The Economic Cost of a Referendum. The Case of Brexit

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Motivation

- 23 June 2016: Brexit Referendum
- 29 March 2017: UK set to formally trigger Brexit process
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- Many researchers, politicians and mass media defend that Brexit will not have relevant economic costs for the British economy

Related Literature

The vast majority of the literature predicts sizable losses for UK after Brexit. However, there is a division between:

EU Defenders

- *Dhingra et al. (2016)*: They predicted that "the effect of Brexit is equivalent to a a decline in average annual household income of between 1.3% and 2.6% (£850 - £1,700 per year)".

Brexit Defenders

- *Patrick Minford (2017)*: He forecast that a 'hard Brexit' would boost Britain's GDP by 6.8% per year.

Synthetic Control Method (Abadie 2003, 2010)

Effect of the treatment on the treated

$$\tau_{it} = Y_{it}^{T} - Y_{it}^{C} \text{ , where } t \geq T_0 \ (\textit{treatment date})$$

Y_{it} = Real GDP (2010 US$ millions)

- Treated country: $i = 1$. Control countries: $i = 2, ..., N+1$
- Treatment occurs at time $t = T_0$, where $t \in [1, T]$
- Target: Create a synthetic UK that is the weighted average of Y_{it} (i$= 2, ..., N+1$) in $t < T_0$, that best approximates Y_{1t}, s.t.

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It must hold that during the pre-treatment period:

$$\sum_{i=2}^{N+1} w_i Y_{it} = Y_{1t} \qquad \& \qquad \sum_{i=2}^{N+1} w_i Z_i = Z_1$$

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To obtain the set of optimal weights (w^*), we have to solve the following minimization problem:

$$min(X_1 - X_C w)' V (X_1 - X_C w)$$

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In that way, $\sum_{i=2}^{N+1} w_i^* Y_{it}$ for $t \geq T_0$ works as the estimate of Y_{1t}^C for the post-treatment period and, the average treatment effect is estimated as follows:

$$\hat{\tau_{it}} = Y_{1t} - \sum_{i=2}^{N+1} w_i^* Y_{it} \quad for\ all \quad t \geq T_0$$

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1. The set of variables chosen before the treatment should not anticipate the effect of treatment (Brexit)
2. "Donor pool" of countries should not be affected by the intervention (SUTVA)

Empirical Results

- Quarterly data
- Data collection from 2013Q1 - 2017Q4
- Donor pool of twelve non-European countries
- Synthetic UK is a weighted average of the following four countries: Mexico (0.554), Brazil (0.201), Korea (0.179) and India (0.066)

Empirical Results

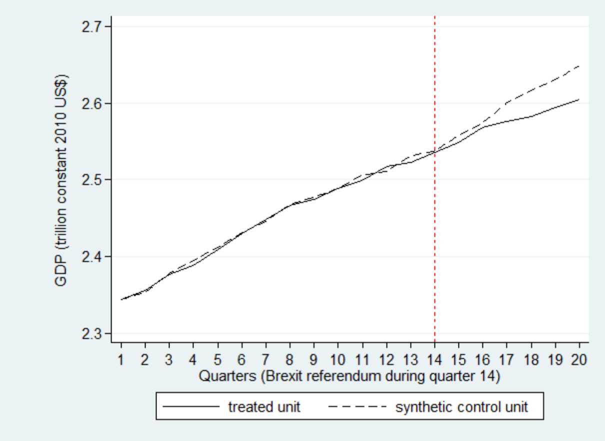

Figure 1: GDP of UK and its synthetic counterpart

Empirical Results

From the last figure we can state that:

- There is a good matching during the pre-treatment period
- There is a clear effect after the treatment period
- This effect is increasing along the time

Empirical Results

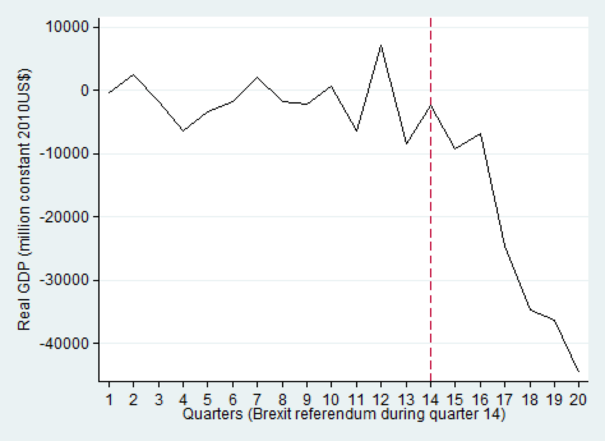

Figure 2: Estimated difference between the synthetic and the treated UK's GDP

Brexit referendum in numbers:

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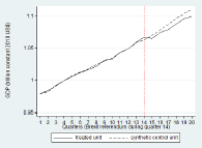
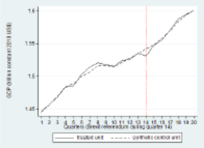
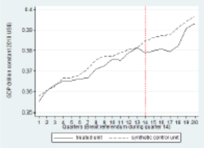
- Equivalent to a cumulative non-growth of 1.01% over the total cumulative GDP for the same period
- The largest amount is registered in the last quarter of 2017 (\$44.50 *billion*)



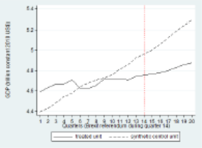
(a) Synthetic Australia



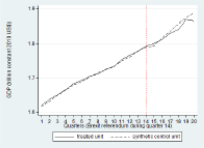
(b) Synthetic Canada



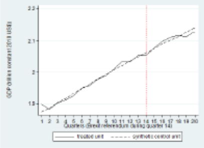
(c) Synthetic Chile



(d) Synthetic Japan

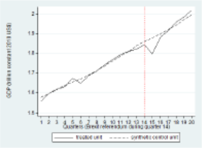


(e) Synthetic Korea

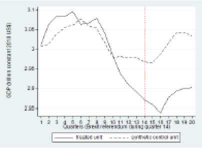


(f) Synthetic Mexico

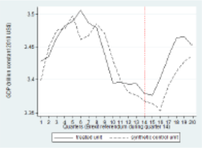
Figure 3: In-Space Placebo Test



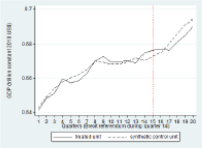
(g) Synthetic Turkey



(h) Synthetic Brazil



(i) Synthetic Russia



(j) Synthetic South Africa

Figure 4: In-Space Placebo Test

Placebo Effects: Exact Inference

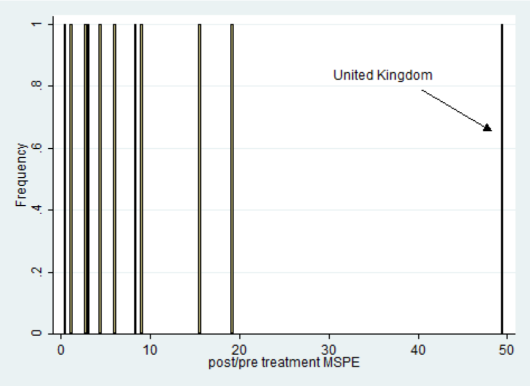


Figure 5: Ratio post/pre treatment MSPE

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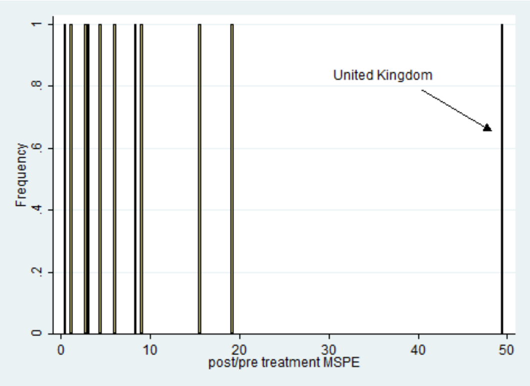


Figure 5: Ratio post/pre treatment MSPE

- The chances to select a country at random, with a MSPE ratio as high as the one for the UK, is $1/11 \simeq 0.09$

Placebo Effects: In-time

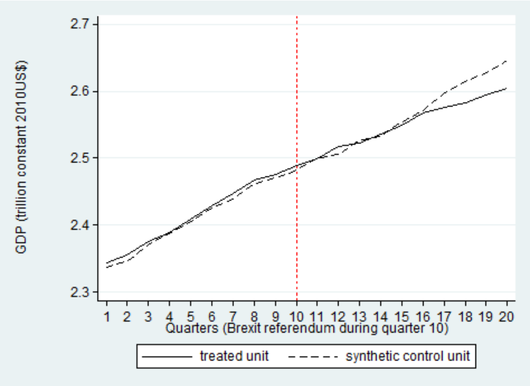


Figure 6: In-Time Placebo Test

- There is no effect around the new treatment period (2015-Q2)

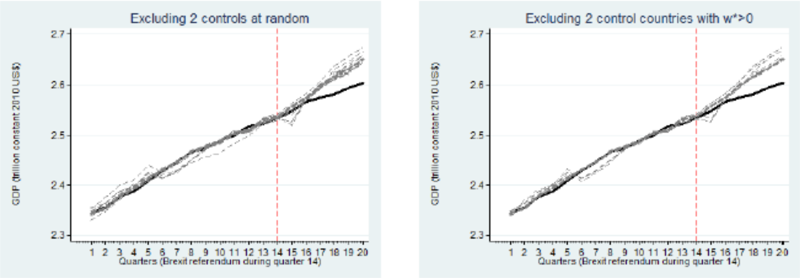
Robustness Checks

To check for the sensitivity of the results we perform 4 robustness checks:

1. Exclusion of countries ▸ Go
2. Bootstrapping ▸ Go
3. Demeaned output - Unobserved heterogeneity ▸ Go
4. De-trended output ▸ Go

Robustness Check - First

Figure 7: Robustness check using the original donor pool sample

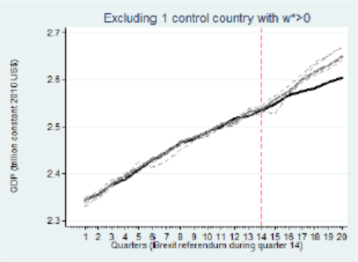


(a) (b)

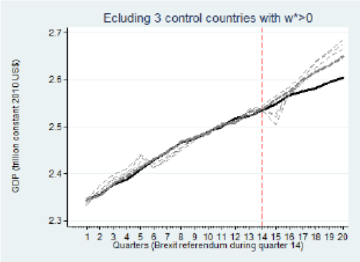
a) Excludes a pair of countries from the original donor pool at random (10 times)

b) Excludes the 6 possible combinations of pairs of countries with w*>0

Figure 8: Robustness check using the original donor pool sample



(c)



(d)

c) Excludes each country with w*>0
d) Excludes the 4 possible combinations of three countries receiving w*>0

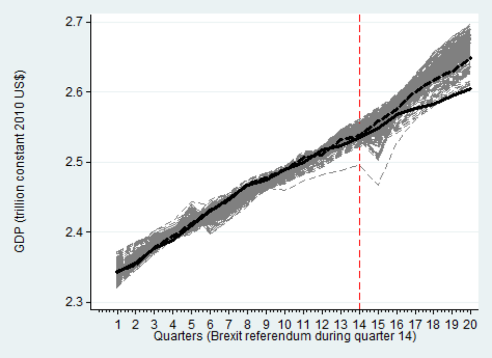
Back

Robustness Check - Second

1. Check for indirect effects of Brexit referendum over European countries. Use placebo tests and post/pre treatment MSPE ratio to conclude that the effect of referendum is not significant for those European countries
2. 22 European countries are also considered to create the donor pool (34 potential countries in total)
3. The donor pool should remain the same size as it had originally (12 units)
4. Consider 1,000 random donor pools of twelve countries (both European and non-European)
5. Select those simulations that present good pre-treatment matching (adjusted $R^2 \geq 0.9$)

Robustness Check - Second

Figure 9: Random donor samples (1,000 replications) - Real GDP in the UK

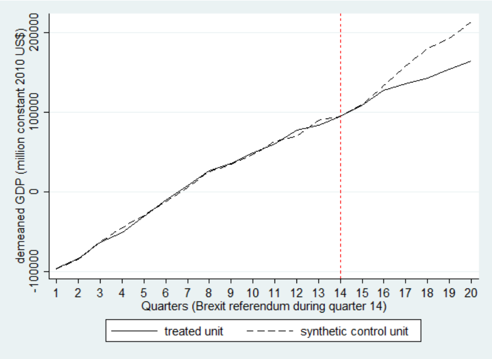


- Almost every simulation follows a similar pattern than the one of the original synthetic UK (black dashed line)

Back

Robustness Check - Third

Figure 10: Demeaned SCM



- Pre-treatment fit is still close to perfect and the estimated effect very similar to the baseline result.

Back

Robustness Check - Fourth

- De-trend the output to eliminate the non-stationary part. Two different ways,

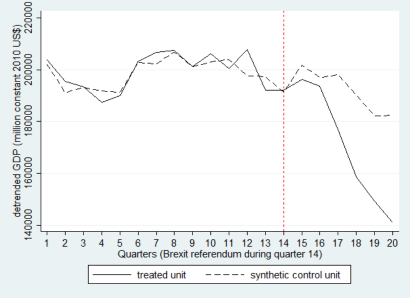


Figure 11: Extract the average GDP of the controls to the treated and control units

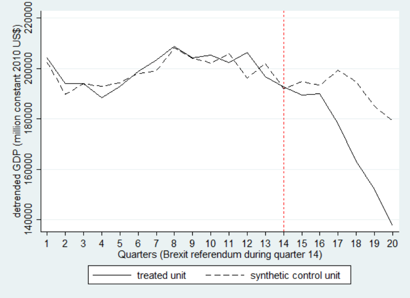


Figure 12: De-trended output by fitting a fourth order polynomial

Back

Conclusions

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3. British GDP "should be booming, but it's just growing"
4. It might not be only a short run consequence