forecast a convergence of the NMS' economies to the EU's average growth rates ones the initial effects of the "shock" have leveled out.

According to the paper by European Commission (2009), the EU accession has also brought challenges to the NMS. The authors analyze 27 EU member states, 11 OECD countries, and 24 additional middle-income countries, for the period 1960-2008. According to the report, through the accession in the EU the foreign investment in NMS increased rapidly, boosting economic restructuring, growth and employment, but this rapid credit growth and foreign borrowing "overheated the economy and led to large external imbalances, sharp increases in labor costs outstripping increases in productivity, and hikes in real estate prices". (p. 3) The paper suggests that "the consequence of the rapid and uncontrolled investment is that the foreign capital could have sometimes been directed to nonproductive use", therefore creating inefficient markets in the NMS' economies. (p. 3) Now that the time of the EU accession optimism has faded away, certain inefficient markets in the economies of the NMS will need to go through the process of adjustment and movement towards the true market equilibrium. This finding is similar to the argument by Breuss (2009) described earlier, that once the initial effects of the " EU shock" have leveled out the economies will converge towards the moderate average growth rates of their steady state equilibria.

Finally, Campos et al. (2014) present new estimates of the economic benefits from economic and political integration by using the synthetic counterfactuals model. The counterfactual method focuses on creating a "synthetic control group" by searching for a weighted combination of other control countries. (p. 9) The weights are assigned to match as close as possible the country affected by the intervention before the intervention occurs. (p. 9) The outcome of the synthetic group is therefore the predicted outcome of the counterfactual. (p. 9) This way the authors predict the GDP per capita of an EU member state under the scenario the country had not joined the EU. Analyzing 27 member states for the period 1956 – 2008 the authors find large positive effects of the EU membership that varies across countries and time. They conclude that without the integration in the EU the countries' incomes would be on average 12% lower.

Author	Year	Method	Time period	Countries analyzed	Results
Henreckson et al.	1997	Panel data	1976-1985	22 OECD countries	**Find** significant and positive effects from EC/EFTA membership. No difference between EC and EFTA in terms of effect on growth.
Crespo-Cuaresma et al.	2006	Panel data	1960-1998	15 member states	**Identify** β-convergence impact of the EU membership on long-term growth between 4% and 6%.
Breuss	2008	CGE	2000-2020	Bulgaria, Romania	**Estimates** a 9.2 % and 8.9 % increase in real GDP for Bulgaria and Romania, respectively, from the accession to the EU for the period 2007-2020. However, EU integration provides a significant shock to the level of GDP but only in the short-run.
European Commission	2009	Panel Data	1960-2008	27 EU member states, 11 OECD countries, and 24 additional middle-income countries	**Suggest** EU optimism could have created inefficient markets in the economies of the new member states.
Campos et al.	2014	Counterfactual	1970-2010	27 EU member states	**Report** that current member states would have been worse off without EU membership. Identify Greece as the only exception.

Table 1: Summary of relevant literature on benefits from EU integration. Most papers find significant positive effects from EU integration, even though there is doubt that EU rapid investment from EU optimism can result in creation of inefficient markets.

IV CONCEPTUAL MODEL AND "IDEAL DATA"

In this paper I use counterfactual analysis to investigate what would have been the level of real per capita GDP in Latvia had Latvia not become a member of the European Union. To perform this analysis I use synthetic counterfactual model, developed by Abadie and Gardeazabal (2003) and Abadie et al. (2010)[3]. Following Imbens and Wooldbridge (2009), the idea behind the model is straightforward: we want to estimate an average effect of the treatment. Imbens and Wooldbridge give a traditional example in economics: "labor market program where some individuals receive training and others do not, and interest is in some measure of the effectiveness of the training". (pg. 1)

[3] I follow Campos et al. (2014) and Abadie (2010) to succinctly describe the model. For more thorough algebraic description of the model and its optimization mechanism please see Abadie et al. (2010, 2014).

Following Abadie et al. (2010), let Y_{it}^{N} be the outcome that would be observed for region i at time t in the absence of the intervention, for units $i = 1, \ldots, J + 1$, and time periods $t = 1, \ldots, T$. Let T_0 be the number of pre-intervention periods, where $1 \leq T_0 < T$. Let Y_{it}^{I} be the outcome that would be observed for unit i at time t if unit i is exposed to the intervention in periods $T_0 + 1$ to T. The assumption is that the intervention has no effect on the outcome before the implementation period (official accession to the EU), so for $t \in \{1, \ldots, T_0\}$ and all $i \in \{1, \ldots, N\}$, we have that $Y_{it}^{N} = Y_{it}^{I}$. In other words, real per capita GDP is expected to be the same before the intervention for both groups. Abadie et al. (2010), nevertheless, point out that interventions may have an impact prior to their implementation.[4] I will address this problem in the section on actual model and results.

Let $\alpha_{it} = Y_{it}^{I} - Y_{it}^{N}$ be defined as the effect of the intervention for unit i at time t, and let D_{it} be a dummy variable that takes value of one if unit i is exposed to the intervention at time t and zero otherwise. Hence, the outcome for unit i at time t will be defined as:

$$Y_{it} = Y_{it}^{N} + \alpha_{it} D_{it}$$

Now imagine that only the first region (region "one") is exposed to the intervention and only after period T_0 (where $1 \leq T_0 < T$). In that case:

$$D_{it} = \begin{cases} 1 \;\; if\ i = 1\ and\ t > T_0 \\ 0 \;\; otherwise \end{cases}$$

and

$$\alpha_{it} = Y_{1t} - Y_{1t}^{N}$$

[4] The benefits from EU membership, for example, are quite likely to manifest themselves before the official date of accession.

We know what the outcome of the treated country Y_{1t}^{I} is as it is observable. It is per capita GDP of Latvia after Latvia joined the EU in 2004. However, in order to estimate the effect of the intervention, α_{it}, we must find Y_{1t}^{N}, which we cannot observe.

Now suppose that we observe the outcome $\boldsymbol{Y_{it}}$ and a set of determinants $\boldsymbol{Z_{it}}$ of the outcome for $N+1$ countries, where $i=1$ is the treated country and $i=2,3,\ldots,N+1$ are the untreated (control) countries, for each period in the interval $t\in[1,T]$, where the treatment period for country $i=1$ begins at time $T_0\in(1,T)$. To construct a counterfactual the model estimates a weighted average of Y_{it}, with $i=2,3,\ldots,N+1$ and $t<T_0$, to approximate Y_{1t} for $t<T_0$, taking into consideration the covariates of the outcome, Z_i. The set of weights is therefore defined as $W=(w_2,w_3,\ldots,w_{N+1})$, where $w_i\geq 0$ for $i=2,3,\ldots,N+1$ and $\sum_{i=2}^{N+1} w_i=1$. The counterfactual is therefore defined through the following identities:

$$\sum_{i=2}^{N+1} \boldsymbol{w_i Y_{it}} = \boldsymbol{Y_{1t}}$$

and

$$\sum_{i=2}^{N+1} \boldsymbol{w_i Z_i} = \boldsymbol{Z_1}$$

The model assigns weights in order to optimize for the two identities given above. In other words, the model selects W^* so that W^* "minimizes the pretreatment distance between the vector of the treated country characteristics and the synthetic control country characteristics" (Campos et al., 2014, p.10). Therefore, using $\sum_{i=2}^{N+1} \mathrm{w}_{\mathrm{i}}^{*} Y_{it}$ the model tries to approximate Y_{1t}^{C}, which is the per capita GDP of synthetic counterfactual Latvia.

The ideal data consist of a measure for human capital and total factor productivity across countries and time, since these are the two main determinants of growth that the counterfactual model contains in its **Z** (determinant) matrix. Ideal data also consist of a measure for innate characteristics of population, for example, some measure of how the two countries are similar in mentality, culture, social norms. If I want to create a synthetic counterfactual, the unit should ideally differ **only** in the fact that the actual received treatment and the synthetic did not. Furthermore, the ideal data contain information on population growth, as well as the strength of different sectors of the economy, i.e. agricultural and industrial sectors.

V ACTUAL DATA

My data include eighteen countries and span the period between 1992 and 2010 resulting in 342 observations. The data consist of one EU member state, Latvia, nine European countries that are non-EU members (Albania, Belarus, Iceland, Macedonia, Moldova, Norway, Russia, Switzerland, Ukraine) and eight non-EU members that are former states of the Soviet Union (Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan). My data come from World Bank Indicators and World Penn Table (7.1). The data contain the following variables for the period between 1992 and 2010: GDP per capita, investment (% of GDP), agriculture, value added (% of GDP), industry, value added (% of GDP), secondary school enrollment rate (% of the population of official secondary education age), tertiary school enrollment rate (% of the population of official tertiary education age), and population growth.

VI ACTUAL MODEL TO BE ESTIMATED AND RESULTS

I ANALYSIS

In this section I give information on the analysis performed in the paper. For my quantitative analysis I use *STATA* and *R*, both of which contain a “synth” package necessary for the counterfactual optimization problems. Using *synth* I can answer the question: “What would have been Latvia’s GDP per capita had the country not joined the EU?” The intervention of interest in this case is the country’s accession into the EU. Therefore, I will estimate the effect of an intervention by comparing the evolution of the real per capita GDP for the actual country to the evolution of the real per capita GDP for a synthetic control group (weighted average of countries that are not in the EU). The *synth* package works so that the evolution of the outcome for the synthetic control group presents an estimate of the counterfactual of what would have been observed for the affected unit in the absence of the intervention.

I construct a synthetic Latvia based on the following variables: investment (% of GDP), agriculture, value added (% of GDP), industry, value added (% of GDP), secondary school enrollment rate (% of the population of official secondary education age), population density, tertiary school enrollment (% of the population of official secondary education age) and per capita GDP. The predictors are averaged over the period 1992 – 2003, the year when Latvia became independent and the year when Latvia held a national referendum on joining the EU. Therefore, 2003 will be used as the treatment year, since signing the official EU member state statute in 2004 could then just be a formality.

I here present the results of the model. Firstly, I obtain weights that as closely as possible replicate Latvia that **had not** joined the EU. As noted earlier, the weights are assigned to match as close as possible the country affected by the intervention before the intervention occurs. From Table 2 below, Latvia can be described through a weighted average of Albania, Belarus and Norway, countries that have not joined the EU in 2004. Hence, the results of this analysis are that synthetic Latvia can be represented as 2.5% Albania, 92.6% Belarus, and 4.9% Norway, controlling for the variables identified earlier.

Control Country	Weight
Albania	0.025
Belarus	0.926
Iceland	0
Macedonia	0
Moldova	0
Norway	0.049
Russia	0
Switzerland	0
Ukraine	0
Kazahstan	0
Kyrgistan	0
Tajikistan	0
Turkmenistan	0
Uzbekistan	0
Armenia	0
Azerbaijan	0
Georgia	0
Weight sum	1.000

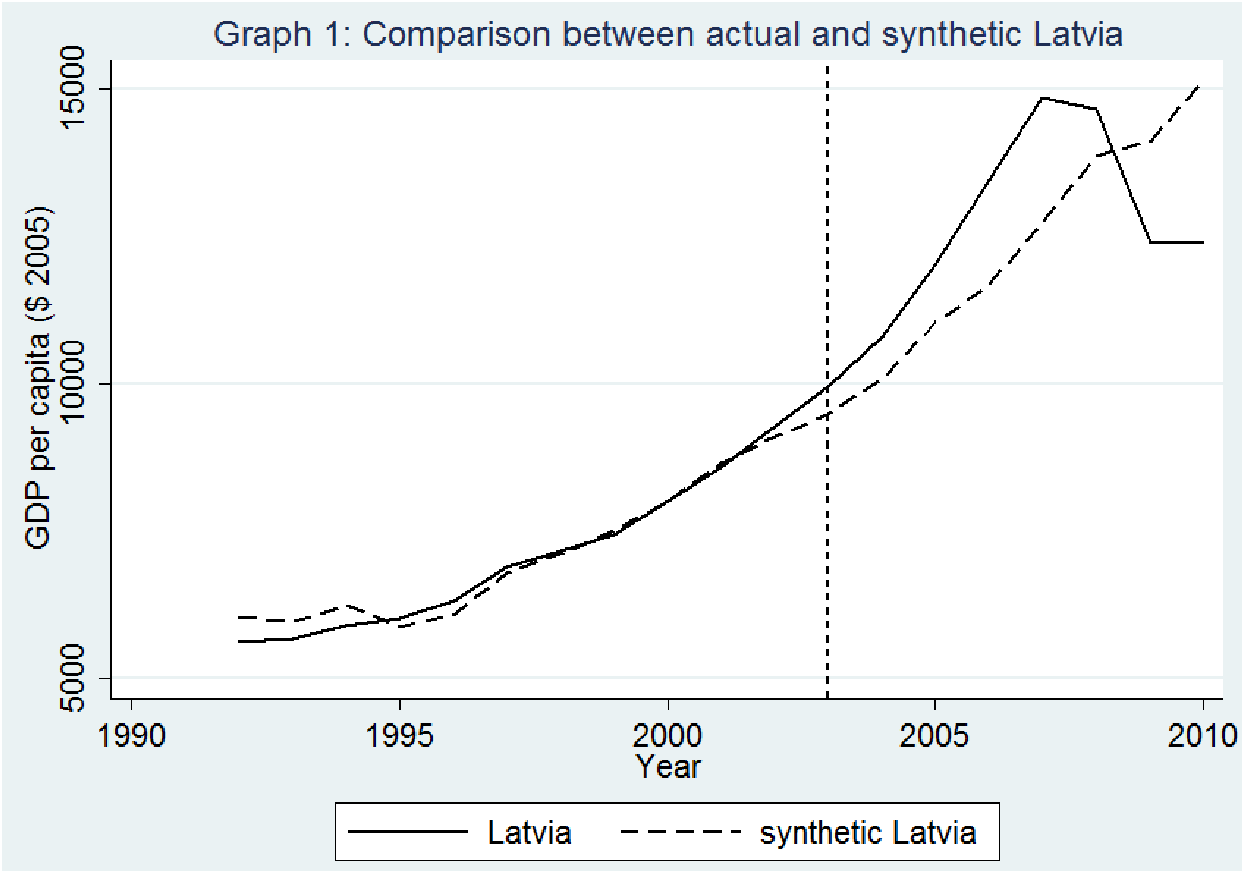
Table 2: Weights are assigned to control countries so that they match as close as possible the country affected by the intervention before the intervention occurs. Latvia is therefore represented as 2.5% Albania, 92.6% Belarus, and 4.9% Norway.

Referring to Table 3 below, I here present the comparison between **actual** Latvia (treated) that joined the EU in 2004 and **synthetic** Latvia, a weighted average of countries that have not become members of the EU. We notice that the two countries compare well in several control variables, such as investment (% of GDP), secondary school enrollment rate (% of the population of official secondary education age), tertiary school enrollment rate (% of the population of official tertiary education age). Population growth, however, differs significantly, and so do the agriculture and industry value added (% of GDP). GDP per capita of both the actual and synthetic unit fairs rather well, as we might observe for per capita GDP levels presented in the table.

Variables	Comparison between actual and synthetic unit	
	Latvia (EU membership treatment)	synthetic Latvia (no EU membership)
Investment (% of GDP)	16.543	15.742
Secondary School Enrollment Rate (%)	90.381	92.92
Tertiary School Enrollment Rate (%)	42.550	47.621
Population growth (%)	-1.226	-0.294
Industry, value added (% of GDP)	27.802	38.567
Agriculture, value added (% of GDP)	7.187	15.200
GDP per capita (1992)	5612.1	6051.0
GDP per capita (1996)	6310.7	6073.6
GDP per capita (2000)	7996.2	8003.3
GDP per capita (2002)	9281.7	9095.6
Root Mean Squared Prediction Error		**246.84**

Table 3: Comparison between actual Latvia (treated) that joined the EU in 2004 and synthetic Latvia in terms of selected componenets of growth. The fit is good for some, but it is not ideal for all the segments analyzed. Difference in real per capita GDP between the synthetic and actual unit is approximately $246.84 per year.

The synthetic Latvia describes the economy of Latvia under the scenario that Latvia had not chosen the EU route. I expect to see that the EU membership brought significant benefits to Latvia and that synthetic Latvia would have been poorer than the Latvia in the EU. The following Graph 1 shows the trajectories of per capita GDP for the actual Latvia and the synthetic Latvia.



We notice that in the pretreatment period synthetic Latvia mimics the per capita GDP of actual Latvia. However, we notice that in 2003 these trajectories diverge. Actual Latvia performs better and demonstrates stronger economic growth. The idea of the counterfactual model is that if the synthetic unit explains well the actual unit in the pretreatment period and there is a sudden divergence around the pretreatment period, whereas the only difference is that the actual unit received the treatment and the synthetic unit did not receive any, then the divergence can be attributed to the treatment. The counterfactual model would therefore suggest that the divergence in real per capita GDP trajectories is the consequence of the EU membership. We can also observe that there are some discrepancies in the fit between the actual and synthetic Latvia in the pretreatment period. The RMSPE, root mean squared prediction error, equals **246.84**. The RMSPE tells us that the difference between the real per capita GDP of Latvia and its synthetic counterpart is roughly $247 (3.5%) per year. To put this number into context, the average *monthly income* of a citizen in an actual unit differs from its counterfactual by about $17 a month, suggesting a rather satisfactory fit.

It is still hard to state whether Latvia benefited from the EU membership overall. We can notice a significant drop in economic output between 2007 and 2010. Latvia was strongly affected by the recent financial crisis and it had to implement harsh austerity measures to receive aid from other EU countries. In fact, we can notice that synthetic Latvia absorbs the crisis better and outperforms actual Latvia after 2008. According to the counterfactual model, Latvia would have had higher real GDP per capita after 2008 had it not joined the EU. Running the *ttest* for the difference between real per capita GDP of actual and synthetic unit, I find that I cannot reject the null hypothesis that *Mean GDP (treated) – Mean GDP (synthetic) = 0* (p-value=0.32, at two significant figures).

II STATISTICAL SIGNIFICANCE

The main drawback of the counterfactual model is that it does not address the problem of statistical significance. The model does not offer traditional confidence intervals or p-values. In order to address this problem, I follow a method first described by Fremeth et al. (2013). The authors propose finding pseudo p-values: p-values that measure the probability of observing a result as extreme as, or more extreme than, the one estimated for the "focal unit", if treatment was "randomly assigned to any observation unit in the population". (p. 23) Therefore, in this paper I want to randomly assign treatment to the control units – countries that I use to create synthetic Latvia that did not receive treatment (EU membership). If the hypothesis is that EU membership has significantly positive effects on the real per capita GDP of the accessing country, then randomly assigning treatment to control units should create no significant impact on their real per capita GDP.

The authors propose first calculating "a scale-independent measure reflecting treatment extremity" so observation units could directly be compared with each other. (p.23) Following this idea I use a ratio of Root Mean Squared Prediction Error (RMSPE) of the treatment period to RMPSE of the pre-treatment period. RMSPE simply presents a difference between real per capita GDP of the actual unit and the real per capita GDP of the synthetic unit. Since the treatment is randomly assigned across control units I should expect to observe the values of the ratio close to ±1.[5] If the ratio of RMSPE of the treatment period to the RMSPE of the pre-treatment period is close to 1 or -1, then it can be deducted that treatment had no major effect on the country's real GDP per capita. It is important here to note that, though variations are naturally distributed chi-squared, I simply transform my results into normal distribution (following Fremeth et. al., 2013). The way this is conducted is, given that the synthetic unit actually performed better than the actual in the treatment period then I multiply the ratio by -1.

I calculate ratio of $RMSPE_{treatment}/RMSPE_{pre\text{-}treatment}$ ("RMSPE ratio") for all 17 control units in the sample. This means that each of the control units is assigned treatment randomly. For example, Russia is randomly assigned a status of a treated unit, and synthetic Russia is created from the rest of the control units. The $RMSPE_{pre\text{-}treatment}$ for Russia equals \$292.82, $RMSPE_{treatment}$ equals \$346.32, and therefore $RMSPE_{treatment}/RMSPE_{pre\text{-}treatment} \approx 1.18$. In the case of Latvia, $RMSPE_{pre\text{-}treatment}$ equals \$246.84 while $RMSPE_{treatment}$ equals \$1695.47, resulting in $RMSPE_{treatment}/RMSPE_{pre\text{-}treatment}$ of approximately 6.87. Hence, difference in real per capita GDP between actual and synthetic Latvia is approximately 6.87 times higher in the post-treatment than in pre-treatment period.

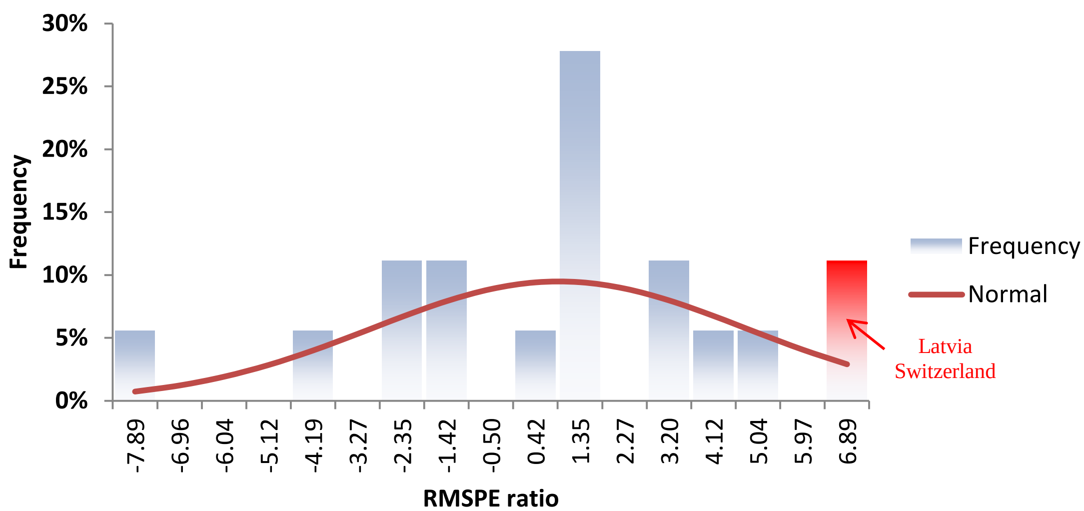
The example of Russia, therefore, demonstrates what I expect to observe most of the time: country that has not received treatment will not have abnormal difference in real per capita GDP between pre- and post-treatment period. Nevertheless, some control countries (which did not receive treatment) still show ratios larger than |1|. This is also not completely unexpected. Countries are affected by political,

[5] If the synthetic unit actually performed better than the actual in the treatment period then I multiply the ratio by -1. This is how I differentiate between positive and negative extremes, and it is crucial for finding the desired p-value, as I explain below.

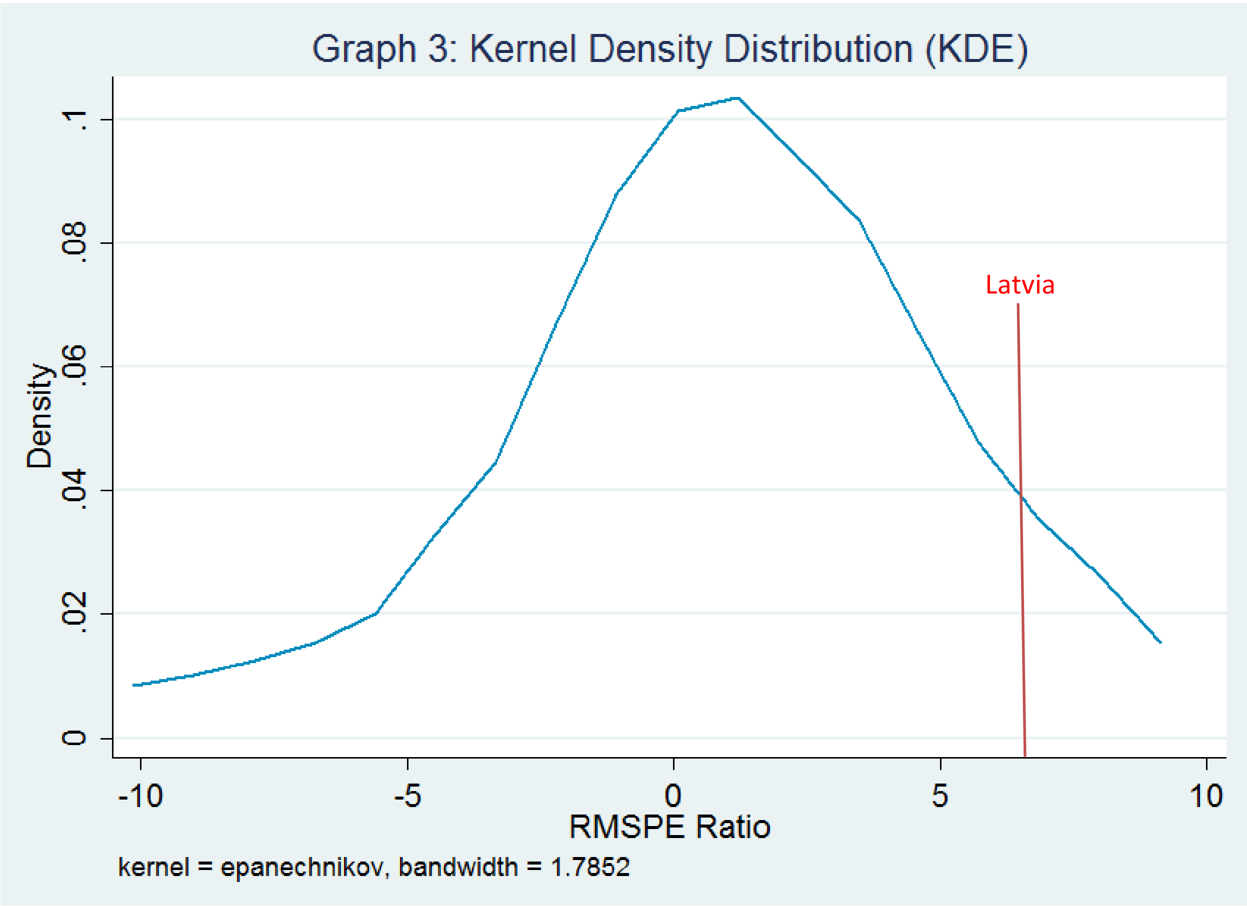
economic, and cultural macro- and microeconomic shocks of their own. It should be expected that some countries grew faster on average in the period between 2003 and 2010 then they did between 1992 and 2003.

The final step to obtaining the p-values is to ask: How often do we expect to see values of the "RMSPE ratio" as extreme as the one we observe for Latvia? The null hypothesis is that *EU membership had no effect on Latvia's economic growth*. Therefore, plotting the distribution of the calculated ratios will provide the answer to our question. If Latvia's ratio is close to the middle of the distribution then it is a strong indicative of null hypothesis being true. However, if Latvia's ratio is on the tale of the distribution then it represents a stronger support of rejecting the null hypothesis. Fremeth et al. (2013) suggest using a histogram and therefore the distribution of "RMSPE ratios" is given in the histogram plot below.

Graph 2: **Distribution of RMSPE Ratio**

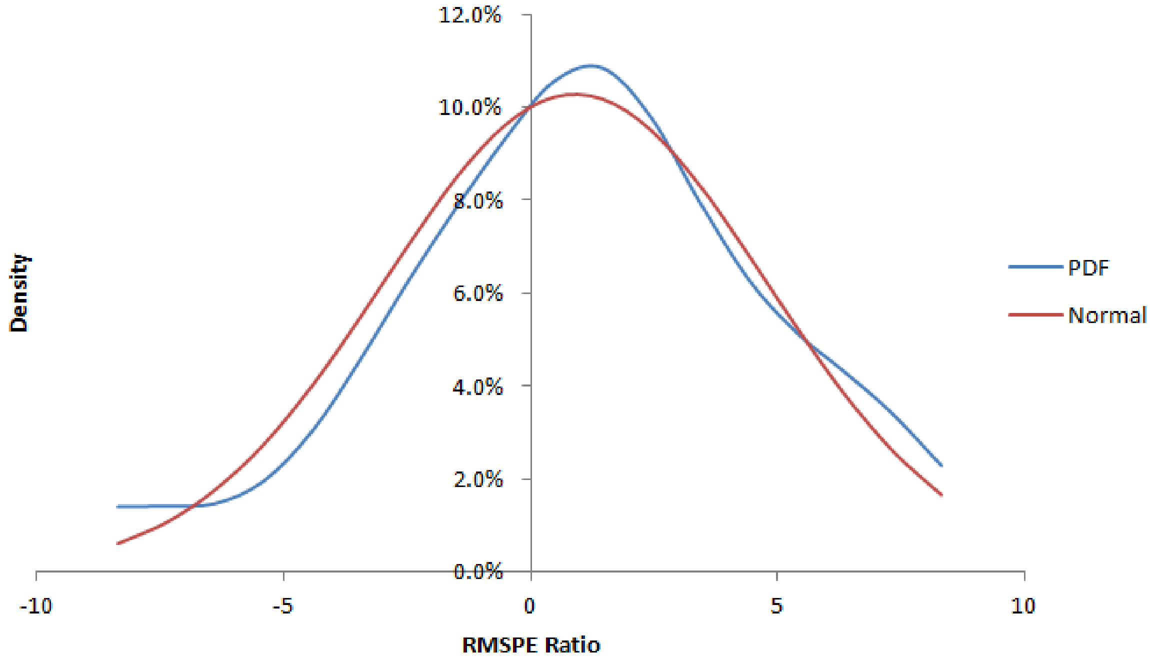


The plot above presents a simple distribution of finite sample. On top of the histogram I also include a fit for normal distribution and we can notice that the value of "RMSPE ratio" for Latvia of 6.87 is quite to the right of the normal distribution. Since there are 18 units in the sample distribution and only Latvia and Switzerland demonstrate "RMSPE ratio" as extreme as 6.87 and higher, according to Fremeth et al. the p-value should be: 2/18 ≈ 0.11. However, even though Fremeth et al. (2013) use a histogram to derive their p-values I decide that Kernel Density Estimation (KDE) could in fact improve my estimation. Even though histogram is useful it does not allow estimate the true density of the observed data with an unknown distribution, as is the case in this paper. Hence, KDE allows estimate probability density function (PDF) of a random variable without making any assumptions about the distribution of the data observed. (Mathematica) Therefore, the PDF for the sample of “RMSPE ratios” is given in the graph below. I use Stata, the method is *epanechnikov* and assigned bandwidth is 1.785.



As I expected, the distribution is centered around 1, because the control units are randomly assigned treatment and hence should not experience any abnormal growth in the post-2004 period. To show how well KDE follows the normal distribution I add another graph below.

Graph 4: **Kernel Density Estimation (KDE): Distribution of RMSPE Ratio for all sample countries**



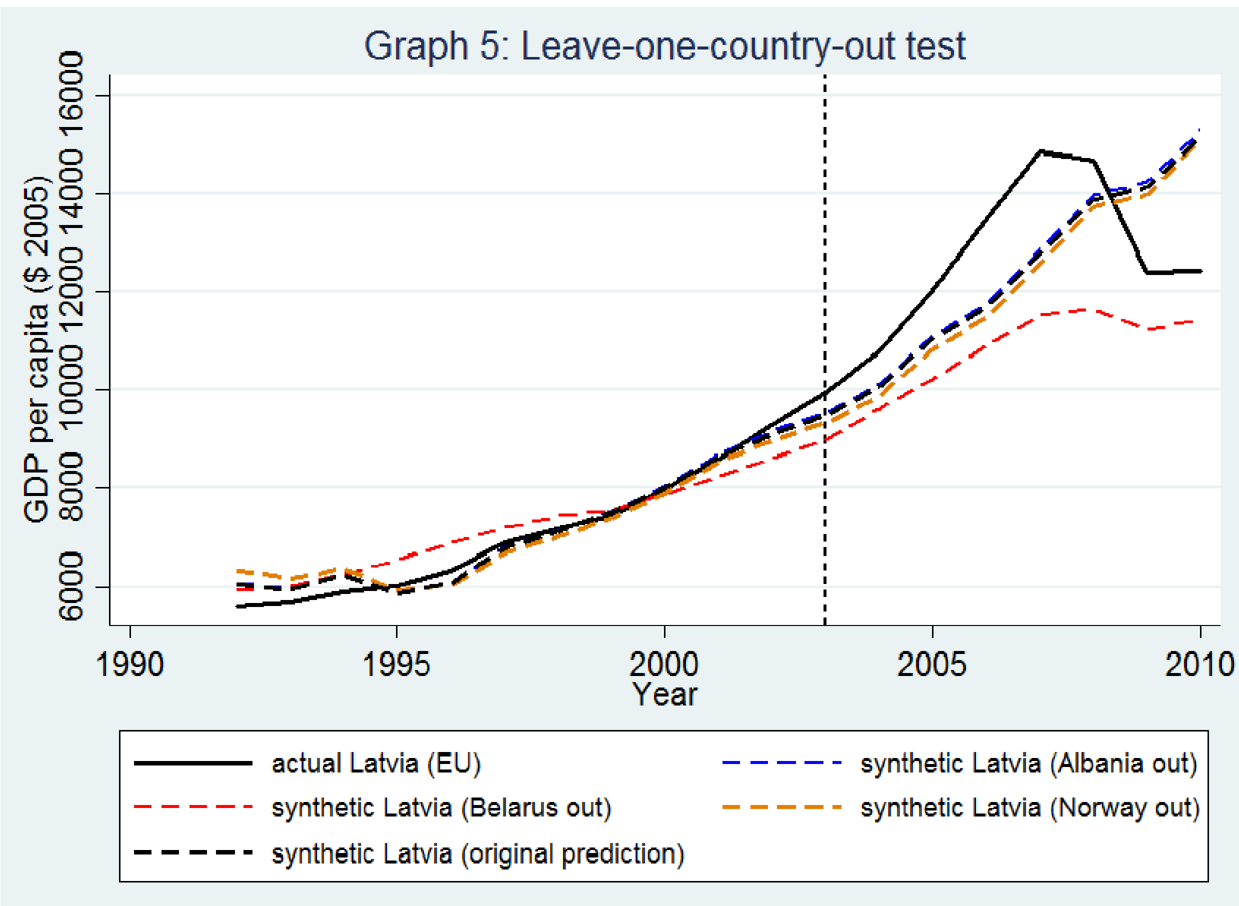
Referring to Graph 4 above, calculating the p-value is now straightforward. The null hypothesis is that EU membership had no effect on Latvia's economic growth. Using Mathematica we find from PDF in Graph 4 that:

$$\text{p-value} \approx 0.082$$

The p-value tells us that around 8.2% of the time will we observe as high treatment-period RMSPE as we did for Latvia if the null hypothesis is true. This result is significant at a 10% significance level. These results suggest that EU membership helped Latvia's economic growth.

III SENSITIVITY ANALYSIS

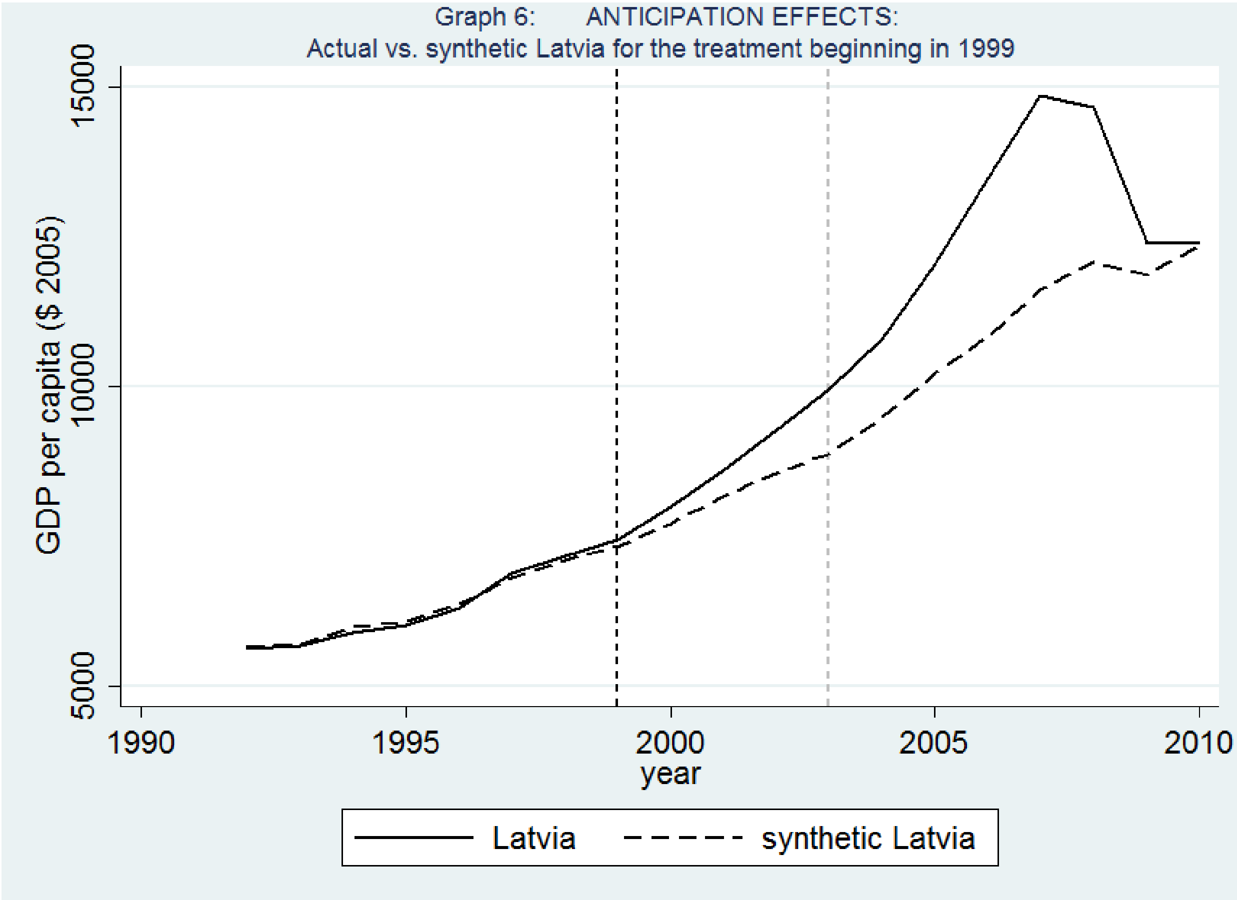
Even though I find that the probability of the null hypothesis being true is around 8% of the time, I want to check whether there is a particular country that significantly drives my results and therefore inspect whether my results are biased. I therefore follow Fremeth et al. (2013) that call this method "leave-one-out" test. The idea of the test is to rerun the model by leaving out every time one control unit that has been assigned a weight to explain the treated unit. In my case, therefore, I want to rerun my constructed model three times, each time leaving out exactly one control unit that represents Latvia in the original model. Hence I rerun the model three times, first time leaving out Albania, second time leaving out Belarus, and finally leaving out Norway. The results are plotted in Graph 5 below.



As we notice from the graph, the solid black line represents actual Latvia and the black dashed line represents the original synthetic Latvia derived earlier. We will notice that both synthetic Latvia where Albania is left out of the control sample (blue dashed line) and synthetic Latvia where Norway is left out of the control sample (yellow dashed line) follow almost identically the trajectory of the original prediction for synthetic Latvia. However, synthetic Latvia where Belarus is left out of the control sample (red dashed line) in fact significantly differs from the other synthetic Latvia units. Synthetic Latvia where Belarus if left out of the control sample provides very poor fit in the pre-treatment period, and it also drastically underperforms in the treatment period. According to this unit of synthetic Latvia, benefits from EU membership for Latvia become significantly greater. These results also suggest bias in the prediction of the original synthetic Latvia.

IV ANTICIPATION EFFECT

Abadie et al. (2010) point out that treatment interventions may have an impact prior to their implementation. The authors call this “anticipation effect”, which refers to the event where the treatment has started even though the *official* date of the treatment start has not yet arrived. In those cases the authors propose redefining treatment period T_0 to be the first period when treatment could have an impact on the treated unit. I propose using the year 1999 as the redefined treatment date. In 1999 Latvia officially opened the negotiations with the EU. Negotiations relate to the “adoption and implementation of the Community acquis” (European Commission). The acquis is divided into 31 chapters, and it covers topics as law, economy, trade, finance, politics, institutions etc. (European Commission). Therefore, I want to redefine the treatment date as the year when Latvia began adoption and implementation of economic, financial, political and other policies according to the EU criteria. The results are given in Graph 6 below.



We can notice from the graph that by redefining treatment date significantly alters the results. If I define treatment date as the time of opening negotiations then the benefits of EU membership become much more apparent. We can notice that compared to synthetic counterfactual actual Latvia economy begins a strong upward trajectory in 1999 and its real per capita GDP significantly diverges from its counterfactual unit. I also add a light-gray line to reference the previously analyzed treatment date, namely year 2003. Referring to Graph 6 above, if it is true that the treatment in fact starts around the opening of negotiations, then by assigning 2003 as the treatment year we would fail to account for the benefits between 1999 and 2003, which are shown as the difference between the area under the "actual Latvia" and "synthetic Latvia" curves in Graph 6 above.

V DIFFERENCE-IN-DIFFERENCES

Campos et al. propose using a difference-in-differences estimator to tackle the issue of statistical significance. The intuition behind the difference-in-difference (DID) method is that we want to observe two groups, the treated and the control, and then see how the treated unit behaves once it is exposed to treatment. Taking the difference of difference between the treated and control unit in the post-treatment period and the difference between the treated and control unit in the pretreatment period gives us the real effect of the treatment intervention.

I use the following specification to identify the DID estimator:

$$Y_{i,t} = a + bTreat_{i,t} + cPost_{i,t} + d(Treat_{i,t} * Post_{i,t}) + e_{i,t}$$

where:

$$Treat_{i,t} = \begin{cases} 1 \text{ if the unit of observation is the treated unit} \\ 0 \text{ if the unit of observation is the control unit} \end{cases},$$

$$Post_{i,t} = \begin{cases} 1 \text{ if the period is post} - \text{treatment} \\ 0 \text{ if the period is pre} - \text{treatment} \end{cases},$$

$$Treat_{i,t} * Post_{i,t} = \begin{cases} 1 \text{ if the unit is treated and in the post} - \text{treatment period} \\ 0 \text{ otherwise} \end{cases}$$

Coefficient d therefore represents the DID estimator. I offer a short proof below. Taking the difference of difference between the treated and control unit in the post-treatment period and difference between the treated and control unit in the pretreatment period, it is true that:

$$\{E(Y_{i1} | T_{i1} = 1) - E(Y_{i1} | T_{i1} = 0)\} - \{E(Y_{i0} | T_{i1} = 1) - E(Y_{i0} | T_{i1} = 0)\}$$

$$\Leftrightarrow \{(a + b + c + d) - (a + c)\} - \{(a + b) - (a)\} = b + d - b = \boldsymbol{d}$$

The following table summarizes the results by presenting DID estimator and statistical significance for: benefits of EU membership assuming 2003 as the treatment date (Latvian national referendum on joining the EU) and benefits of EU membership assuming 1999 as the treatment date (opening pre-accession negotiations with the EU).

Treatment year	DID Estimator and Standard Errors	No of obs and R^2
1999	3217.54	38
	936.24***	0.69
2003	346.10	38
	996.00	0.78
Inference: $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.10$		

Table 4: DID Estimator is used to show benefits from EU membership for different scenarios. First 1999 is treated as the treatment year and I find positive and statistically significant results. Second 2003 is treated as the treatment year and I find positive but statistically insignificant results.

As we can notice from Table 4 above, the benefits of EU membership are more apparent with 1999 as the pretreatment year. The benefits for Latvia from EU membership per year are estimated to be around $3218 per citizen. All else equal, EU membership helped Latvian economic growth by $3218 per citizen per year if I suppose the benefits from EU membership started when Latvia opened accession negotiations in 1999. If there were no benefits before 2003, the year when Latvia finally closed the last chapter, then I cannot show evidence in support of EU membership benefits for Latvia. Even though DID estimator equals approximately 346.10, the result is not significant at any traditional level.

VII CONCLUSION

In this paper I analyzed benefits of EU membership for Latvia, a former transition country and a former member of the Soviet Union that joined the EU in 2004. My motivation for this topic was the recognition of growing concerns about the actual membership benefits, which arouse as a consequence of the recent financial crisis and a severe struggle of various economies in the EU. In the paper I performed counterfactual analysis to answer whether Latvia benefited from EU membership and to quantify the benefit if so.

The main results of the paper are that there is a significant difference in outcomes depending on which year is taken as the beginning of the treatment intervention. The selection of the treatment year was at the same time the hardest part of the analysis. The issue with the treatment year is that the concept of EU membership is not binary. As Campos et al. (2014) explain, there is a continuum of degrees of economic integration, many areas over which economies integrate, and hence it is difficult to decide which date should be taken as the beginning of the treatment period. In the paper I propose two. One treatment year in the paper is proposed to be the opening of accession negotiations in 1999, when Latvia initiated implementation and alteration of its laws and policies according to the EU criteria. Second treatment year proposed in the paper is 2003, when Latvia fulfilled and successfully closed all negotiation chapters. Clearly, the latter is more conservative than the former.

The results are significant and positive for treatment year 1999. According to this analysis, Latvia benefited significantly from EU membership, benefiting by about $3218 per citizen every year from EU integration. The results are significant at a 1% significance level. However, there is very little evidence in support of EU membership positively affecting Latvia's economic growth, given 2003 as the treatment year. In this case, the benefits from EU membership are marginal ($346) and not statistically significant.

This paper brings up a very important question. The results were found to be significant and positive for the treatment year 1999, however these results do not pertain so much to EU *membership* as to *integration in the European Union*. The study suggests that EU membership could in fact be irrelevant, and it is the integration inside the EU (financial markets, market for goods and services, labor market, etc.) rather that brings significant and positive effects to economic growth. This is an important implication for the countries of Europe that have not yet become members of the European Union but are at the present time struggling to do so.

Finally, a detailed discussion about the impact of the financial crisis in 2008 should be included in this paper. We saw that the results show that synthetic Latvia would have done better without the EU membership (with 2003 as the treatment year). However, the distinction between short and long term has to be taken into account when addressing the results. *The crisis is a completely external force to the process of EU membership*. It would be extremely useful to rerun this analysis in the light of the past five years (2011 – 2015). I believe that differentiating between a short and long run is a crucial aspect when thinking of this analysis. Performing this analysis again with 2015 as the final year in the dataset would most certainly reveal interesting conclusions and it should be imperative for future research.

VIII FUTURE RESEARCH

In "Counterfactual Analysis in Macroeconometrics: An empirical Investigation into the Effects of Quantitative Easing", Prof. Pesaran from the University of Cambridge states that by a counterfactual we mean "what would have occurred if some observed characteristic or aspects of the processes under consideration were different from those prevailing at the time." (Pesaran, 2012, p.2) For instance, Pesaran argues, what if the level of a policy variable, x_t, is set differently, or what if the parameters of the process that determines x_t are changed. According to Pesaran, therefore, we are interested in comparing an *ex post* realized outcome with a counterfactual outcome that could have been obtained under certain assumptions regarding a policy variable. (Pesaran, 2012, p.2) Focusing on ex post evaluation gives us a great dosage of precision because we know what the circumstances and conditions were in the past, and hence we can account for them in our modeling. Ex ante evaluation, however, becomes much more difficult. To draw an analogy, think of weather forecasting. Tomorrow we will be able to describe the weather of today very precisely. The opposite is not true. The argument of the paper is that the model can have much success in evaluating policy effects ex post, but has to be significantly altered to have a place in ex ante evaluations. This begs the question of how we can use the model in economics to *predict*, rather than evaluate history.

I would like to offer another criticism of this model that has not yet been mentioned in the studies of the synthetic counterfactual model. There is a certain problem related to how some authors have dealt with deriving statistical significance in the model. The authors use frequentist statistics to derive probability, but if we approached the issue with Bayesian statistics the resulting probabilities would be different. Imagine that the probability that any country significantly benefits from the EU is 0.5. A country has fifty percent to benefit from the EU, and it is essentially decided by flipping a coin. However, imagine that a particular country is already doing quite well economically. The probability that this country benefits significantly from the EU is, most likely, no longer 0.5.

Notice that $P(A|B) \neq P(A), \forall x$, where x_i is the country entering the EU, unless A and B are independent events. Whether A and B are independent, and how much does their dependence affect the results if they are not, is a serious question and perhaps the most important one in tackling the question of statistical significance for this model. Therefore, I believe this would be one of the most critical questions to address in the future. This is the most serious flaw of the synthetic counterfactual model, but if it could be improved upon it would represent a tremendous success and a breakthrough in ex ante policy evaluations.

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