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## How the short run effects of Brexit on trade, investment and GDP have been miscalculated in some recent work

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# Cardiff Economics Working Papers



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## **How the short run effects of Brexit on trade, investment and GDP have been miscalculated in some recent work**

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**Abstract:** We look for statistically significant effects of Brexit events in UK data relationships. We find evidence of trade disruption by Brexit departure from the single EU market, much as we would expect. However, with investment, we find no statistically significant effects of Brexit. With GDP, inflation and interest rates we find some positive effects due to the fall in the pound. Previous work using weighted averages of selected other countries to mimic UK behaviour is inconsistent with economic theory stressing the key role of idiosyncratic country structure and shocks; it is also vulnerable to selection bias and does not test for the statistical significance of Brexit events, which have occurred in the context of enormous turbulence in the past few years in all economies due to Covid and the Ukraine war, besides accompanying large fiscal and monetary policy fluctuations.

### **Introduction**

There has been a lot of recent comment in the media to the effect that Brexit has damaged trade and the economy, for example, from LSE's Dr. Swati Dhingra in oral evidence to the Commons Treasury Committee<sup>1</sup>, and also Chris Giles' recent report in the FT<sup>2</sup>. Yet these claims are puzzling, given the numerous shocks that have hit both the world generally and the UK in particular, including Covid and the Ukraine war. How can it be possible to discern a Brexit effect in all this volatility? Of course, the economy today has many problems; to those who opposed Brexit, it must be tempting to blame them on Brexit. However, the issue when so many shocks are impacting on the economy, is to sort out the wheat from the chaff and identify the Brexit element in them all. This is the task that good statistical methods aim to address. In principle, the way they take is to set out a 'normal relationship' determining the economic variables of interest and then to identify the point of time at which the Brexit element intervened; this key date of Brexit arrival then allows us to identify the Brexit effect mathematically as a shift in the relationship definitely due to Brexit owing to its coinciding with that date. This type of analysis is known as an 'event study'. Because there are so many other shocks occurring before and after this event, the question arises whether the estimated effect is 'statistically significant'. By this is meant that it could not have occurred by chance, rather than due to the event- here Brexit. This is judged by estimating a range of estimated effects that could occur simply by chance due to general shock volatility. The estimated effect is considered to be due not just to chance if it is bigger than this range: it is then considered to be 'statistically significant'. Usually we set this range at what could occur with up to 95% probability; if the estimated effect exceeds this, it would only have a 5% chance of occurring and so we consider that the event most probably had an effect. This is the yardstick we will use in judging whether there was an effect or not for sure.

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<sup>1</sup> <https://committees.parliament.uk/committee/158/treasury-committee/publications/oral-evidence/> -Nov16

<sup>2</sup> <https://www.ft.com/content/e39d0315-fd5b-47c8-8560-04bb786f2c13>

Accordingly, we have looked carefully for such effects on the relevant UK data; they should show up as big statistically significant effects of the date of Brexit in appropriate regression relationships of UK variables on their determinants. Of course, the data has notoriously been highly volatile due to the major shocks just noted. This militates against finding significant Brexit effects, as common sense indicates. To anticipate our findings, we find significant effects of trade disruption from Brexit but no effects on investment or GDP, as claimed in the comments quoted above.

As noted in the FT by Giles, the work that claims to find damaging Brexit effects mainly uses ‘doppelgänger (D) methods’ in which a group of other economies which in the past has behaved similarly to the UK is compared with the UK over the period since Brexit; if performance changes this is attributed to Brexit. There are three problems with this method. The first is that there is no such relationship in economic theory: every country is different because of its own economic structure and its own shocks from policy, firms and consumers. Valid relationships are based on each country’s own behaviour, based on a model of this or the solution from such a model, such as a Vector Autoregression.

The second is that the D method of finding a ‘comparable’ average set of countries creates a potential for selection bias, in that the group can be selected precisely because it ‘shows an effect’; those using this method claim to have controlled for this by using an algorithm that chooses country weights based solely on maximising the group similarity to the UK prior to Brexit. Their superficial claim is that this similarity of the chosen country group makes it ‘the same’ as the UK in causal processes and behaviour; but this claim is plainly incorrect as all these countries are different in numerous ways. What we have is an average where country shocks cancel out; but this does not imply it is the same economy, obeying the same shocks and with the same behaviour. Economic theory tells us this cannot be the case.

The chosen D Group (e.g. in the Centre for European Reform paper, ‘What can we know about the cost of Brexit so far?’<sup>3</sup>) is a weighted average of a variety of countries chosen differentially for each ‘comparison’ of the UK with others- trade, investment, GDP etc: for each a different D group is chosen to match UK data. The first problem with this method, as just noted, is that there is no reason to expect this D Group to be directly causal of the UK’s behaviour. The second is that it is vulnerable to selection bias: the group for each comparison is chosen ad hoc for the purpose in hand- this can in practice bias the choice to ‘prove’ the effect desired. To avoid this, if one is going to compare performance, countries should be chosen that are similar in economic structure, such as trade and production composition, to the UK. This was a point made powerfully by Gudgin, Jessop and Western (2022) in their paper for Briefings for Brexit<sup>4</sup>, where they showed in a number of comparisons with countries structurally like the UK that there was no evidence of a Brexit effect.

The best general group of countries to which the UK is related through its economic relationships is the OECD average, on which one would expect the UK’s economic behaviour to be dependent, both because we trade a lot with these countries and so their fluctuations affect demand for our output. This is not using the group as a comparator but as an exogenous variable directly influencing UK performance. As such, there is no issue of selection because the OECD average is based on relative size in the world economy, which is the relevant measure

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<sup>3</sup> [https://www.cer.eu/sites/default/files/pbrief\\_costofbrexit\\_8.6.22\\_0.pdf](https://www.cer.eu/sites/default/files/pbrief_costofbrexit_8.6.22_0.pdf)

<sup>4</sup> <https://www.briefingsforbritain.co.uk/what-impact-is-brexit-having-on-the-uk-economy/>

of its influence on us. The D group weights by contrast chosen differ substantially from this, giving high weights to economies like Australia, New Zealand and Iceland that have little effect on the UK.

The third and important problem with the 'D method' is that it identifies the effect of Brexit as any changes in the UK's performance since Brexit compared with the estimated relationship.

This is manifestly incorrect. There are many other shocks to any UK relationship occurring both before and after Brexit that can between them generate these changes. It is necessary to identify carefully the shock due to the Brexit 'event' and estimate its size. The standard way to do this in such 'event studies' is to introduce a 'dummy variable' into a regression of the UK relationship which takes the value of one from the date of the event- namely, here the dates of the various EU exit events; for simplicity we identify two key events: the referendum result (known from Q3 2016) and the exit from the single market and customs union (from Q1 2021). Our argument is that the coefficients on these event terms must be statistically significant to be evidence of a Brexit effect, as opposed to being simply part of the statistical noise, i.e. all those other shocks, surrounding the relationship.

Our approach is to estimate valid UK relationships based on economic theory and check if the Brexit events shift them significantly. Thus for trade we estimate import and export equations in which UK and world demand and competitiveness enter. For investment/GDP we estimate a relationship with the OECD ratio proxying world forces driving investment that would also affect the UK. For GDP, we estimate a relationship with OECD GDP as a world demand variable impacting the UK through trade. In all these relationships the error terms reflect UK shocks and there is a lagged dependent variable picking up slow adjustment. We interpret all these relationships as the result of UK and foreign shocks interacting in a structural model of the UK and giving rise to the observed UK behaviour as solved out ('reduced form'). We then insert the Brexit dummies to check whether Brexit shifted them.

We can now use economic theory to suggest how the Brexit events might impact on the UK economy. As we have noted by Minford and Meenagh (2020) the effects of Brexit will come in over the long term as free trade agreements are completed and a new regulative environment established. In the short run we expect some temporary and minor disruption as existing relationships with the EU are remade under UK independence; 'temporary and minor' because the Trade and Cooperation Agreement is intended by both the UK and the EU to maintain cooperation and avoid new trade barriers, whereas short run effects as people and firms adapt may well be found. But we would not expect to find any permanent effects.

### **Empirical analysis**

Any effects of Brexit must come through via trade, so we explore here first the effects on trade before looking at those on GDP and investment. In examining trade, in our first set of regressions we specify normal trade demand relationships and check whether they shifted due to the Brexit dummies. We examine imports and exports, to the EU and to the non-EU; in volume terms and in current price terms, the latter including effects on traded prices.

**Table 1 Variable definitions**

<b>Dependent Variable</b>	<b>Definition</b>	<b>Source</b>
Export EU	Exports trade goods & services EU, SA	ONS
Export non-EU	Exports trade goods & services Non-EU, SA	ONS
Import EU	Imports trade goods & services EU, SA	ONS
Import non-EU	Imports trade goods & services Non. EU, SA	ONS
<b>Independent Variable</b>		
RXR	Effective real Exchange rate index	BoE
UK GDP	GDP, Chained Volume measure (CVM), SA	ONS
EU GDP	Millions of Chained 2010 Euros, Seasonally Adjusted	Eurostat
World import	Import trade in goods & services, constant price & PPPs	OECD
Brexit dummies	Referendum: 1 from Q3 2016; departure 1 from Q1 2021-rest 0	-
COVID dummy	1 from Q2 2020 to Q4 2020, 0 otherwise	-
COVID recovery dummy	Q1 2021 = 1, 0 otherwise	-

$$\ln(\text{Export EU}_t) = C + \beta_1 \ln(\text{Export EU}_{t-1}) + \beta_2 \ln(\text{EU GDP}_t) + \beta_3 \ln(\text{RXR}_t) + \beta_4 \text{Brexit referendum} + \beta_5 \text{Brexit departure} + \beta_6 \text{COVID} + \beta_7 \text{COVID recovery} \quad (1)$$

$$\ln(\text{Export nonEU}_t) = C + \beta_1 \ln(\text{Export nonEU}_{t-1}) + \beta_2 \ln(\text{World import}_t) + \beta_3 \ln(\text{RXR}_t) + \beta_4 \text{Brexit referendum} + \beta_5 \text{Brexit departure} + \beta_6 \text{COVID} + \beta_7 \text{COVID recovery} \quad (2)$$

$$\ln(\text{Import EU}_t) = C + \beta_1 \ln(\text{Import EU}_{t-1}) + \beta_2 \ln(\text{UK GDP}_t) + \beta_3 \ln(\text{RXR}_t) + \beta_4 \text{Brexit referendum} + \beta_5 \text{Brexit departure} + \beta_6 \text{COVID} + \beta_7 \text{COVID recovery} \quad (3)$$

$$\ln(\text{Import nonEU}) = C + \beta_1 \ln(\text{Import nonEU}_{t-1}) + \beta_2 \ln(\text{UK GDP}_t) + \beta_3 \ln(\text{RXR}_t) + \beta_4 \text{Brexit referendum} + \beta_5 \text{Brexit departure} + \beta_6 \text{COVID} + \beta_7 \text{COVID recovery} \quad (4)$$

**Table 2: Trade in volume, OLS estimate results, 2005Q1 to 2022Q2**

	Export EU	Export non-EU	Import EU	Import non-EU
Lagged dependent variable	0.475* (0.093)	0.287* (0.112)	0.550* (0.055)	0.541* (0.065)
EU GDP	0.575* (0.248)			
World imports		0.443* (0.093)		
UK GDP			1.154* (0.154)	1.026* (0.169)
RXR	-0.031 (0.084)	-0.320* (0.114)	-0.376* (0.071)	-0.393* (0.083)
Brexit referendum	0.014 (0.031)	-0.014 (0.026)	-0.043* (0.017)	-0.047* (0.021)
Brexit departure	-0.032 (0.030)	-0.151* (0.045)	0.026 (0.017)	0.005 (0.020)
COVID	-0.107* (0.038)	-0.126* (0.041)	0.062* (0.027)	0.031 (0.030)
COVID recovery	-0.179* (0.059)	0.021 (0.068)	0.005 (0.037)	0.009 (0.043)

Note: \*significant at the 5% level; Constant is not reported but included in the regression

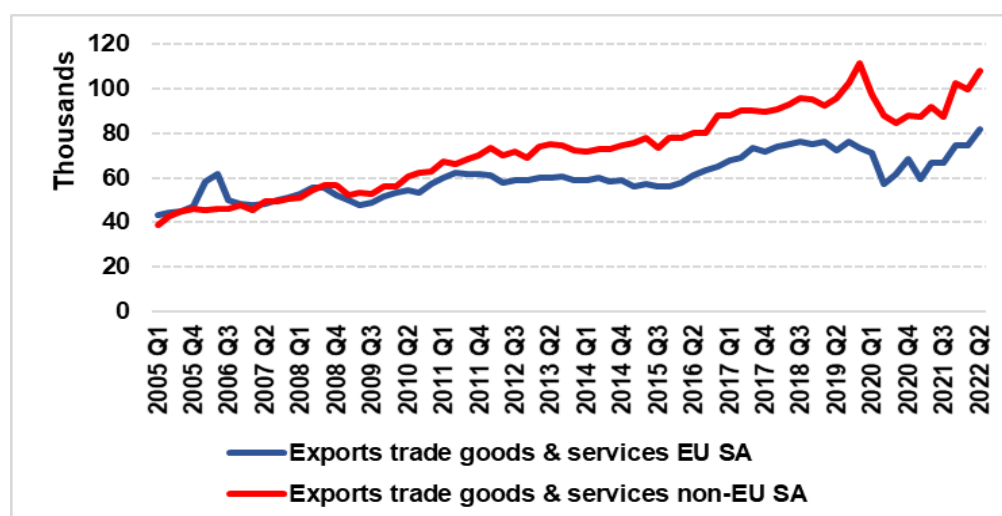
**Table 3 Trade in current prices, OLS estimate results, 2005Q1 to 2022Q2**

	Export EU	Export non-EU	Import EU	Import non-EU
Lagged dependent variable	0.515* (0.089)	0.486* (0.078)	0.366* (0.107)	0.425* (0.091)
EU GDP	0.422* (0.142)			
World imports		0.497* (0.084)		
UK GDP			0.745* (0.145)	0.722* (0.136)
RXR	-0.123 (0.087)	-0.303* (0.080)	0.022* (0.094)	-0.356* (0.097)
Brexit referendum	0.036 (-0.025)	0.009 (0.016)	0.021 (0.028)	-0.030 (0.022)
Brexit departure	-0.002 (0.031)	-0.060* (0.025)	-0.092* (0.042)	0.072* (0.025)
COVID	-0.076* (0.032)	-0.020 (0.024)	-0.111* (0.040)	-0.033 (0.029)
COVID recovery	-0.175* (0.055)	0.013 (0.042)	-0.200* (0.065)	-0.063 (0.049)

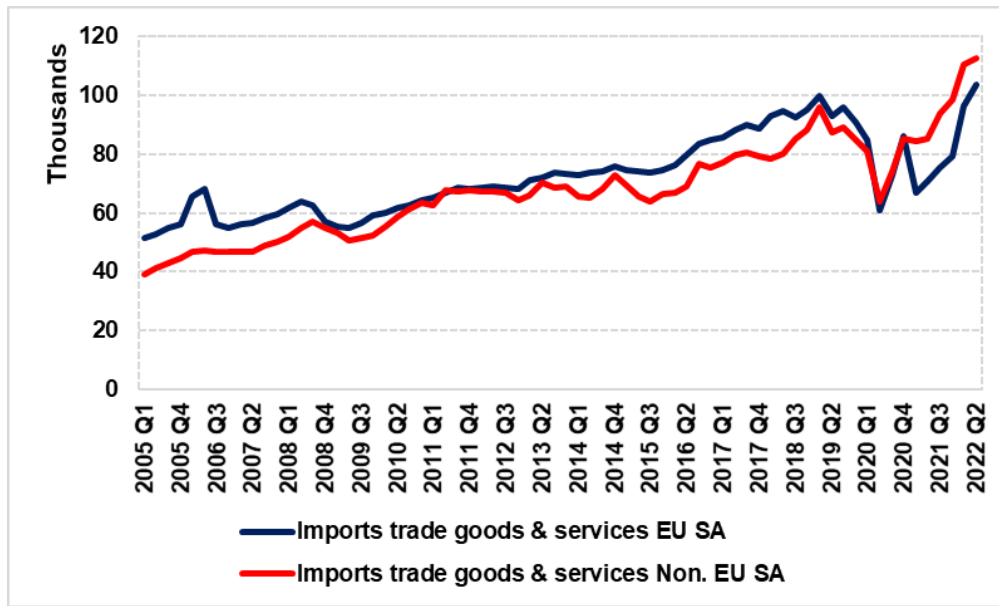
Note: \*significant at the 5% level; Constant is included in the regression

What we see is that there a significant Brexit effect in several of these regressions, as we would expect. Coefficients in the regression that are significant at the 5% level are asterisked. The data are heavily trended so we do not interpret the regression coefficients as structural relationships but as ‘reduced form’ ones reflecting the correlation of the underlying trends. The focus here is only on whether they are shifted by Brexit. In volume terms, the Brexit departure in Q1 2021 significantly reduced the value of non-EU exports and the referendum significantly reduced the value of both EU and non-EU imports. In current price terms the referendum had no significant effect; but Brexit departure hit non-EU exports and raised non-EU imports at the expense of EU imports. Notice that there were also substantial effects of COVID. Thus both the introduction of the new UK border in place of the old EU border and the pandemic significantly disrupted trade.

**Figure 1 UK Export, EU and Non.EU**



**Figure 2** UK Import, EU and Non.EU



We go on to consider the investment/GDP ratio and regress the UK data on the OECD data, as follows. The regression relates the UK investment/GDP ratio to that in its OECD peers; we include this variable as a proxy for worldwide influences on investment which could also affect the UK. As the Figure 3 of the two series shows, shows, the UK ratio is lower than the OECD average, probably because as a predominantly service economy UK capital is much more intangible so not included in the fixed investment figures. The UK ratio is also more stable than the OECD's, fluctuating about half as much, probably for the same reason. It can be seen from table, there is no significant effect of Brexit. Because there could be expectations effects from the Brexit referendum, we include the referendum dummy in these regressions.

**Table 4 Variable definitions**

<b>Dependent Variable</b>	<b>Definition</b>	<b>Source</b>
UK investment	Total gross fixed capital formation, CVM, SA	ONS
UK GDP	Gross domestic product, CVM, SA	ONS
<b>Independent Variable</b>		
OECD Investment	Total gross fixed capital formation, CVM, fixed PPP, SA	OECD
OECD GDP	Gross domestic product, CVM, fixed PPP, SA	OECD
Brexit dummies	Referendum: 1 from Q3 2016; departure 1 from Q1 2021-rest 0	-
COVID dummy	1 from Q2 2020 to Q4 2020, 0 otherwise	-
COVID recovery dummy	Q1 2021 =1, 0 otherwise	-

Note: \*significant at the 5% level; Constant is included in the regression

$$\ln(\text{UK Investment GDP ratio}_t) = C + \beta_1 \ln(\text{UK Investment GDP ratio}_{t-1}) + \beta_2 \ln(\text{OECD investment GDP ratio}_t) + \beta_3 \text{Brexit referendum} + \beta_4 \text{Brexit departure} + \beta_5 \text{COVID} + \beta_6 \text{COVID recovery} \quad (5)$$



**Table 5 Investment GDP ratio, 2005Q1 to 2022Q**

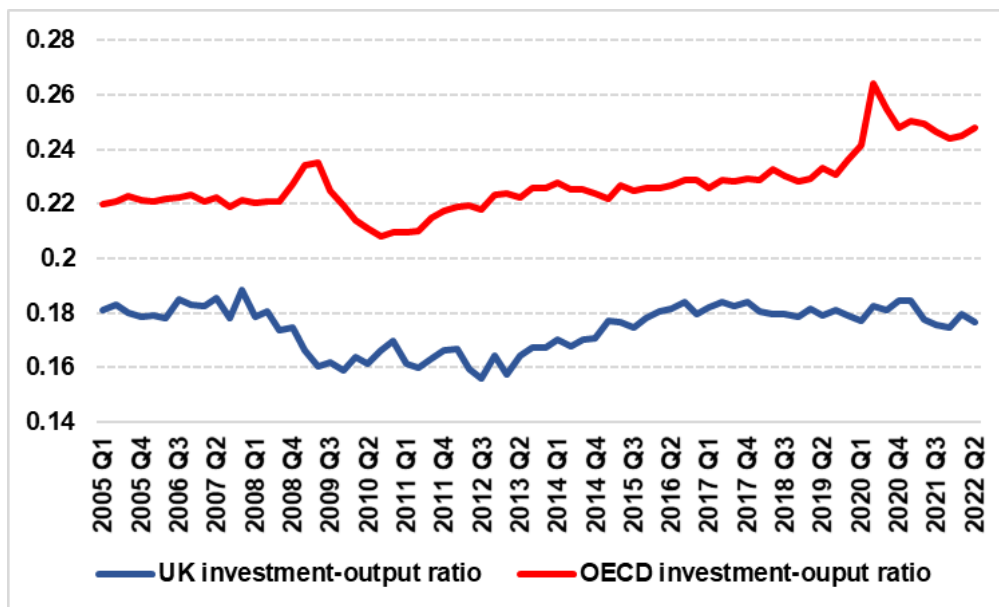
	UK Investment/GDP
Lagged UK Investment/GDP	0.837* (0.071)
OECD Investment/GDP	-0.033 (0.099)
Brexit referendum	0.002 (0.001)
Brexit departure	-0.001 (0.003)
COVID	0.003 (0.004)
COVID recovery	0.002 (0.005)

Note: \*significant at the 5% level; Constant is included in the regression

As can be seen the investment/GDP ratio is only related to its own past. Neither the OECD ratio nor any of the dummies have any effect.

We now turn to GDP.

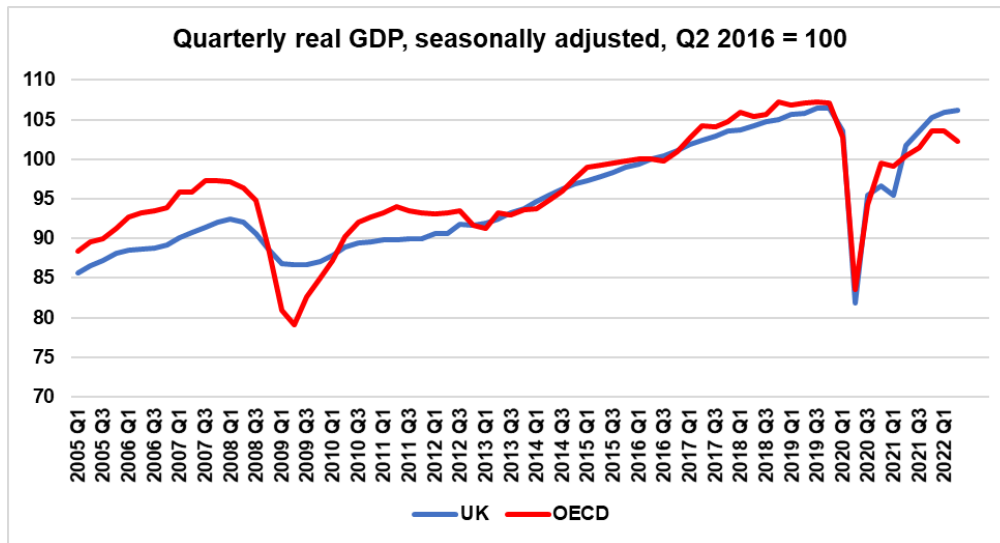
**Figure 3 Investment-output ratio, UK and OECD**



Next, we do the same for GDP, regressing the UK on the OECD as a major influence on our economy via trade demand; again we include the same dummy variables. We find here that both the Brexit dummies have a small but significant positive effect. The OECD has a strong effect, and Covid has a strong negative effect.

$$\ln(UK\ GDP_t) = C + \beta_1 \ln(UK\ GDP_{t-1}) + \beta_2 \ln(OECD\ GDP_t) + \beta_3 \text{Brexit referendum} + \beta_4 \text{Brexit departure} + \beta_5 \text{COVID} + \beta_6 \text{COVID recovery} \quad (6)$$

**Figure 4 Output, CVM index measure, UK and OECD**



**Table 6 GDP regression, CVM, 2005Q1 to 2022Q2**

	UK GDP
Lagged UK GDP	0.242* (0.074)
OECD GDP	0.553* (0.065)
Brexit referendum	0.031* (0.011)
Brexit departure	0.023* (0.011)
COVID	-0.035* (0.016)
COVID recovery	-0.059* (0.024)

Note: \*significant at the 5% level; Constant is included in the regression

**Using a full macroeconomic model and its implied relationships to check for Brexit effects**

So far we have explored some fairly simple relationships implied by a UK model for its data behaviour. Now we turn to an exploitation of a full model of the UK, estimated in recent years and which we use for our forecasting activities- for a full write-up see Zhu (2017)). This model was estimated by indirect inference, with its parameters selected to create the closest possible match between the model’s simulated behaviour and the actual data behaviour. The latter is represented by a VARX, in which the economy’s variables are related to their own past and to exogenous variables (X) representing trend influences such as productivity. We show this below.

To discover the Brexit effects we insert our Brexit dummies into the VARX to find their estimated impact. We then see how this impact would alter the path taken by the economy according to the model.

The first and the biggest effect we find is the Brexit referendum impact on the exchange rate, depreciation of 8.5% on the day the result was announced. This shock acts as a stimulus to the economy, raising, output, inflation and interest rates.

Next, we estimate a VARX for our four variables together with the Brexit dummies relating to the post-referendum and departure periods. In this VARX we find a variety of significant coefficients on these dummies. Output is reduced on departure presumably by net export disruption. Inflation rises both post-referendum and post-departure; interest rates rise post-referendum. These shocks seem to be connected with continuing sterling weakness.

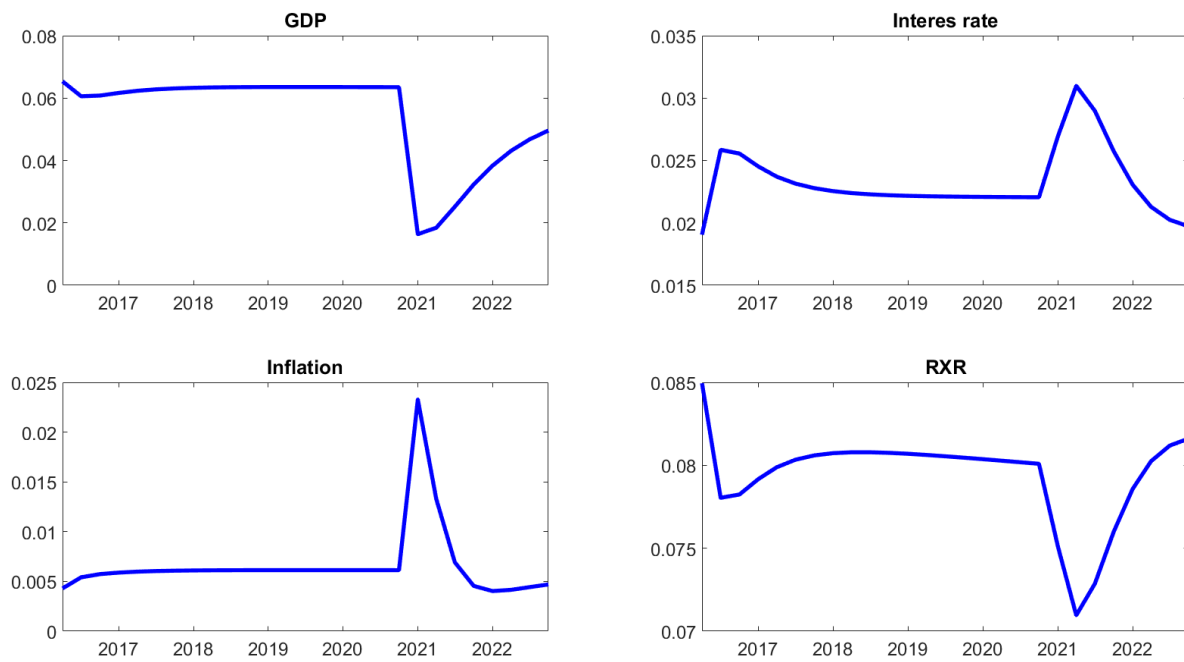
**Table 7 VARX estimation results, 2005Q1 to 2022Q2**

	GDP	Inflation	Interest rate	RXR
Lagged GDP (-1)	-0.352* (0.102)	1.343 (3.212)	-0.610 (1.109)	-0.065 (0.0690)
Lagged Inflation (-1)	0.005 (0.003)	0.964* (0.085)	0.167* (0.047)	-0.000 (0.004)
Lagged Interest rate (-1)	0.010* (0.003)	-0.079 (0.099)	0.716* (0.052)	-0.005 (0.004)
Lagged RXR (-1)	0.116 (0.070)	0.695 (2.153)	6.669* (1.187)	1.007* (0.096)
Brexit referendum	0.009 (0.011)	0.591 (0.355)	0.610* (0.202)	-0.023 (0.016)
Brexit departure	-0.039* (0.014)	1.913* (0.464)	-0.275 (0.204)	0.019 (0.021)
COVID	-0.180* (0.017)	-0.217 (0.525)	-0.109 (0.236)	0.000 (0.024)
COVID recovery	-0.079* (0.035)	-1.594* (0.702)	0.422 (0.394)	0.019 (0.032)

Notes on VARX: Below each coefficient in parenthesis is shown the standard error and the t-value; those with t-value greater than 2 are considered significant at 5% and are asterisked and used in the model simulation. The VARX includes a time trend and the log of potential output (derived from an HP filter) as the X set of trended variables.

When we put all these Brexit shocks into the UK model, we get an overall set of impulse responses that tend to raise output slightly, and raise inflation and interest rates measurably, largely in response to a depreciating pound. What it all amounts to therefore is no real net effects on output but modest rises in inflation and interest rates, with a depreciation of the pound. In the context of the Covid period of a weak economy with weak inflation and interest rates close to zero, these effects are hardly damaging. The big policy mistake of the Covid era was a greatly excessive monetary stimulus that pushed up asset prices and pushed interest rates close to zero. Beside this, the Brexit effects are largely nugatory. The Figure below shows the combined impact of these Brexit-related shocks on the economy since 2016.

**Figure 5 IRFs to joint shocks in a full macroeconomic model**



## Conclusions

Thus we find in this data evidence of trade disruption by Brexit departure, much as we would expect. However, with investment, we find no statistically significant effects of Brexit. With GDP we find some positive effects. We also find some small positive effects on interest rates and inflation due to the fall in the pound. There has been enormous turbulence in the past few years in all economies due to Covid and the Ukraine war, besides accompanying large fiscal and monetary policy fluctuations. This can be seen in the charts of these data series, shown above. Brexit is one policy shift among many shocks, and estimating its effect is fraught with uncertainty. Economic theory suggests it will have had a disruptive effect on EU trade in the short run as businesses adapt to a new border and the resulting new paperwork and related processes. But the TCA is designed to create a barrier-free and seamless border; so we should expect this effect to be dissipated steadily- including in the future as the TCA is streamlined by new talks- and not to be permanent. This is consistent with these regressions on the data.

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