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Modelling events: The short-term economic impact of leaving the EU☆

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ABSTRACT

This paper presents a framework for modelling important socio-economic events in order to provide an informative counterfactual. This involves mapping the deep underlying shock associated with the event itself into a series of more tractable shocks consistent with the model being applied and calibrated from data, existing literature or ancillary analysis. The results should then be subject to testing of their sensitivity to the assumptions made. As a practical example, the paper uses the National Institute's Global Econometric Model (NiGEM) to consider the short-term economic impact to the UK of leaving the European Union. We find that the UK economy would be around 2 1/2% smaller 2 years after a decision to leave the EU when compared to the counterfactual of deciding to remain a member.

1. Introduction

Counterfactual paths for the economy, or forecasts conditional on a specific deviation, are a common feature of economic modelling. They can inform about the likely impact of a policy change, such as a decision by the monetary authority to raise interest rates, or of shocks such as an unanticipated drop in the global oil price.

The same analytical techniques used in the creation of such counterfactuals can also be applied to understanding the potential outcomes of more complex, large-scale socio-economic events. These events can be characterised as forks in the road travelled by the economy whereby the event itself determines which path prevails.

At the time of writing the impending referendum on the United Kingdom's continued membership of the European Union (EU) is one such event. As with many of these significant socio-economic events, the fact that the event will occur is foreseeable and anticipated, even though the precise outcome is not. In the case of the EU referendum, the date of the vote, 23rd June 2016, was officially announced 4 months earlier in February 2016, with a vaguer commitment that it would take place in the near future signalled even earlier. It also represents a relatively clear-cut fork in the economy's trajectory with the option to maintain the status quo or transition to a new regime, and the choice over which of these futures occurs decided at a fixed point in time. Whilst prior to the event either outcome may prevail, reflected by the highly bi-modal nature of the probability distribution, once the event has occurred, in this case the vote itself, the distribution of outcomes will be narrowed to only those associated with that outcome. That is not to say that there will not exist a distribution of outcomes associated with each path, or even conceivably some overlap in the distributions around each. For instance, a narrow margin on the vote, either way, may lead to a very different outcome compared with a world in which the result is decisively in favour of one campaign or the other. However, despite this, the question facing voters in the referendum is binary, and so this presents a useful basis for deriving a counterfactual.

Such an event allows for a specific type of modelling exercise to be undertaken. It becomes possible to think about the two distinct possible states of the world separately and thus contrast the impact of taking one path compared to the other. In essence the bi-modal view of the future is disaggregated to the two separate modes, each conditioned on the outcome of the event being one way or the other.

The main contribution of this paper is two-fold. First, as a general point it seeks to provide a blueprint for undertaking an exercise of the nature described above. Second, it provides a practical exposition of the proposed method by means of a contemporary example, the UK's referendum on membership of the EU. In doing so it provides both a qualitative and quantitative assessment of the likely impact for the UK economy of a decision to leave the EU.

In a similar piece of work using NiGEM's predecessor, NiDEM, Pain and Young (2004) also analyse the effects of leaving the EU on the UK economy. They conclude that living standards would be adversely affected, mostly due to a decline in technical efficiency resulting from lower future levels of inward FDI. Our analysis differs from theirs in that we are primarily concerned with the short-run effects of a decision

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to leave the EU and we additionally include the effects of heightened uncertainty and associated increases in risk premia as trade deal negotiations take place.

To that end, the remainder of the paper is structured as follows; Section 2 details the proposed framework for studying a socio-economic event of the type described. Section 3 provides a general overview of the model used in the applied work, which follows in Sections 4–7. Section 8 then describes the particular results of our work on the European Union before the paper concludes.

2. Modelling a large socio-economic event

The referendum on the UK's membership of the European Union represents a large and complex shock that will transmit through the economy via a myriad of channels. Other such examples might be a switch to an independent central bank, see for example Chadha et al. (2007) who analyse the effects of the surprise decision by the UK government to grant operational independence to the Bank of England, or German unification, see Hallett et al. (1996).

Most, if not all economic models are ill-equipped for the introduction of a deep shock of this nature in its most primitive form. Rather, the first stage of any analysis of such an event must be a mapping exercise, decomposing the underlying disturbance into a constellation of more tractable shocks based on the likely channel of transmission and that, when applied in conjunction with one another, serve as a reasonable proxy for the single primitive innovation.

It is then necessary to provide plausible calibrations for each of these chosen shocks. This can be done by analysing historic data, drawing on the existing evidence base, or through more in-depth ancillary analysis such as impulse response matching, or more generally, using output from one model to inform the inputs for another. It is this 'inputs' stage that can introduce variation in eventual outcomes, even among economists that agree on the broad qualitative narrative and even among those that use the same modelling framework for their analysis.

Having established the set of shocks that drive the analysis and their calibrations it is enlightening to evaluate each in turn. This allows the clear exposition of the various transmission mechanisms at play, and also enables relative comparisons across these channels. For instance, in a scenario of increased risk that manifests as a shock to the exchange rate and a tightening of domestic credit conditions; how much does the impact on demand from a shock to the exchange rate offset the impact from a tightening of domestic credit conditions?

These shocks must then be brought together in a consistent manner. Of crucial importance is the timeline of the socio-economic event in question. Thought must be given to the sequencing of shocks and when exactly the new information contained within the shock enters the decision-making process of agents within the model. This is especially important when operating with forward-looking agents and financial markets, as we do in the exercise that follows. The shock may occur at time t, but if it is anticipated, it may feature either fully or partially, in agents' expectations at time t-1 or earlier. Conversely, if agents are forward-looking but do not anticipate the shock, then any forward-looking variables cannot reflect the shock in their information set until the moment it is introduced, or else agents will pre-emptively change their behaviour, generating an inconsistency in the exercise.

Once all of this is done, and if possible at each stage along the way, sensitivity analysis should be undertaken to gauge how robust the result is to varying assumptions and the choice of shock size, combination and timing. Other important sensitivity analysis for exercises on shocks like these focus on the policy response. Variation in policy reaction functions can be both a way to ensure robustness, but also of interest in and of itself when policy makers are searching for guidance on how to respond to a large socio-economic event.

In summary, our proposed framework for modelling a large socio-economic event is:

1. Decompose the underlying event into a collection of more tractable shocks consistent with the model to be utilised for the analysis.
2. Calibrate these individual shocks.
3. Analyse each shock in isolation to uncover transmission mechanisms.
4. Combine the shocks in a manner consistent with the event timeline and expectation formations.
5. At all stages, carry out sensitivity analysis to differing calibrations, expectations and policy specifications.

This paper will now consist of an exposition of the process outlined above through the lens of the United Kingdom's referendum on membership of the European Union, held on 23rd June 2016.

3. The NiGEM model

This section provides a succinct non-technical exposition of the National Institute's Global Econometric model, NiGEM. Where relevant to the analysis, details of the model will be presented in the text to follow, but an in-depth discussion falls beyond the scope of this paper.[1]

NiGEM is a global econometric model, and most countries in the EU[2] and the OECD[3] as well as major emerging markets are modelled individually. The rest of the world is modelled through a set of regional blocks so that the model is global in scope. All country models contain the determinants of domestic demand, export and import volumes, prices, current accounts and gross foreign assets and liabilities. Output is tied down in the long run by factor inputs and technical progress interacting through production functions. Economies are linked through trade, competitiveness and financial markets and are fully simultaneous.

Agents are presumed to be forward-looking, at least in some markets, but nominal rigidities slow the process of adjustment to external shocks. The model has complete demand and supply sides and there is an extensive monetary and financial sector, together with household and government sectors. As far as possible the same theoretical structure has been adopted for each country. As a result, variations in the properties of each country model reflect genuine differences emerging from estimation, rather than different theoretical approaches.

Policy reactions are important in the determination of speeds of adjustment. Nominal short-term interest rates are set in relation to a forward looking feedback rule. Long-term interest rates are the forward convolution of future short-term interest rates with an exogenous term premium. An endogenous tax rule ensures that governments remain solvent in the long run; the deficit and debt stock return to sustainable levels after any shock, as is discussed in Chen (2014). Exchange rates are forward looking and so can 'jump' in response to a shock.

Within NiGEM, labour markets in each country are described by a wage equation (see Barrell and Dury, 2003 for a detailed description) and a labour demand equation (see, for example, Barrell and Pain, 1997). The wage equations depend on productivity and unemployment, and have a degree of rational expectations embedded in them – that is to say the wage bargain is assumed to depend partly on expected future inflation and partly on current inflation. The speed of the wage adjustment is estimated for each country. Wages adjust to bring labour demand in line with labour supply. Employment depends on real producer wages, output and trend productivity, again with speeds of adjustment of employment estimated and varying for each country.

[1] For further details, the reader is referred to the separate appendix which accompanies this paper and the NiGEM website: https://nimodel.niesr.ac.uk/.
[2] With the exception of Cyprus, Luxembourg and Malta.
[3] With the exception of Chile, Iceland and Israel.