Research proposal: Utilizing the synthetic control method to investigate the causal impact of Brexit on the UK's scientific performance through publication records. The steps of the research are as follows:

1. Research Objective:

 Investigate how Brexit has affected the UK's scientific performance, specifically through changes in publication output and quality before and after Brexit.

2. Literature Review

- Summary of the existing literature on the impact of political events on scientific output.
- Discussion on the synthetic control method as per Abadie et al. (2010) and its applications in policy analysis.

3. Methodology:

- Description of the data: publication records before and after Brexit.
- Apply the synthetic control method to create a synthetic UK as a comparison group, using data from countries similar to the UK but unaffected by Brexit.
- Collect pre- and post-Brexit publication records as the main dataset, ensuring that data covers a significant period before and after Brexit to capture long-term effects.

4. Variables:

- **Dependent Variables**: Scientific output measures (number of publications, citation impact, research collaboration networks).
- **Independent Variables**: Time (pre- and post-Brexit), Research and Development (R&D) expenditure, researcher mobility.

5. Validation:

- Employ permutation tests to validate the synthetic control model, assessing the distribution of the test statistic under the null hypothesis of no treatment effect (Brexit).
- Analyze potential size distortion of permutation tests through Monte Carlo simulations, as discussed in the literature provided.

6. Research Hypotheses:

- Null Hypothesis (H0): Brexit has no impact on the UK's scientific performance.
- Alternative Hypothesis (H1): Brexit has a significant impact on the UK's scientific performance.

7. Data Analysis:

- Estimate treatment effects by comparing the actual UK's scientific performance to that of the synthetic UK post-Brexit.
- Assess the impact by examining changes in the dependent variables relative to the synthetic control.

8. Validation of Synthetic Control:

 Undertake robustness checks and sensitivity analyses to ensure the credibility of the synthetic control. • Consider alternative methods of inference, if necessary, based on findings from Monte Carlo simulations and the properties of permutation tests.

9. Expected Outcomes:

- Detailed quantification of Brexit's impact on scientific performance.
- Policy recommendations based on findings to mitigate adverse effects or enhance positive outcomes.

10. Limitations:

 Acknowledge potential biases and limitations of the synthetic control method and data availability.

11. Further Research:

 Suggest areas where further studies could explore deeper or broader impacts of Brexit, possibly using other econometric techniques or longerterm data.

This research will include visualizations, such as graphs or charts, to demonstrate the synthetic control model and its findings effectively. It will be presented in a clear, structured manner that articulates the research problem, the synthetic control methodology, and its implications in the context of Brexit and scientific research.