The Effect of Brexit on UK Productivity: Synthetic Control Analysis

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Abstract

In this paper I analyse the effect of Brexit on UK labour productivity and its components using a synthetic control methodology. My results show that the Brexit vote had a negative impact on labour productivity, causing GDP per hour worked to decrease by 2.4% by 2019 in comparison to the absence of Brexit. The two components of labour productivity are GDP and hours worked. I find that the decrease in the GDP is more than the increase in hours worked per person, causing the labour productivity to decline.

Keywords: Brexit, Labour productivity, Productivity puzzle, Synthetic control method

JEL Classification: E24, E65, F13, O47

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1 Introduction

On the 23th of June 2016, 51.9% of the UK electorate voted to leave the European Union (EU), these results mean that the UK will enter into new trade and immigration arrangements with the EU. The UK can negotiate trade arrangements and immigration policies with the EU to stay in the single market, the custom union and provide easy access to European skilled labour, or fail to negotiate a trade arrangements and thus fall back to the World Trade Organisation (WTO) terms with the EU and new immigration policies. The uncertainty associated with negotiating trade arrangements may affect the UK productivity and output through various channels. For example, companies may be discouraged from investing in productivity-boosting technology. Trade, FDI, skilled labour, and the movement of people between the United Kingdom and the European Union will be reduced, leading to less innovation, less investment, less competition, less access to talent, and fewer economies of scale. Thus, this will disproportionately harm the productive, traded sectors of the economy, Dimson et al. (2016).
The UK formally signed the withdrawal agreement on the 31st of January 2020, but until the point of writing this paper, the UK has not agreed on any trade deal with the EU. Given that trading relationships between the UK and the EU member states have not changed yet at the time of writing this paper, I expect that any slowdown in the economic activities are due to expectations of the future uncertainty associated with the negotiation of a trade agreement in the UK economy.

In this paper, I use synthetic control method of Abadie, Diamond, and Hainmueller (2010) in order to measure the causal effect of the Brexit vote on the UK's productivity by constructing a synthetic UK series that is not affected by the Brexit vote and analyse what the UK series will look like in the absence of the Brexit referendum and the vote to leave. The difference between the UK series and the synthetic UK series is the causal effect of the Brexit vote. The variables that I investigate are labour productivity (GDP per hour worked) and its components.

The rest of the paper is organised as follows: Section 2 provides literature review. Section 3 provides a detailed overview of the synthetic control method. Section 4 describes the data used. Section 5 provides the results and discussion. Section 6 assesses our validity of the results using permutation tests. Section 7 concludes.

2 Related Literature

Other papers who used the synthetic control method to assess the impact of Brexit vote are Breinlich et al. (2020) and Born et al. (2019). Breinlich et al. (2020) found that the UK outward FDI increased by 17% and inward FDI decreased by 9% to and from the remaining 27 EU member states as firms and manufacturers shifted their operations from the UK to the remaining EU member states to benefit from the access of the single market. Born et al. (2019) found that the Brexit vote caused a UK output loss of 1.7% to 2.5% by year end 2018. The results of these papers using the same methodology of synthetic control are consistent with my results that the UK is worse off following the results of the Brexit vote. Additionally, Gasiorek, Serwicka, and Smith (2019) analyses the implications of Brexit on the 122 manufacturing industries through investigating 5 different scenarios of trade arrangements to find that all the 5 scenarios will have negative outcome impact on the UK manufacturing sector. Bloom et al. (2019) use survey approach of UK firms to identify the effects of the Brexit referendum. They also found that the Brexit referendum reduced the investment by 11% over the three years following the referendum. They found that the productivity dropped by 2 - 5% in the three years following the referendum, much of this is from a negative within-firm effect as top management commit number of hours per week on Brexit planning. Crafts and Mills (2020) found that by 2018, 10 years after the great recession, the UK productivity was 19.7% below the productivity growth trend. They attribute this under performing to the great recession, waning impact of Information and Communication Technology (ICT) and the uncertainty about international trading following Brexit. That is to say, the results of our analysis will complement the literature about factors causing slowdown in the UK productivity.

3 Methodology

The synthetic control method uses a weighted average of a set of potential control units to provide a synthetic control units that closely resembles the affected unit in terms of predictors. In the context of the UK Brexit scenario, suppose that I have $J+1$ units (here: country pairs) in periods $t = 1, 2, ..., T$(here: years), where unit $j = 1$, is the treated unit (here:UK) and units $j = 2, ...J+1$ are the untreated units used in the control group (here: OECD countries). Unit $j = 1$ is exposed to the intervention (here: outcome of the Brexit referendum) of at periods $T_0+1, ..., T$, while being unaffected during the periods $1, ..., T_0$. In my analysis, I use 2016 as the period of intervention. Y_{it}^N is the outcome of unit i in the absence of intervention for units $i = 1, ..., J + 1$. Y_{it}^I is the outcome of unit i at time t if the unit is exposed to intervention in periods $T_0 + 1, ..., T$. The intervention has no impact on the pre-intervention periods. $Y_{it}^N = Y_{it}^I$ for $t = 1, ..., T_0$. However, in practice, interventions may have an impact prior to their implementation (e.g., via anticipation effects) Abadie, Diamond, and Hainmueller (2010). Y_{it}^N can not be observed in the post-intervention period $t = T_0 + 1, ...T$. Thus, it can best be modelled by a weighted average combination of untreated units in the donor pool.

The synthetic control can be represented by a $(J\text{x}1)$ vector of weights $W = (w_2, ..., w_{j+1})'$ where $0 \leq w_j \leq 1$ for $j = 2, ...J + 1$ and $w_2 + ... + w_{j+1} = 1$.The constructed synthetic control unit is $\hat{Y}_{1t}^N$ is a weighted average of the untreated units of in the donor pool. One of the main assumptions of the synthetic control approach is that countries in the donor pool are not directly affected by the results of the Brexit referendum, nor any contemporaneous events. The choice of W such that the characteristics of the treated unit are best resembled by the characteristics of the synthetic control. X_1 is a $(k\text{x}1)$ vector of pre-intervention characteristics of the treated unit. X_0 is $(k\text{x}j)$ matrix of the same characteristics of the donor pool[1]. The vector W^* is chosen to minimise the difference between the pre-intervention characteristics of the treated unit and the the synthetic control unit $X_1 - X_0W$. W^* is the value of W that minimises $||X_1 - X_0W||$

[1]See Abadie, Diamond, and Hainmueller (2010) for details about the calculation of the weights matrix.

subject to the constraints of w_j mentioned above. According to Abadie, Diamond, and Hainmueller (2015) W^* is chosen to minimise

$$\sum_{m=1}^{k} v_m (X_{1m} - X_{0m} W)^2$$

where v_m is a weight that reflects the relative importance that we assign to the m-th variable when we measure the discrepancy between X_1 and $X_0 W$. Typically, V is selected to weight the predictors in accordance to their predictive power on the outcome. If V is diagonal with main diagonal equal to $(v_1, ..., v_k)$, then W^* is equal to the value of W for the above minimisation. The constructed synthetic control unit is $\hat{Y}_{1t}^N$ is a weighted average of the untreated units of in the donor pool.

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

Abadie, Diamond, and Hainmueller (2010) show that if the weighted average of the synthetic control characteristics X_0 can match the treated unit characteristics X_1, it provides a valid counterfactual for Y_{jt}^N in the sense that $\hat{Y}_{1t}^N - Y_{jt}^N$ is close to 0 in the pre-intervention period, $t = 1, ..., T_0$. For the post-intervention period, where $t \geq T_0$, the treatment effect is the difference between the realized outcome and the synthetic control outcome.

$$Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

4 Data

The sample dataset include 19 OECD countries, the sample spans from 1995 to 2019[2]. All the data are with annual frequency and obtained from the OECD database. Description of each variable used are available in table 1.

[2]The original sample included 23 OECD countries, but I had to remove Belgium, Canada and Switzerland due to the lack of data for GDP per hour worked

Variable	Description	Source
GDP	Annual GDP, expenditure approach, USD current prices fixed PPPs, annual levels	Annual national accounts
Consumption	Annual private final consumption expenditures, volume	Quarterly national accounts
Investment	Annual gross fixed capital formation, total, volume	Quarterly national accounts
Exports	Annual exports of goods and services, national account basis, volume	Quarterly national accounts
Imports	Annual imports of goods and services, national account basis, volume	Quarterly national accounts
Employment	Annual total employment, labour force survey basis	Quarterly national accounts
Population	Annual working age population, age 15-74	Quarterly national accounts
GDP per hour worked	Annual total, 2010 = 100	OECD database
Hours worked	Annual total hours per worker	OECD database
Labour productivity growth	Log difference between the GDP and the employment	OECD database
Inflation	Annual CPI annual growth rate	OECD database

Table 1: Descriptions of the economic variables used and their sources.

5 Results:

5.1 Impact of Brexit Vote on Labour Productivity

Table 2 shows the weights assigned to each country in the donor pool to construct Synthetic UK's productivity, where its constructed by a combination of USA, Norway Finland, Italy and Portugal. Table 3 compares the pre-Brexit vote characteristics of the UK to that of Synthetic UK and weighted average of all countries in the donor pool. The results of table 3 show that for the pre-Brexit period (1995 - 2015) on average for all the variables the synthetic UK provides much closer values to the UK compared to the values of the sample mean of all the countries in the donor pool.

Figure 1 shows a plot of the GDP per hour worked of the UK against the Synthetic

Country	Synthetic Control Weight	Country	Synthetic Control Weight
USA	32.3%	Finland	26.8%
Norway	23.0%	Portugal	1.8%
Italy	7.5%	Netherlands	2.4%
Austria	<1%	Australia	<1%
New Zealand	<1%	Luxembourg	<1%
Spain	<1%	Germany	<1%
Sweden	<1%	Hungary	<1%
Slovak	<1%	France	<1%
Japan	<1%	Korea	<1%
Czech	<1%		

Table 2: Weights assigned to each country in the donor pool to construct synthetic UK.

Variable	UK	Synthetic UK	Sample mean
Investment share of GDP	0.168	0.215	0.23
Log GDP	14.649	13.929	13.301
Imports share of GDP	0.253	0.268	0.396
Exports share of GDP	0.252	0.291	0.423
Labour productivity growth	28.106	28.222	27.848
Employment share	0.631	0.626	0.596
CPI	2.180	2.107	2.562
Log GDP (2011)	14.749	0.445	0.489
GDP per hour worked (2000)	4.461	4.461	4.603
GDP per hour worked (2012)	4.602	4.608	4.621
GDP per hour worked (2015)	4.621	4.627	4.651
GDP per hour worked (2012)	4.616	4.634	4.653

Table 3: GDP per Hour Worked Predictors Means before UK Brexit Vote. Column 1 reports X_1, column 2 reports WX_0 and column 3 reports a simple average of all the countries in the donor pool.

UK from 1995 to 2019. The plot shows that the UK and the synthetic UK GDP per hour worked both had the same trend over time, as the synthetic UK closely mimics the performance of the UK for the entire sample. However, following the Brexit vote, the UK series under performed the synthetic UK series and the gap between the 2 series widened after 2016. Figure 2, shows a plot of the gap between the UK and the synthetic UK, following the Brexit vote, the gap between the UK and the synthetic UK widened and is negatively significant. The results show that at 68% confidence interval, the Brexit vote had a significant negative impact on the UK's productivity after mid 2016. The confidence interval bands are constructed as one standard deviation of the difference between the UK and synthetic UK in the pre-Brexit period [3].

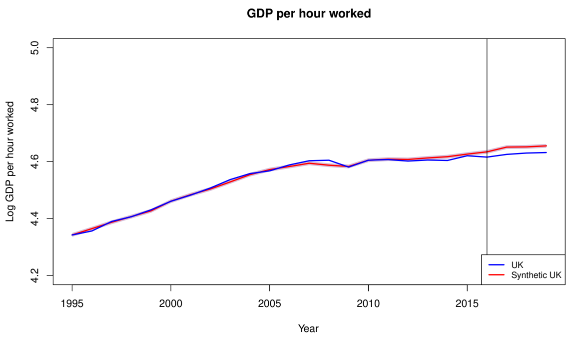


Figure 1: Log of annual GDP per hour worked for the UK and the synthetic UK.

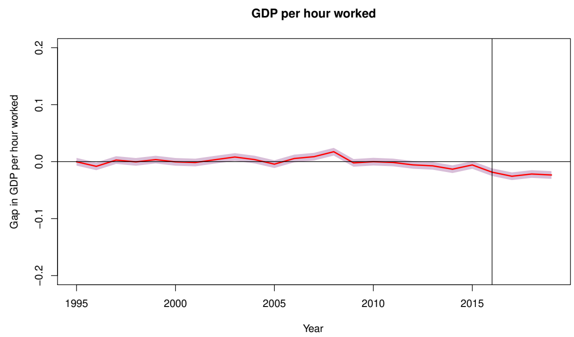


Figure 2: Gap between the UK and the synthetic UK GDP per hour worked .

The Brexit impact can be modelled by a step dummy and a set of pulse dummies Harvey and Thiele (2017). The set of pulse dummies $\lambda_j d_t^*$ show the intermediate effect of the Brexit vote over the short run, while the step dummy variable λd_t models the long run impact. The long run impact takes effect after $m \geq 1$ time periods. In the case of the Brexit analysis, the long run impact will take place after the UK leaves the EU and a Brexit deal is negotiated, in our sample a Brexit deal is still in the process of negotiation. Therefore, I will be modelling the intermediate effect of the Brexit vote on the labour productivity.

$$y_{0t} - y_t^c = \mu_t^c + \lambda d_t + \sum_{j=1}^{m} \lambda_j d_t^* + \epsilon_{0t},, \qquad t = 1, ..., T \tag{1}$$

$$d_t = \begin{cases} 0, & \text{for } t < T_0 + m \\ 1, & \text{for } t \geq T_0 + m, \qquad 1 < T_0 + m \leq T \end{cases}$$

$$d_t^* = \begin{cases} 0, & \text{for } \ t \neq T_0 + j - 1, \\ 1, & \text{for } \ t = T_0 + j - 1, \qquad j = 1, ..., m \end{cases}$$

The Brexit referendum took place in June 2016, the pulse dummy variables take value of 1 from, T_0, 2016 till the end of the sample 2019 to model the uncertainty associated

[3] I follow the approach of Born et al. (2019) in constructing the confidence interval as 1 standard error of the difference between the UK and synthetic UK in the pre-Brexit period.

with the Brexit deal negotiations, while the step dummy variable takes a value of 1, after a Brexit deal is negotiated to model the long run impact of the Brexit deal, which is not captured by this paper yet.

Variable	Coefficient	P-value
Pulse dummy variable 2016	-0.01858548	4.904e-09***
Pulse dummy variable 2017	-0.02573311	1.678e-11***
Pulse dummy variable 2018	-0.02182044	3.161e-10***
Pulse dummy variable 2019	-0.02353821	8.313e-11***

Table 4: Estimation of equation 1, the pulse dummy variables take a value of 1 in each of the years 2016, 2017, 2018, 2019 and 0 in other years. The regression is estimated using Newey west HAC-SE to avoid the problem of serial correlation, the significance codes are . 0.1 ,* 0.05 significance, ** 0.01 significance, *** 0 significance.

The results of equation 1, are in table 4, show that due to the Brexit vote, the UK's labour productivity under performed its synthetic counterpart by an average of 2.37% in the three years following the Brexit vote, where in the absence of the Brexit vote, the UK's productivity would have been on the same growth path as that of the synthetic UK.

5.2 Impact of Brexit Vote on GDP

In assessing the impact of the Brexit vote on the UK's GDP, I construct the synthetic UK from a pool including 18 countries. Table 5 shows the weights assigned to each country in the donor pool. Synthetic UK GDP is best constructed by a combination of USA, Italy, New Zealand, Luxembourg and Portugal. Table 6 compares the pre-Brexit vote characteristics of the UK to that of the synthetic UK and weighted average of all countries in the donor pool. The synthetic UK series characteristics are matched closely to the UK series than the weighted average of the donor pool.

Figure 3 displays a plot of the UK's GDP against the synthetic UK GDP from 1995 to 2019. The plot shows that the UK and the synthetic UK series are both on the same trend for the entire sample, following the Brexit vote the UK GDP series underperformed the synthetic UK. Figure 4 shows the gap between the UK series and the synthetic UK

Country	SC Weight	Country	SC Weight
USA	48.0%	Italy	23.7%
New Zealand	19.6%	Luxembourg	7.2%
Portugal	1.4%	Netherlands	<1%
Finland	<1%	Australia	<1%
France	<1%	Norway	<1%
Austria	<1%	Korea	<1%
Spain	<1%	Japan	<1%
Sweden	<1%	Germany	<1%
Slovak	<1%	Hungary	<1%

Table 5: Weights assigned to each country in the donor pool to construct synthetic UK real GDP.

Variable	UK	Synthetic UK	Sample Mean
Consumption share of GDP	0.656	0.610	0.534
Investment share of GDP	0.168	0.204	0.224
Imports share of GDP	0.253	0.277	0.402
Exports share of GDP	0.252	0.282	0.429
Labour Productivity Growth	28.106	28.389	27.797
Employment share [4]	0.631	0.606	0.596
Log Real GDP (2011)	14.749	14.765	13.452

Table 6: GDP predictors Means before UK Brexit Vote. Column 1 reports X_1, column 2 reports WX_0 and column 3 reports a simple average of all the countries in the donor pool.

series, where the gap between the UK and its synthetic counterpart widened following the Brexit vote and on a downward trend. The deviation between the two series is statistically significant. Born et al. (2019), who constructed the UK GDP series using quarterly Real GDP found similar results to mine that the UK under performed the synthetic UK[5]. In monetary terms, I find that the UK underperformed its synthetic counterpart in 2016 by 2.3 billion dollars, 18.2 billion dollars in 2017, 51.2 billion in 2018 and a further loss of 63.9 billion dollars in 2019. Hence, the cumulative of loss for the UK GDP between 2016 to 2019 is almost 133.3 billion dollars. Table 7 below shows the estimation of the regression of equation 1, where the real GDP was significantly negatively affected in 2017 by 0.2%, 1.4% in 2018 and 1.8% in 2019 as a result of the Brexit vote and the uncertainty associated with the negotiation of the Brexit deal.

[5]Born et al. (2019) found that by end of 2018, the GDP loss accounted for £55 billion.

Variable	Coefficient	P-value
Pulse dummy variable 2016	0.0028155	0.2033
Pulse dummy variable 2017	-0.0026668	0.2273
Pulse dummy variable 2018	-0.0137861	2.794e-06 ***
Pulse dummy variable 2019	-0.0177481	6.692e-08 ***

Table 7: Estimation of equation 1, the pulse dummy variables take a value of 1 in each of the years 2016, 2017, 2018 and 2019 and 0 in other years. The regression is estimated log of the real GDP using Newey west HAC-SE to avoid the problem of serial correlation, the significance codes are . 0.1 ,* 0.05 significance, ** 0.01 significance, *** 0 significance.

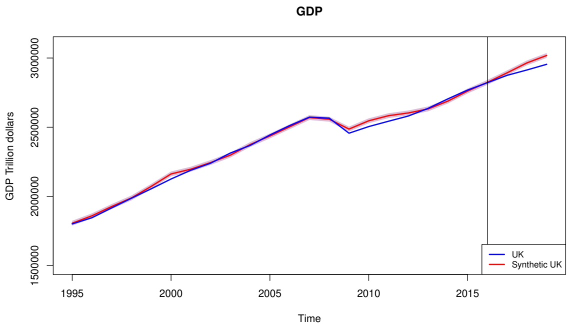


Figure 3: Annual real GDP UK and the synthetic UK in trillion dollars

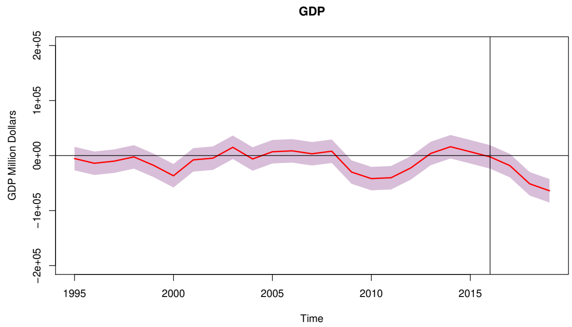


Figure 4: Gap between the UK and the synthetic UK real GDP.

5.3 Impact of Brexit Vote on Labour Input

Labour input, measured as the labour hours worked, is defined as the total number of hours actually worked per person, effectively used in production[6]. In assessing the impact of Brexit vote on the labour input in the UK, I construct the synthetic UK based on a combination of all the countries in the donor pool. Table 8 shows the weights assigned to each country in the donor pool to construct synthetic UK labour hours worked. Table 9 shows that the pre-Brexit vote predictors of the UK are closely matched by the synthetic UK series compared to weighted average of all the countries in the donor pool. Hence, the combination of the synthetic UK series made up of 18 countries is best used to mimic the performance of the UK series than any other weighted average. Figure 5 shows a plot of the UK labour hours worked against that of the Synthetic UK. Although the UK number of hours worked started to decrease

[6]Hours actually worked reflect regular hours worked by full-time and part-time workers, paid and unpaid overtime hours worked in additional jobs, excluding hours not worked because of public holidays, annual paid leaves, strikes and labour disputes, bad weather, and economic conditions. (**OECDhours)**

following the Brexit vote, the synthetic UK was on a steady trend for the whole entire period and the UK series was above it, but the gap between the two series narrowed following the Brexit vote [7].

Country	Synthetic Control Weight	Country	Synthetic Control Weight
Netherlands	58.5%	USA	29.7%
Germany	7.7%	Luxembourg	<1%
Italy	<1 %	France	<1%
Slovak	<1 %	Spain	<1%
Finland	<1%	Portugal	<1%
Austria	<1%	Norway	<1%
Australia	<1%	Hungary	<1%
New Zealand	<1%	Czech	<1%
Sweden	<1%	Japan	<1%

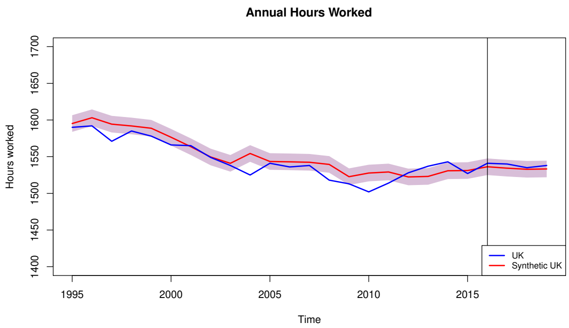
Table 8: Weights assigned to each country in the donor pool to construct synthetic UK.

Variable	Treated Unit	Synthetic Unit	Sample Mean
Investment	0.168	0.203	0.225
Log GDP	14.649	14.490	13.324
Labour Productivity Growth	28.106	28.146	27.818
Employment share	0.631	0.631	0.604
CPI	2.180	2.156	2.435
Log Labour Hours Worked (2010)	7.315	7.332	7.401

Table 9: Labour hours predictors means before UK Brexit Vote. Column 1 reports X_1, column 2 reports WX_0 and column 3 reports a simple average of all the countries in the donor pool.

Figure 6 displays that in the post-Brexit period, the gap in the number of hours worked between the UK and its synthetic counterpart narrowed. Table 10 shows the regression estimation of equation 1, the results show that although the coefficients of the dummy variables are positive and significant, they decreased significantly between 2017 and 2018 before it increased again in 2019 but still below that of 2017 to explain the negative impact on the number of hours worked in the UK.

[7]The ONS average weekly hours of for full-time workers in the UK decreased from 37.5 in 2016 to 37.4 in 2017 and 37.1 in 2018.



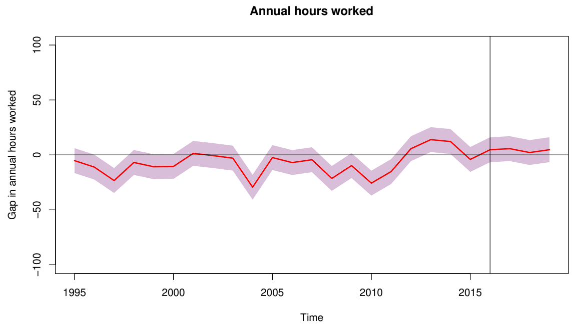


Figure 5: UK against synthetic UK annual labour hours worked per person.

Figure 6: gap between the UK and the synthetic UK annual labour hours worked per person.

Variable	Coefficient	P-value
Pulse dummy variable 2016	0.0079071	0.0007529***
Pulse dummy variable 2017	0.0085328	0.0003611***
Pulse dummy variable 2018	0.0062414	0.0052200**
Pulse dummy variable 2019	0.0079218	0.0007400***

Table 10: Estimation of equation 1, the pulse dummy variables take a value of 1 in each of the years 2016, 2017, 2018 and 2019 and 0 in other years. The regression is estimated log of the hours worked using Newey west HAC-SE to avoid the problem of serial correlation, the significance codes are . 0.1 ,* 0.05 significance, ** 0.01 significance, *** 0 significance.

6 Permutation Tests

In order to evaluate the credibility of my results that the UK labour productivity was affected due to the Brexit vote, I perform two permutation tests. In time permutation test and leave one out permutation test.

6.1 In Time Permutation Test

I assign the Brexit to a different year, 2012, instead of 2016. I use the same predictors of table 3 and still finding that the synthetic UK series is closely matched to the UK series than the weighted average of all the countries in the donor pool. Figure 7 displays the results of the in time permutation test. The results show that the synthetic UK GDP per hour worked almost reproduces the evolution of the UK GDP per hour worked between 1995 and 2012. After the hypothetical 2012 Brexit assigned, the UK and the synthetic UK do not diverge significantly and considerably from each other between

2012 and 2015, the small divergence was already present in the data as in figure 1. Therefore, I can conclude that the widening of the divergence following 2016 in figure 1 is the casual effect of the Brexit vote on the UK GDP per hour worked.

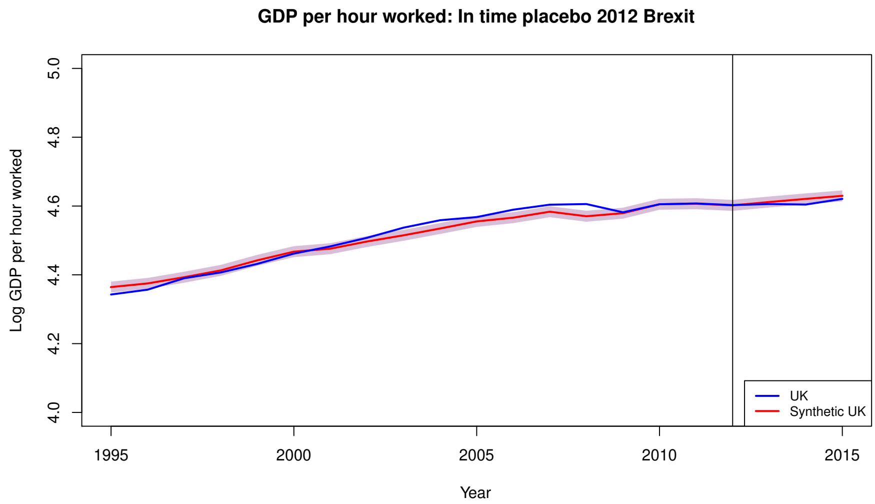


Figure 7: In Time Permutation Test, 2012 Brexit

6.2 Robustness Test

As the GDP per hour worked is constructed as a weighted average of the six countries USA, Finland, Portugal, Norway, Italy and Netherlands. I run a robustness check to test the sensitivity of my results to changes in weights assigned to each country in the donor pool, I do so by re-estimating the synthetic UK five times each time by omitting one of the countries in the donor pool. Figure 8 displays the UK, Synthetic UK and the re-estimated synthetic UK when omitting one of the countries in the donor pool. The results show that the synthetic UK constructed in figure 1 by the combination of the six countries is robust to the exclusion of any particular country from the donor pool.

6.3 Balanced growth test

Harvey and Thiele (2017) suggest that the target and its synthetic counterpart should be cointegrated during the pre-intervention period, by using KPSS balanced growth co-integration test on the contrast between the target and its synthetic counterpart to

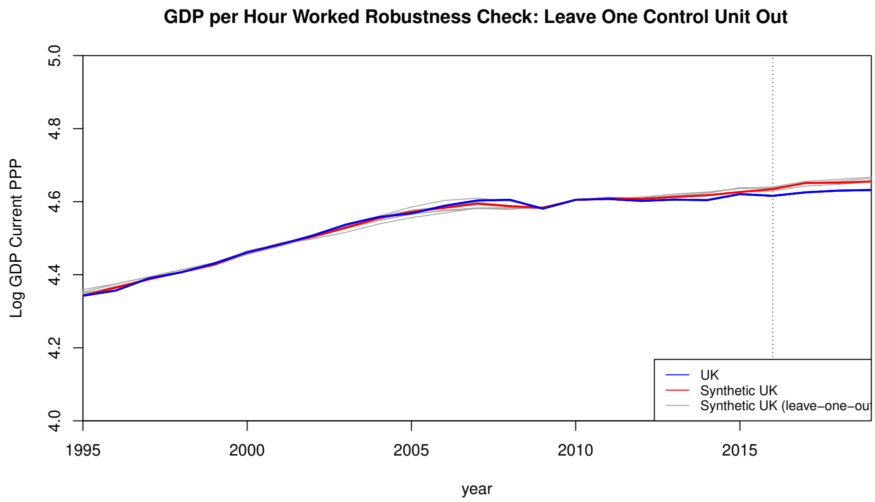


Figure 8: Robustness Check, Leave One Control Unit Out

test if both series are on the same growth path in the preintervention period. If the null hypothesis of stationarity is not rejected, then the UK and its synthetic counterpart are on the same growth path, thus cointegrated over the pre-Brexit period. The results of table 11 below shows that the contrast between the UK and synthetic UK GDP per hour worked is stationary. Therefore, both series had the same growth path in the pre-Brexit period.

KPSS level	Critical value(10%)
0.21002	0.347

Table 11: KPSS(2) balanced growth test for the contrast between the UK and synthetic UK GDP per hour worked

7 Conclusion:

In this paper I examined the impact of the Brexit vote on the labour productivity of the UK. By using synthetic control method, I identify the effect of the Brexit vote by constructing synthetic UK series to compare it to the actual UK series. My estimates found three key impacts the Brexit vote caused to the UK economy. Firstly, in comparison to its synthetic counterpart, the UK's labour productivity under performed by an average of 2.37% over the three years following the Brexit vote, and by 2.4% in 2019, which reflects the uncertainty in the UK investment and labour markets associated with leaving the EU without a trade deal. Secondly, the UK Real GDP had a cumulative loss of 133.3 billion dollars between 2016 to 2019. Lastly, I found that average annual hours worked per person are 2.16 and 4.17 hours more in 2018 and 2019 than the synthetic UK. As the labour productivity is constructed by the GDP and the labour hours worked, the decrease in the GDP is more than the slight increase in the labour hours worked, thus the labour productivity was negatively affected.

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