

THE CER DOPPELGANGER INDEX DOES NOT PROVIDE A CREDIBLE MEASURE OF THE IMPACT OF BREXIT

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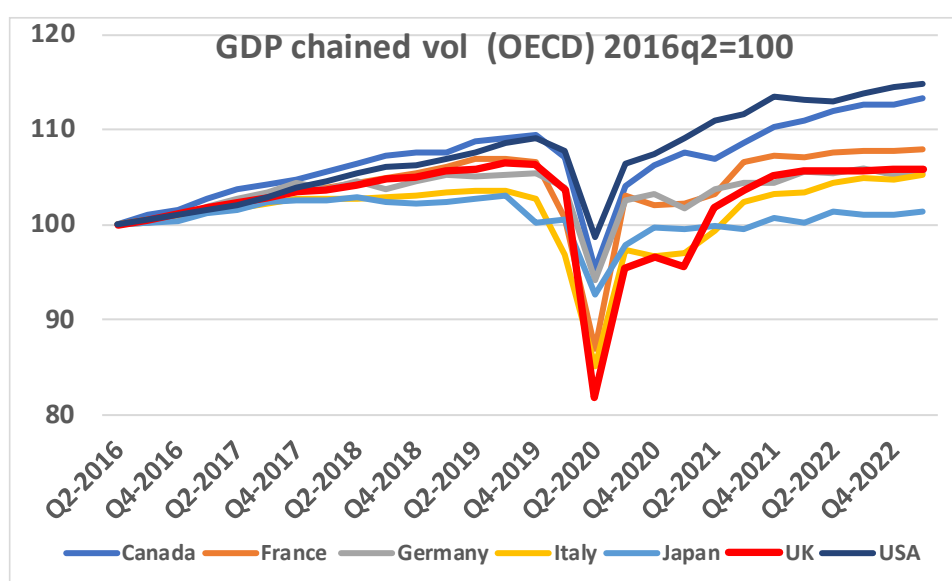
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INTRODUCTION

There is a widespread perception that Brexit has damaged the UK economy. In the perception of the public and indeed many politicians, forecasts get confused with evidence on the current economic impact. Since the evidence on GDP shows the UK performing in line with several major comparator economies, arguments for a negative impact have to rely on counterfactual analyses in which estimates are constructed of how the UK economy might have performed in the absence of Brexit. Counterfactuals based on the past experience of the UK economy are necessarily selective on time periods and can confuse cyclical upturns with secular growth. More important are comparisons with other countries over the period since the Brexit referendum in 2016. Perhaps the most widely cited of such studies are the [doppelganger analyses](#) undertaken by the Centre for European Reform (CER).

Before outlining the CER approach, we can examine the raw data on UK GDP in comparison with other G7 economies. OECD data on GDP volumes shows that the UK growth has been intermediate among G7 economies since 2015. Only the US and Canada have performed significantly better since the referendum. In the case of the USA, substantial fiscal expansion under Trump and Biden have been important factors in the growth of the US and its major trade partner Canada. The UK has performed as well as, or better than major EU economies or Japan.

Figure 1 - Change in real GDP in G7 economies



Source of data: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#>

This ought to be the end of the matter. If Brexit has had a negative impact on the UK economy, it is unlikely to have been large. This is where the counterfactuals come in. If it can be plausibly argued that the UK economy would have grown significantly faster in the absence of Brexit, then it can be posited that there is evidence for a negative Brexit impact. This could be asserted even with an economic growth performance in line with major EU economies or Japan.

The CER estimates use a technique known as the Synthetic Control Method (SCM). This constructs a counterfactual index series that may be compared with the actual path of economic growth. The CER do this for trade and investment as well as GDP, but we focus only the latter here since any substantial impact on trade or investment should also affect GDP. The CER application of the SCM method derives a set of weights for a group of countries which are considered comparators for the UK. The weighted combination of countries' GDP time series forms an SCM index, often called a doppelganger index.

The weights are obtained from data covering a 'training' period before the start of the policy being assessed, in this case from 2009q1 to 2011Q4 and a 'fitting' period from 2012q1 to the Brexit referendum in 2016Q2.

In general, we expect the index to fit the UK data closely in the period before 2016q2 and especially from 2012q1-2016q2. Any deviation of the actual UK from the doppelganger index after 2016 is then used as a measure of the impact of Brexit. Of course, many factors other than Brexit have affected UK GDP since the Brexit referendum but the assumption is that these will also have affected countries with similar economic structures to the UK. Any remaining difference in the growth paths

of the UK and the doppelganger index is assumed to be due to specific UK-factors and in particular to Brexit.

It would be possible (and indeed better) to obtain a set of weights directly as a weighted combination of the time series for GDP in the matching countries, but the SCM methodology does more than this or in some cases it does something altogether different. It matches the countries on a range of structural economic variables. These are weighted averages over a period of time rather than annual or quarterly time series. A founder of the technique, Alberto Abadie used the following six predictors to obtain a set of weights for his study¹ of the impact of German unification on per capita GDP in the West German economy after 1990. The predictors were averaged over the entire period of or part of the 1980s² for each country.

- Rate of growth of GDP per capita
- Gross Fixed Capital Formations (% of GDP)
- Average years of schooling of the adult population
- Industrial production as a percent of GDP
- Inflation rate
- Goods and services trade (exports plus imports) as a percentage of GDP

A set of weights was chosen to minimise the deviations between the West German values of these variables and the values of the weighted average of the variables in the other countries. Abadie's study started with 16 countries, but the minimisation algorithm limited the set to only six countries to construct the weighted values which optimise the fit to the West German values. The predictor variables are also weighted in this process, based on their relevance in predicting the outcome variable. In Abadie's case, the outcome variable is GDP per capita. The choice of weightings for these predictors will influence the country weights as well.

In this West Germany example there is no mention of using the time series for per capita GDP to obtain the weights. The weights are calculated subject to the constraint that they are all positive and sum to unity. Abadie et al stress that the positivity of the weights and their summing to unity is a major advantage of this technique over the use of traditional regression techniques in which

¹ Abadie, Diamond and Hainmueller (2012) Comparative Politics and the Synthetic Control Method, Journal of Political Science June 2012 p59 [file:///C:/Users/Owner/Dropbox/PC/Downloads/Abadie_et_al-2015-American_Journal_of_Political_Science%20\(2\).pdf](file:///C:/Users/Owner/Dropbox/PC/Downloads/Abadie_et_al-2015-American_Journal_of_Political_Science%20(2).pdf)

² Averages between 1981 and 1990 applied to trade, inflation, industry and GDP per capita. Schooling is the average between 1980 and 1985 and investment is the mean of year 1980. Optimisation is applied to the period between 1960 and 1989

negative coefficients are possible. The weights selected in this study are then applied to the per capita GDP time series data in the six selected countries after German unification in 1990. This generates an index which fits the path of per capita GDP in West Germany well before unification and gives confidence that the same index, calculated for periods after unification, will provide a meaningful indicator of the how per capita GDP would have evolved in West Germany in the absence of unification.

The CER study does something similar using the same structural variables as Abadie *op cit* plus an index for real GDP (described in the CER study as GDP growth). In the CER case the weights are obtained from data between 2009q1 and 2016q2 split into two periods. All six predictors are averaged between 2009q1-2016q2. A successful creation of synthetic control would generate weighted averages of these predictors³ and the dependent variable (real GDP), over the pre-treatment periods, that are as close as possible to the UK averages. Note that a 2021 working- paper by Kuosmanen *et al* shows that this method has flaws and may fail to find the optimal weights with potentially serious consequences for the analytic conclusions⁴.

As in the West Germany study what are optimised are averages rather than quarterly time series. CER then randomly sample 20 % of the population (i.e., 4 out of 22 countries are selected randomly) and construct another (index_20pc). The same practice is repeated using 30% random sample, 40% of random sample, and all the way to 90%. In addition to the initial index that is constructed using all 22 countries, 8 more indices were created. The final synthetic index is the average of all these indices⁵. This complex process is described as being undertaken to prevent the USA, or other countries, dominating the index too much. In the run reported by CER the USA appears in 60% of the samples.

The averaged synthetic real GDP index is thus the doppelganger index with weights obtained for each of the 22 OECD countries⁶. The doppelganger index in the CER dataset covers the whole period starting in 2009q1. The weights, which are given in the annex, are dominated by the USA (0.304), Germany (0.152), New Zealand (0.143), Norway (0.08), Australia (0.055) and Iceland (0.053).

Two things should be noted at this stage. Firstly, the set of structural characteristics selected for the

³ Good predictors will be assigned higher weights. If the predictors are assigned minor weights, then a not so close match between their synthetic controls and the treated unit does not seem to undermine the credibility of the inference.

⁴ Kuosmanen, Timo and Zhou, Xun and Eskelinen, Juha and Malo, Pekka (2021). Design flaw of the synthetic control method. Munich Personal RePEc Archive. "Computational difficulties associated with the joint optimization of the donor and predictor weights casts serious doubts on the reliability of the method" (p29). This research also finds that a single predictor variable is often as good as the extended set of variables usually used.

⁵ Note that because the sampling process is random, so each index will not be the same each time when one runs the programme. It is thus not possible to exactly reproduce the results.

⁶ Three countries are assigned zero weights. These are Austria, Belgium and Japan.

West German (and Brexit) analyses are rather arbitrary. Since the sample period for the structural variables is short, it would be more relevant to include data on factors such as the cyclically adjusted budget deficits or the growth of export markets. Abadie et al describe them as '*a standard set of economic growth predictors*'⁷ but no support is given for this contention. Secondly, a weighted average of such indicators has no obvious economic meaning. While we might say that the UK economy is structurally similar to the USA (although much smaller) it is not obvious what is meant by stating the UK economy is structurally similar to an index composed of 30% USA, 15% Germany and 14% New Zealand etc.

Abadie et al use the structural characteristics to replicate per capita GDP (i.e. living standards or productivity) in West Germany, but CER use the same set of indicators in a study of GDP (i.e. the size and growth of the economy). It helps that CER added real GDP to the list of indicators but it is unclear why the others have been selected. In one sense they are meant to indicate similarity of the economies but what is required for the Brexit application is similarity of growth rates not living standards or economic structure. There is some tendency for economies at similar levels of economic development to have broadly similar rates of economic growth but this cannot be pushed too far. Developed economies with heavy dependence on raw material exports, like Australia, New Zealand or Canada can have different growth trajectories than post-industrial economies like the UK, while countries with low population densities and high net in-migration will grow faster than those like the UK with high densities and lower net migration. The Netherlands, Luxemburg and especially Ireland are tax havens, tiny Iceland (with a population as large as a single London borough) has only two significant exports, and so on.

The CER analysis appears not to observe the principle of sparsity used in Abadie et al. The CER doppelganger index for GDP generates positive weights for all but three of 22 countries in the dataset. This includes very different economies like Greece which had a totally distinctive experience of economic growth in the 2009-16 period, and countries like Iceland where the economic structure is unlike that of the UK, or indeed of anywhere else. It also includes Ireland where the GDP data is highly distorted by the huge inflow of profits from multi-national companies attracted by Ireland's tax haven policies. Large weights are given to continental economies with large raw material exports, including the USA, Canada and Australia.

The CER state that the doppelganger index is '*based on a basket of countries whose performance closely matches the UK before the referendum and the end of the transition period*'⁸. This may be

⁷ Abadie, Diamond and Hainmueller (2012) Comparative Politics and the Synthetic Control Method, Journal of Political Science June 2012 p59

⁸ https://www.cer.eu/sites/default/files/pbrief_costofbrexit_8.6.22_0.pdf page 2.

partially true for the somewhat arbitrary structural characteristics listed above, although even here it is open to question when the US economy is six times bigger than the UK and when Australia and New Zealand are dependent on commodity exports rather than services or manufactures as in the UK. However, the statement is not correct for the growth of GDP. In fact, in the great majority of the 22 selected countries quarterly growth in GDP is not statistically significantly correlated with the UK over the 2009q1-2016q2 period. The doppelganger index is thus a combination of country GDP indices which are not significantly related to the UK but in aggregate can reproduce the UK's growth path for GDP over the pre-2016q2 period⁹. As we point out below it is easy to closely reproduce the UK growth path with a combination of other countries as long as these include some which grow faster than the UK and some which grow slower.

One response to the criticism of non-significance is that correlations between the UK and individual countries do not matter. All that matters is the aggregate. As a counter example, supporters of the CER work cite a case where a synthetic index is composed of the sum of a number of random time series. In this case the index will not be significantly related to the individual series. It is difficult to see that this example is relevant to our situation in which random series are being combined to match an independent time series, in our case GDP in the UK. As Abadie et al warn, if a large enough number of series are combined it is always possible to fit anything¹⁰.

The CER exercise generates an index which provides a good fit to the path of GDP in the UK between 2012q1 and 2016q2. The CER find that the UK series for GDP lies 5.5% below the doppelganger index by the second quarter of 2022¹¹. This is then interpreted as indicating that Brexit had led to a reduction in UK GDP by that date¹².

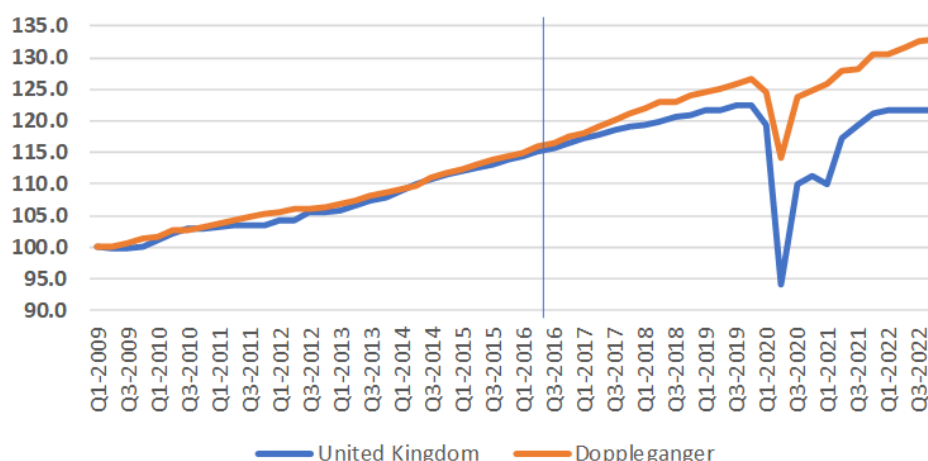
⁹ Harvey, A., Thiele, S., 2021. Cointegration and control: Assessing the impact of events using time series data. *Journal of Applied Econometrics* 36, 71–85. <https://doi.org/10.1002/jae.2802>. The authors state that “In order to determine whether series from a pool of potential donors are valid as controls, we propose selecting series that are found to be co-integrated with the target series on the basis of stationarity tests applied to the contrast with the target”. And also, “the target and control variables must have a common trend with the property that subtracting one series from the other gives a stationary series prior to the intervention”.

¹⁰ <https://www.aeaweb.org/articles?id=10.1257/jel.20191450>

¹¹ <https://www.cer.eu/insights/cost-brexit-june-2022>

¹² John Springford has subsequently privately sent the data and results of an updated analysis using revised OECD data. This estimates a 7% difference between the UK and the revised doppelganger index by 2022Q2. This analysis uses a revised set of weights and these are included in the annex to this article.

Figure 2 – GDP Volume Index with 2009Q1=100, UK vs Doppelgänger



Source of data: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#>

In the chart above we have reproduced the index using GDP volume data obtained from the OECD¹³ with the CER weights (reproduced here in the annex). For reasons we do not understand, this generates a substantially larger Brexit impact than the CER estimate, at 9.7 percentage points by 2022q2 growing to 11.1 percentage points by 2022q4.

Such a large negative Brexit impact by the end of 2022 is implausible as indeed is the CER's own estimate of 5.5%. We can see this by comparing the UK GDP index with that of Germany in Figure 3. The German economy recovered faster than the UK after the banking crisis of 2008/9 but the UK caught up by 2016, and over the whole pre-referendum period 2009q1-2016q2 the two economies grew at much the same rate. This similarity in growth continued up the eve of the Covid pandemic in 2019q4 and through to the latest data for 2023q1. The UK recession during the pandemic in 2020 looks deeper than in Germany but this is partly because the UK recession is exaggerated in ONS and OECD data due to differences in the way in which public sector output is measured¹⁴. It is unclear whether this distortion is fully out of the data by 2023.

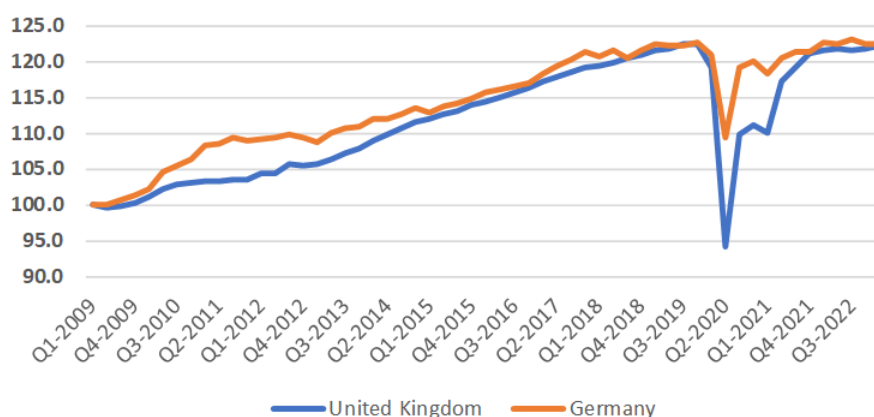
¹³ OECD GDP expenditure approach volume index 2015=100 <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#>

¹⁴ <https://blog.ons.gov.uk/2022/02/21/how-different-countries-have-measured-the-output-of-public-services-during-the-pandemic/>

And:

<https://www.ons.gov.uk/economy/economicoutputandproductivity/output/methodologies/internationalcomparisonsofth measurementofnonmarketoutputduringthecoronaviruscovid19pandemic>

Figure 3 – GDP Volume Index with 2009Q1=100, UK vs Germany



Source of data: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#>

Germany in the chart above. The German economy recovered faster than the UK after the banking crisis of 2008/9, but the UK caught up by 2016, and over the whole pre-referendum period 2009q1-2016q2 the two economies grew at much the same rate. This similarity in growth continued up the eve of the Covid pandemic in 2019q4 and through to the latest data for 2023q1. The UK recession during the pandemic in 2020 looks deeper than in Germany but this is partly because the UK recession is exaggerated in ONS and OECD data due to differences in the way in which public sector output is measured¹⁵. It is unclear whether this distortion is fully out of the data by 2023.

The observed long-term similarity in UK and German growth in GDP would suggest little impact from Brexit. However, the doppelganger analysis suggests that the UK would have been 5.5% (CER estimate) or 11.1 percentage points (using OECD volume data) above Germany by the start of 2023. We can ask why would UK GDP have been expected to have grown much faster than Germany in the absence of Brexit after 2016q2 when it did not do so before 2016q2. Alternatively, we can ask why German GDP grew by so much less than the 'expected' non-Brexit estimate for the UK after 2016q2. The CER explanation is that the German economy slowed due to problems in its important Chinese markets caused by the US-China trade wars¹⁶. However, the first chart in this article shows that German GDP grew at close to the average rate for G7 countries after 2016. Moreover, the growth in German exports of goods was average from 2016q2 into 2023, much the same as France and better than Japan or the UK.

¹⁵ <https://blog.ons.gov.uk/2022/02/21/how-different-countries-have-measured-the-output-of-public-services-during-the-pandemic/>

And:

<https://www.ons.gov.uk/economy/economicoutputandproductivity/output/methodologies/internationalcomparisonsofthetreatmentofnonmarketoutputduringthecoronaviruscovid19pandemic>

¹⁶ <https://www.cer.eu/insights/cost-brexit-june-2022>

The lack of correlation between the volume indices for the UK and the CER's other 22 individual countries is, on the face of it, a weakness. We are asked to believe that a composite index composed of countries which did not individually have a similar growth pattern to the UK prior to 2016q2 should nevertheless in aggregate provide a meaningful counterfactual for the UK.

As an alternative to this doppelganger analysis, we can attempt to include only statistically significant relationships in an index. We have done this using a conventional regression equation. The equation below is of the error correction method (ECM) type which uses quarterly changes in UK GDP as a dependent variable, and both levels and changes in independent variables (which estimate long-term and short-term influences). The equation below includes the countries from the CER dataset which have statistically significant relationships for the real GDP time-series. The equation is economically plausible (unlike the doppelganger index) because the included countries are all major markets for UK exports. The following chart shows that this equation provides an excellent fit for the UK quarterly GDP index between 2009q1 and 2016q2 ($R^2=0.997$ in a linear regression without a constant).

Dependent Variable: DLOG(UK)

Method: Least Squares

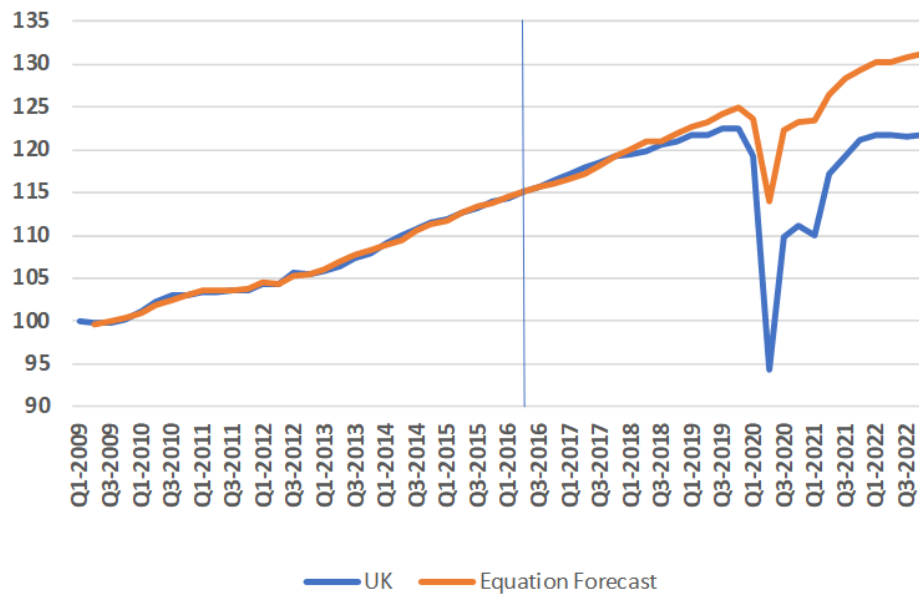
Date: 05/11/23 Time: 08:58

Sample (adjusted): 2009Q2 2016Q2

Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.057666	0.054001	-1.067863	0.2972
LOG(UK(-1))	-0.371176	0.082381	-4.505598	0.0002
LOG(USA(-1))	0.382531	0.077431	4.940256	0.0001
DLOG(USA)	0.371915	0.110376	3.369521	0.0028
DLOG(GER)	0.282747	0.079837	3.541537	0.0018
DLOG(SWITZ)	0.339442	0.141255	2.403039	0.0251
D2012Q2	-0.006897	0.002521	-2.735781	0.0121
R-squared	0.721833	Mean dependent var	0.004849	
Adjusted R-squared	0.645970	S.D. dependent var	0.003954	
S.E. of regression	0.002353	Akaike info criterion	-9.059927	
Sum squared resid	0.000122	Schwarz criterion	-8.729890	
Log likelihood	138.3689	Hannan-Quinn criter.	-8.956564	
F-statistic	9.514881	Durbin-Watson stat	1.703255	
Prob(F-statistic)	0.000033			

Figure 4 – GDP volume index with 2009Q1=100, UK vs ECM Forecast

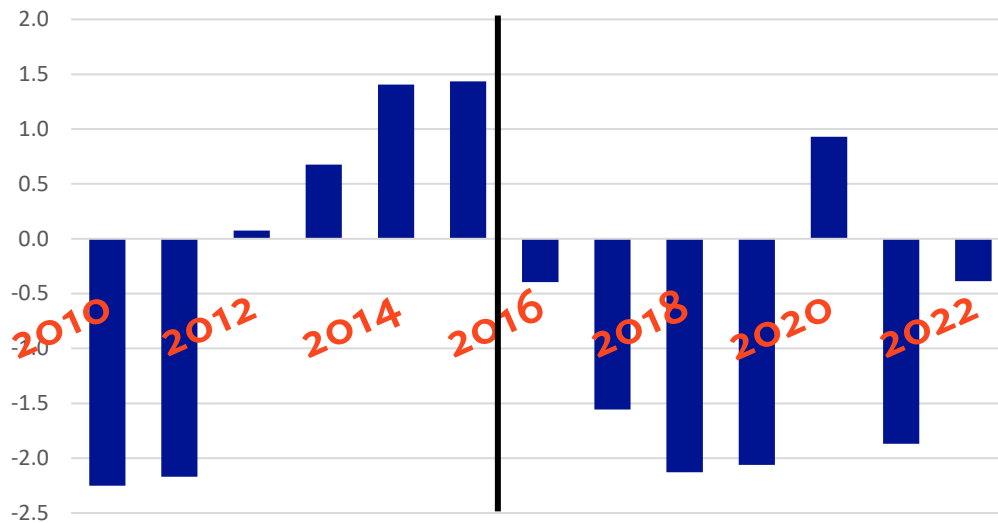


Source of data: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#> The forecast uses the parameters from the equation above.

As already noted, Abadie et al argue that a major reason that the SCM approach is superior to a regression analysis is that regression often generates negative weights. The ECM equation above however shows that all the coefficients are positive and that the coefficients on the long-term variable (USA) is approximately equal to that of the UK. The measured Brexit impact by 2023q1 is almost identical to that obtained using the CER-weighted doppelganger with OECD data for GDP volume indices.

In using fewer countries, the ECM equation is more transparent. It is clear that it is the USA which is generating the counterfactual and hence the large negative impact. The reason for the USA's superior performance since 2016 is not hard find. US fiscal policy has been more expansionary than in the UK under both the Trump and Biden administrations as shown in the chart below.

Figure 5 - Structural primary budget deficits, difference between USA and UK % of GDP (IMF data)

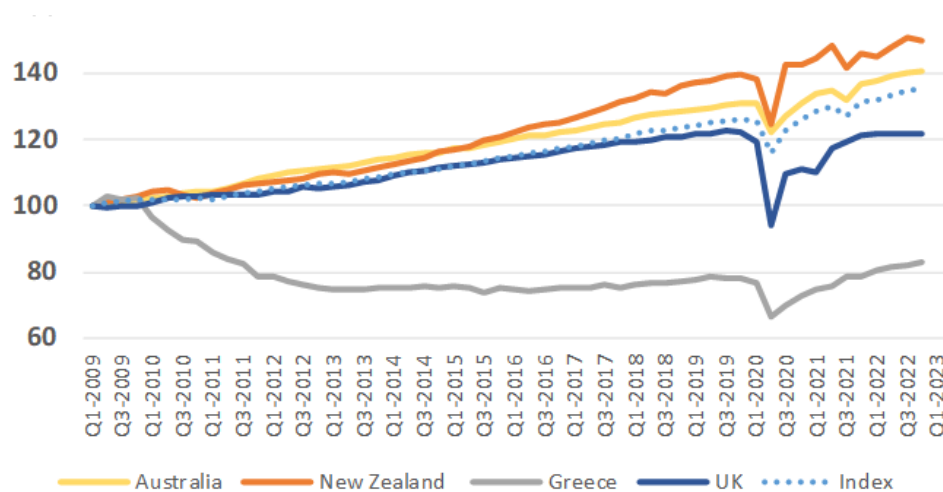


The CER argues that even excluding the USA from the index a similar result is obtained. In this case the index is composed almost wholly of countries for which the change in GDP 2009q1-2016q2 is not significantly correlated with that in the UK. It is thus an index composed largely of what are essentially random variables, but variables which (with the exception of Greece) were on an upward trajectory during the pre-referendum ‘fitting’ period.

The point can be seen in the chart below showing the GDP volume index for the UK alongside the indices for Australia, New Zealand and Greece. The antipodean economies grew faster than the UK before the referendum and have continued to do so subsequently. The Australian and New Zealand indices from the CER list can be combined with a slower growing country like Greece to generate an index¹⁷ which matches well the UK trajectory for GDP over the 2009-2016 period and generates a Brexit’ impact similar in size to the full doppelganger above.

¹⁷ Weights of 0.72, 0.16 and 0.12 for Australia, New Zealand and Greece respectively provide a good fit to UK GDP for the period 2009q1-2016q2. These weights which are close to proportional to the GDP in US dollars for each country, are all positive and sum to unity as in a SCM analysis. The R^2 value for a linear regression with no constant, for 2012q1-2016q2 is 0.987.

Figure 6 – GDP volume index with 2009Q1=100, selected countries



Source of data: <https://stats.oecd.org/Index.aspx?DataSetCode=QNA#> The index uses weights of 0.72, 0.16 and 0.12 respectively for Australia, New Zealand and Greece.

Even though this Australia-New Zealand-Greece index fits the UK time series well over the pre-referendum period its economic rationale is not obvious. It is crucial to the construction of a SCM doppelganger that the choice of variables is made on convincing evidence as to their relevance. Even so, this index still generates a negative 'Brexit' impact for the UK and this should be explained. One factor in this particular case is the improved economic performance of Greece after 2016. Despite slow growth after 2016, Greece's economic performance was nevertheless much better than the decline which followed the banking crisis. Other factors may be involved and we would need to examine the fiscal stances of Australia and New Zealand and the expansion of China and other important export markets for these two countries. One thing that does emerge from this index is that the UK post-covid recovery (relative to the index) stalls from the second half of 2021 following the UK's actual departure from the EU in January 2021. Something similar, but less marked, occurs using the indices formed from the ECM regression and the CER doppelganger. Whether this is due to Brexit or to Covid-related factors, such as differential rates of return to work following the pandemic, requires further research. In any case, the period since 2021q2 currently has data for only six quarters and no important conclusion can yet be drawn on the impact of Brexit.

CONCLUSIONS

While we recognise the potential value of SCM and other difference in difference type analyses, the meaningfulness of any particular application depends on the way in which the weights are derived and how these weights are deployed in constructing a synthetic index. It is not obvious that the technique is appropriate for use with time series data as in the CER's Brexit analysis. In the case of the CER doppelganger index, the weights were chosen to minimise the differences between the UK and 22 other countries across a range of six economic variables. In each case the minimisation was done for a relatively short period in a complex manner. The selected weights were then applied to GDP indices for the 22 countries to construct the doppelganger index. The idea was to select a weighted average group of national economies structurally similar to the UK and similar in their growth over the part of the pre-Brexit periods.

The problems with this application are two-fold. Firstly, the structural variables are somewhat arbitrary and adapted from the study of West German unification by Abadie et al to match GDP per head (i.e. living standards or productivity) rather than the growth of GDP. The two are related but only loosely over short periods. Secondly, the weights apply to all 22 countries in the dataset despite the fact that GDP growth in almost all of these economies is not significantly related in the statistical sense to GDP growth in the UK. Many of these countries are not particularly similar to the UK, either in economic characteristics or in growth of GDP 2009q1-2016q2. Most extreme is Greece where per capita GDP is under half that of the UK and where the economy was declining in the years between the banking crisis and the Brexit referendum. Tax-havens, especially Ireland with its highly distorted GDP data, are another example.

It is in fact easy to construct a weighted combination of countries to match the path of GDP in the UK. Countries with faster growth than the UK (e.g. Australia and New Zealand) need to be combined with a slower-growing economy like Greece to achieve the match. A regression-based approach based solely on statistically-significant relationships reveals that the best fit comes from the USA plus additional short-term influences from other major trade partners Germany and Switzerland. This is more transparent about what is happening. The heavy influence of the USA produces an index in which matched GDP growth in the UK both up to the referendum and subsequently grew faster than the UK due to fiscal expansion under the Trump and Biden administrations. Any country compared to such a US-dominated index will appear weak after 2016. This is true for other major economies, including Germany and Japan, even though no-one suggests that Brexit is the cause.

In summary, what the CER doppelganger index has picked up is the widening difference in GDP growth after 2016 between the USA and UK. If the USA is dropped from the index, then a similar

result is still possible as long as some fast-growing economies are combined in the index with slower growing economies. It is not obvious that the resulting counterfactuals will be reliable, especially over short time-periods. It is helpful to attempt to match countries with similar levels of economic development, but a meaningful comparison would also need to match other major influences on economic growth such as fiscal and monetary policy and economic expansion in the main trade partners. This is asking a lot and may not be feasible in practice. As long as economic growth in the UK is keeping pace with its major trade partners, or is falling behind for easily understood reasons unconnected with Brexit, there is probably little reason to become exercised with Brexit or its reversal.

Perhaps the last word can go to Abadie. *“Synthetic controls provide many practical advantages for the estimation of the effects of policy interventions and other events of interest. However, like for any other statistical procedure (and especially for those aimed at estimating causal effects), the credibility of the results depends crucially on the level of diligence exerted in the application of the method and on whether contextual and data requirements are met in the empirical application at hand. In this article, I emphasize the notion that mechanical applications of synthetic controls that do not take into account the context of the investigation or the nature of the data are risky enterprises.”*¹⁸

¹⁸ Data Requirements, and Methodological Aspects, *Journal of Economic Literature* 2021, 59(2), 391–425

ANNEX

Weights used in the CER GDP doppelganger index

United States	0.304
Germany	0.152
New Zealand	0.143
Norway	0.08
Australia	0.055
Iceland	0.053
Canada	0.042
Switzerland	0.028
Greece	0.023
Denmark	0.022
Luxembourg	0.02
Sweden	0.017
Netherlands	0.014
Ireland	0.013
Portugal	0.011
Spain	0.009
Italy	0.007
Finland	0.005
France	0.001
Austria	0
Belgium	0
Japan	0

Weights used in revised estimates J Springford June 2023

United States	0.28
Germany	0.25
New Zealand	0.13
Australia	0.07
Portugal	0.06
Iceland	0.04
Luxembourg	0.04
Finland	0.03
Norway	0.03
Belgium	0.02
Ireland	0.02
Netherlands	0.02
Greece	0.01
Austria	0
Canada	0
Denmark	0
France	0
Italy	0
Japan	0
Spain	0
Sweden	0
Switzerland	0

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