How has the introduction of the Darlington Economic Campus impacted the local economy?

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HOW HAS THE INTRODUCTION OF THE DARLINGTON ECONOMIC CAMPUS IMPACTED THE LOCAL ECONOMY?

A Synthetic Control Difference-in-Differences quantitative analysis

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Abstract

This paper considers the impact of the creation of a public sector hub: the opening of the Darlington Economic Campus (DEC) in 2021. We identify effects of the DEC using a Synthetic Control Difference-in-Differences method applied to local-area level data on the economic indicators of productivity, pay, and employment. We find no significant aggregate effect on productivity or pay, but a negative effect on unemployment. We estimate that, following the introduction of the DEC, unemployment in Darlington was approximately 1.32 percentage points lower than what it would have been in its absence.

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Introduction

The Darlington Economic Campus (DEC) was announced in March 2020 and opened in 2021 in Darlington, North-East England. It is a core component of the then-government's Levelling Up and Devolution agenda and aims to correct regional disparities by decentralising policymaking and bringing civil servants closer to communities. Consisting of over 1000 civil servants from nine government departments (including CMA, DBT, HMT, and the ONS) its primary objective, as outlined in the Interim Evaluation of the DEC (HMT, 2024), is to drive regional economic growth, foster job creation and decentralise policymaking from Whitehall. While this qualitative interim evaluation provided an initial foundation for evaluation of the DEC's success through interviews and surveys, the report lacked detailed quantitative analysis. Therefore, this project aims to fill this knowledge gap by estimating the DEC's causal impact through a Synthetic Control Difference-in-Differences (SCDID) approach.

Economic theory indicates the DEC would generate economic agglomeration effects. The North of England has traditionally been less affluent than London and the South of England, in resources and opportunities. By relocating skilled labour from the South of England to the North-East, the DEC is expected to reduce regional unemployment and raise average wages, as skilled labour typically earns more than the unskilled workforce. This would also generate wider positive externalities, such as driving local economic productivity.

Early insights into agglomeration and labour come from Smith (1776), who linked it to the division of labour, and Thünen (1826) who extended his work by exploring the interactions between fixed and transport costs. Marshall (1980) further refined these ideas by identifying three key agglomeration externalities: a large pool of skilled labour, easy access to local customers or suppliers, and local knowledge spillovers. The DEC directly addresses two of these by increasing the pool of skilled labour and increasing the knowledge spillover through decentralising policy making from London.

The literature debates which externality is most influential. Duranton and Puga (2004) explore the micro-foundations of urban agglomeration, aiming to understand the clustering behaviour in development and look inside the "black box that justifies the very existence of cities". They attribute urban agglomeration to various sharing mechanisms, including shared facilities (both tangible and intangible), access to a wider variety of input suppliers for larger industries, gains from narrower specialisation in large-scale production, and risk sharing.

Mirroring this, the DEC's unique, barrierless working culture fosters collaboration and knowledge sharing among specialists across government departments, which may directly enhance regional productivity. This environment allows experts to share and disseminate their unique and niche knowledge, bolstering the productivity of the working environment and thus the overall productivity of the area.

Governments incentivise regional development and devolution to correct regional disparities across the UK. The Levelling Up White Paper (2022) highlights the UK's greater geographical differences in productivity, pay, education and health compared to many other developed countries. These are attributed to trends like globalisation, technological progress, the shift from technical training to university education, and the move from heavy industry to a service-based economy. This report therefore investigates the DEC's impact on the local economy by analysing pre- and post-treatment differences.

Ensuring social mobility and skill development across the UK is important for both private and public services (McKinsey & Company, 2023). Recognising this, many public organisations have decentralised beyond central London, for example the BBC in Salford, the Bank of England in Leeds, and the Civil Service in Darlington. Whilst we focus on the first-order economic impacts, the intangible and qualitative impacts of initiatives like the DEC are equally important. Social mobility drives better decision-making and improves accessibility for traditionally marginalised communities. These advancements are arguably as important as economic indicators in evaluating the overall success of these initiatives. With greater social mobility projected to increase UK GDP by £19 billion annually and generate over 500,000 jobs (Demos and Co-op, 2024), the success of the DEC and similar programs is vital to foster long-term equality across the UK and improve public services for the entire country.

Academic papers that we have identified as being similar to our empirical question include: Quigley et al (2004) on the effects of 11 new universities in Sweden in the 1970s; Faggio (2019), on the impact of a programme of UK government relocations; Becker et al (2021), on the move of the German government from Berlin to Bonn after WWII; and Nathan et al (2024), who study the causal effects of the BBC's relocation to Salford. Our approach is similar to Nathan et al (2024), who use general synthetic control methods to study the impact on employment and wages, though we utilise the more robust Synthetic Control Difference-in-Differences technique.

Empirical question and estimation strategy

Empirical Question:

Our empirical analysis aims to estimate the causal impact of the establishment of the DEC on the local economic outcomes of productivity, wages and unemployment. This question is critical for evaluating the effectiveness of place-based government policies aimed at regional economic development.

Estimation Strategy:

To answer our empirical question, we employ a Synthetic Control Difference-in-Differences (SCDID) method. This framework is particularly well-suited for estimating the causal effect of real-world interventions when random assignment is unfeasible, and a natural control group is difficult to identify. A standard Difference-in-Differences (DID) model, controlling for time and area fixed effects, can be represented by the following equation.

$$Y_{it} = \beta_0 + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 (Treated_i \cdot Post_t) + \alpha_i + \beta_t + \varepsilon_{it}$$

Where β_3 is our coefficient of interest. This coefficient represents the estimated average treatment effect on the treated (ATT), capturing the causal impact of the DEC on the outcome variable, after accounting for pre-existing differences between Darlington and the control group and general time trends.

However, the validity of a standard DID approach relies on the assumption of pre-existing parallel trends between the treated unit and a naturally occurring control group. In our real-world context, where the DEC was introduced without random assignment and Darlington lacks a clear, comparable counterfactual area, this assumption is unlikely to hold naturally.

Methodological approach:

To overcome the limitations of a standard DID and construct a credible counterfactual, we utilise a synthetic control (SC) method. The core idea of SC involves constructing a 'synthetic' counterfactual unit, created as a weighted average of untreated units and time, representing what Darlington would have been without the DEC. These weights are chosen to minimise discrepancies between the synthetic area and the treated area in their pre-intervention trends, whilst controlling for time and fixed effects between Darlington and the entire set of control areas. By doing so, the method aims to make the vital parallel trends assumption more plausible (Ashenfelter and Card, 1985). As Abadie (2021) states, this technique is ideal for estimating the effects of "interventions that are implemented at an aggregate level affecting a small number of large units (such as cities, regions, or countries), on some aggregate outcome of interest".

To robustly estimate the DEC's impact, we employ an extension of the SC method, the Synthetic Control Difference-in-Differences (SCDID) methodology. This addresses limitations of a standard DID and general SC mechanisms, providing a more accurate and robust estimator for the average causal relationship estimate (Arkhangelsky et al., 2019). Specifically, the SCDID is more robust than general SC approaches, as it emphasises parallel trends in the pre-treatment, rather than SC which tries to match the pre-treatment identically often at a loss of accuracy. Furthermore, SCDID allow for both time and unit weights, whereas general SC only allows for unit weights (Nguyen, 2025). This means that SCDID puts more emphasis on areas and times that are most closely matched to Darlington. SCDID also includes unit fixed effects across all the control areas. Taken together, the SCDID produces a more robust estimation strategy than that of SC or standard DID. The SCDID approach solves the following equation:

$$\left(\hat{\tau}^{sdid}, \hat{\mu}, \hat{\alpha}, \hat{\beta}\right) = arg \min_{\tau,\mu,\alpha,\beta} \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau)^2 \widehat{w}_i^{sdid} \hat{\lambda}_i^{sdid}$$

Where:

- $\widehat{w}_i^{sdid}$ are unit weights, calculated as a weighted average of the pre-treatment period. These are identified through a separate system of linear optimisation, to replicate the parallelism of Darlington's pre-treatment trends.
- $\hat{\lambda}_i^{sdid}$ are time weights, calculated as a linear optimisation. This reduces bias in the choice of time periods (where general SC treats all pre-treatment time periods equally, SCDID places less weight on periods with vastly different pre-treatment results), making the ATT estimation more precise (Arkhangelsky et al., 2019).
- μ is the intercept
- $\alpha_i \; and \; \beta_t$ captures unit and time fixed effects respectively.
- Y_{it} is the outcome variable for unit i at time t
- W_{it} is a binary variable equal to 1 for post-treatment results in Darlington and 0 elsewhere. This is akin to the interaction term in the standard DID formula.
- τ is the treatment effect and the coefficient of interest

Although this approach might seem complex, it is conceptually an extension to the estimated effect standard DID aims to solve:

$$\left(\hat{\tau}^{did}, \hat{\mu}, \hat{\alpha}, \hat{\beta}\right) = arg \min_{\tau,\mu,\alpha,\beta} \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\tau)^2$$

Where the value for τ is the estimate for β_3.

The validity of the SCDID approach relies on the following key assumptions:

1. **Parallel trends:** that Darlington and its control would have followed the same trend in its economic outcomes in the counterfactual scenario in the absence of the DEC:

   $$E(Y_{0,t_1} - Y_{0,t_0} | group = Darlington) = E(Y_{0,t_1} - Y_{0,t_0} | group = Control)$$

   As will be shown later, the SCDID makes this assumption plausible.

2. **No anticipation effects:** That the opening of the DEC does not influence the outcome variables in the treated region *before* 2021. If there was significant anticipation, for example, due to public announcements and/or job listings, this could bias results in the pre-intervention period and thus the estimated ATT. In our context, this is not a significant concern, as major changes in local unemployment, average pay and productivity are unlikely to have occurred until individuals were formally employed at the campus and local businesses started to interact with it.

3. **No spillover effects:** That DEC's impact on Darlington does not affect control unit outcomes. To minimise this risk, we explicitly exclude areas that comprise the 'North-East' region from our donor pool. This aims to reduce the likelihood of shared labour and business markets that could lead to spillover effects between Darlington and our pool of local areas.

4. **Sufficient pre-treatment period:** That we have data for a long enough period pre-DEC to accurately assess the pre-treatment trends and to create a robust and stable control.

5. **Sufficient donor pool:** There must exist a linear combination of control units such that the SCDID calculation can adequately replicate the pre-treatment trends of Darlington, to ensure that there is a valid synthetic counterfactual.

Data

Data sources:

Our data is sourced from the Office for National Statistics' (ONS) Local Statistics. These Local Statistics are a comprehensive panel dataset, consisting of 77 different local indicators for around 350 lower-tier/unitary authorities in the UK. This dataset offers varying coverage over time for different indicators, meaning we had to carefully select relevant and feasible variables.

Data Period and Preparation:

Our annual data spans 2012 to 2023, providing sufficient pre-intervention data (2012-2020) to identify or construct a reliable counterfactual for Darlington, and adequate post-intervention period (2021-2023) data to observe the potential impacts of the DEC. Although the data did go back further than 2012, the quality of the data was suboptimal: there were many missing data, which could bias our results. To reduce this risk, we study trends from 2012 to 2020.

Despite this, there remained some units with extensive missing data across our outcomes. We excluded these from the potential control pool to avoid issues in control construction. This ensured our panel was balanced. To mitigate the risk of spillover effects, we excluded 13 areas close in proximity to Darlington, which together comprise the 'North-East' (County Durham,

Hambleton, Hartlepool, Gateshead, Middlesbrough, Newcastle upon Tyne, Northumberland, North Tyneside, Redcar and Cleveland, Richmondshire, South Tyneside, Sunderland, and Stockton-on-Tees).

Outcome variables:

Based on their economic relevance and data availability, we selected the following three indicators to use as outcomes of interest. These three indicators serve as the focus of the HMT Interim Review, as well as wider focuses of the then-government's Levelling-Up agenda:

- **Gross Domestic Product (GDP) per head at current market prices (£):** this serves as a measure of local economic productivity, indicating the total economic output that is generated per person within the area.
- **Average Gross Median Weekly Pay (£):** the typical earnings of workers in the area, offering insights into local labour market demand and the standard of living.
- **Unemployment (%):** the proportion of economically active people aged 16 and over without a job who have been actively seeking work within the last 4 weeks and are available to start work within the next 2.
    - Ideally, we would have looked at Labour Force Participation, or constructed this using local population numbers, but these were not available in our dataset, and we were not able to access such statistics at the local authority level or over time.

Control group selection and robustness checks:

We used the 'synthdid' package in R to construct the synthetic counterfactual to Darlington, using the same pre-treatment period of 2012-2020. This package implements an estimator that minimizes pre-treatment differences between Darlington and its synthetic counterpart by optimising for a combination of area and time weights to best fit the pre-intervention trends. These weights then generate the SCDID's post-DEC counterfactual outcomes. As expected, the largest weights are given to the areas in the North of England, which would be most similar to Darlington across the three outcomes, with little to no weight placed on the more affluent areas in London and the South of England. To ensure the credibility and robustness of our synthetic area counterfactual, we undertook the following checks:

1. **Visual inspection:** In Figure 1, we plot Darlington's pre-treatment outcome trends against its synthetic to assess whether the assumption of parallel trends holds.

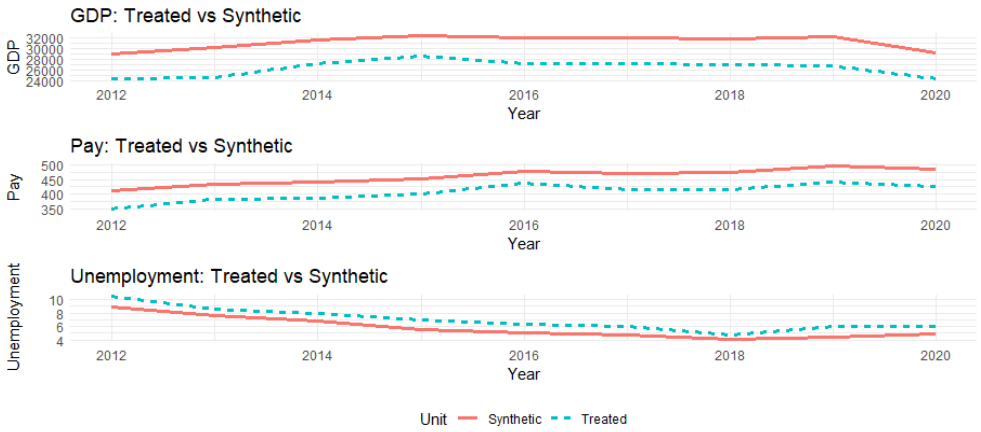


Fig 1. Darlington and the counterfactual show suitably parallel trends over the three outcomes from 2012-2020. Whilst there are some instances of the gap between Darlington and its synthetic narrowing or widening, these are not large enough to conclude the assumption of parallelism is violated.

2. **Event study analysis:** This assesses the parallel trends assumption by computing statistical significance of the annual changes between Darlington and its synthetic. It uses 2020 (the final pre-treatment year) as a reference point. It computes the following regression analysis:

$$\Delta Y_{it} = \alpha + \sum_{s=-q}^{-2} \delta_s^{lead} D_{it} + \varepsilon_{it} \ where \ D_{it} \ equals \ 1 \ for \ Darlington \ and \ 0 \ elsewhere$$

We seek evidence to support the null hypothesis, that the lead coefficient is statistically insignificant (H_0: $\delta_s^{lead} = 0$).

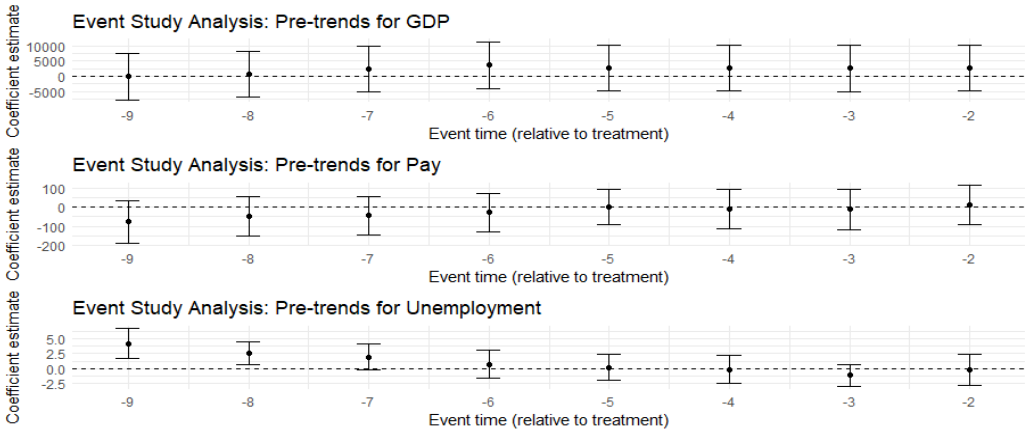


Fig 2. Event Study Lag coefficients with 95% confidence intervals. The vast majority of the lag variables are statistically insignificant, supporting the parallel trends assumption; there is nothing to suggest the gap between Darlington and its synthetic changes significantly pre-treatment.

For Figure 2, as the last pre-treatment period (and thus baseline for comparison), t - 1 is excluded. Where there is some evidence (t - 9 and t - 8 for unemployment), this is far enough from the treatment to be inconsequential. There is nothing to suggest the parallel trends assumption does not hold for the years immediately preceding the treatment and therefore, we are confident the value of the ATT produced by the SCDID is reliable and robust.

Results

Approach

As described above, we are confident the SCDID has successfully created a synthetic area that satisfies the parallel trends assumption. The 'synthdid' package directly calculates the ATT value we are interested in estimating, by calculating the expected outcome post-treatment for Darlington based on the values observed in the synthetic counterfactual, and assuming the difference between the two observed in the pre-treatment period continues to hold. The

difference between the expected and actual outcome variables observed for Darlington is the ATT. This is the estimate of τ in the abovementioned equation.

We then calculate the statistical significance of the treatment on the outcome variable, i.e. the statistical significance of β_3. The null hypothesis would be that there is no statistical evidence that the treatment had an impact on the outcome variable. We seek evidence to reject the null hypothesis and conclude whether the creation of the DEC influenced the outcome variable in question in Darlington. Therefore, the null and alternative hypotheses are as follows:

$H_0: \beta_3 = 0$
$H_1: \beta_3 \neq 0$

To understand the statistical significance of this estimate, we use placebo-based inference to calculate its standard error. In their paper, Arkhangelsky et al. (2019) show that placebo-based standard error calculation delivers the most robust estimation. The estimator produced by Arkhangelsky et al. (2019) is consistent and asymptotically normal. Under this property, we then calculate a 2-sided confidence interval and validate our results by calculating p-values.

Summary of Results

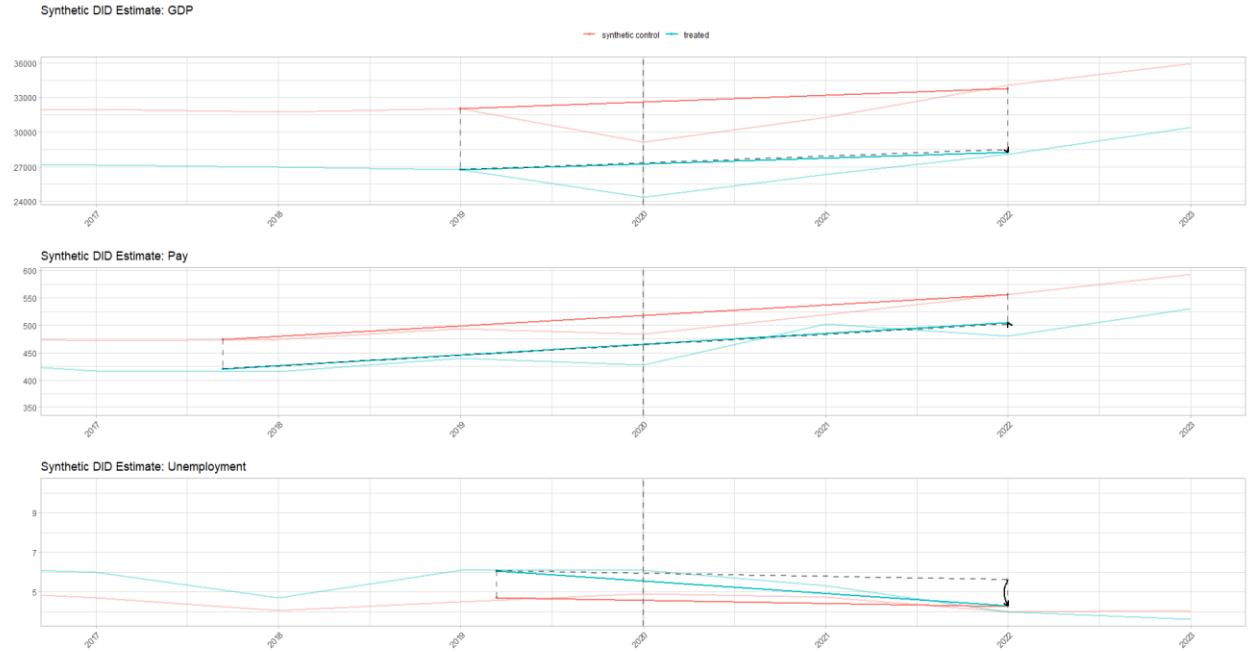


Fig 3. SCDID for all three outcome variables. The ATT is displayed by the black line connecting the expected and actual values for Darlington. These plots are zoomed in to focus on the post-treatment period.

Outcome Variable	ATT Estimate	95% Confidence Interval	p-value
GDP per capita	-192.24 (3970.59)	[-7974.59, 7590.11]	0.96
Average Pay	2.53 (21.32)	[-39.25, 44.32]	0.91
Unemployment	-1.32*** (0.53)	[-2.35, -0.29]	0.01

Standard errors in parentheses
Statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1: Results for all three outcomes. There is evidence to support the hypothesis that unemployment fell in Darlington due to the creation of the DEC. We do not have enough evidence to suggest that the creation of the DEC had any causal impact on productivity or pay.

Analysis of GDP per capita

The high p-value and inclusion of 0 in the confidence interval means we fail to reject the null hypothesis and conclude we have no evidence to show that the DEC had any impact on Darlington's productivity levels. Indeed, the trends seen in the pre-treatment periods continue in the post-treatment period.

Initially, the negative sign of the ATT is counterintuitive. Given the DEC's aim to boost productivity in Darlington and the wider North-East, an increase in Darlington's GDP per capita would have been expected. However, the post-treatment period coincides with significant macro-economic trends, notably the after-effects of the COVID-19 pandemic. These impacts may be disproportionately more negative on areas in the North of England than elsewhere (National Institute for Health and Care Research (NIHR), 2024). These macro-economic trends may be bigger drivers of Darlington's GDP than local productivity initiatives. This, combined with limited post-treatment data, likely explains the observed negative ATT. Furthermore, these results must be interpreted considering broader macroeconomic trends and other concurrent government policies. As the DEC was introduced in a real-world context – not under controlled experimental conditions – Darlington may have been subject to other confounding influences affecting the ATT estimates and their statistical significance. However, to mitigate this, the methodology we employed accounts for time and area fixed effects (Arkhangelsky et al., 2019).

Analysis of Average Pay

Similarly to GDP per capita, the high p-value and confidence interval including 0 means we fail to reject the null hypothesis. However, unlike GDP per capita, the results for pay do not include continuation of parallel trends after the treatment began. The movement in Darlington's average pay after the introduction of the DEC in 2021 indicates that there might be an impact on average pay immediately after the DEC introduction; however, this is offset by falls in wages the following year. It may also provide insight into the large standard error estimate seen.

We therefore ran a simulated test using a subset of post-treatment periods (in this case, only 2021). This was to test whether the DEC may have had a statistically significant impact on pay in Darlington at some point, but that there has been a "cooling off effect" or reversal that therefore shows limited statistical significance in aggregate.

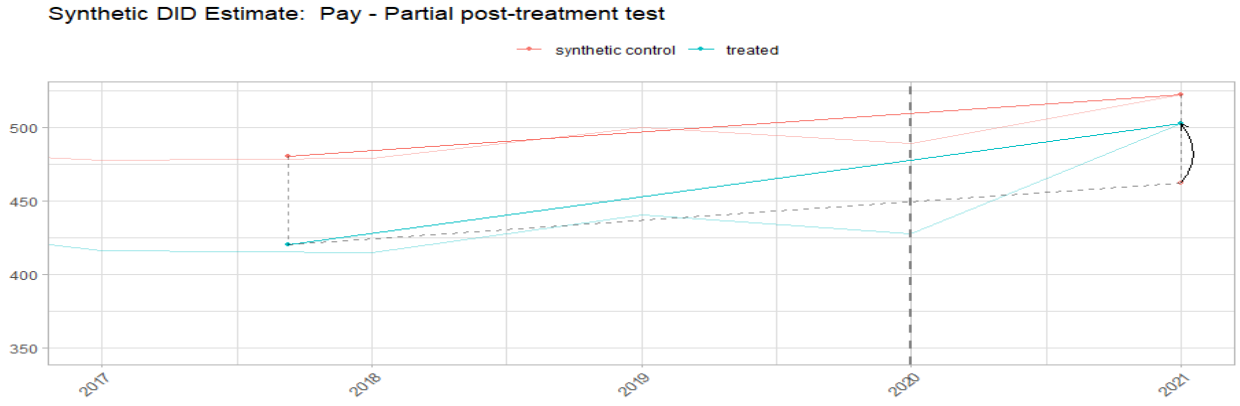


Fig 4. SCDID simulated test estimate for Pay using only 2021 as the post-treatment period

Outcome Variable	ATT Estimate	95% Confidence Interval	p-value
Average Pay (2021 – 2023 as post-treatment period)	2.53 (21.32)	[-39.25, 44.32]	0.91
Average Pay (2021 as the only post-treatment period)	40.4** (24.1)	[-6.83, 87.63]	0.09

Standard errors in parentheses
Statistical significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Results for Average Pay

As expected, like in the full period, the parallel trends assumption continues to hold. The size of the ATT indicated by the black arrow is substantively larger than that of Figure 3, when we consider 2022 and 2023, and the p-value of 0.09 leads us to reject the null hypothesis at a 90% confidence level. Therefore, if we only considered pay data immediately following the DEC's opening, we would have some evidence to conclude it had a positive impact on wages in Darlington. This might be directly attributable to hiring sprees from the DEC or could be from hiring sprees for temporary workers seen in Darlington in 2021 (Shepard, 2021). The latter might explain the drop in wages seen in the following year, as the need for temporary workers subsided.

The downwards shift in wages in 2022, as seen in Figure 4, may indicate an unwinding of some of DEC's positive impacts on wages. Therefore, we conclude that whilst there is some evidence the DEC introduced a positive impact on wages in 2021, in aggregate we have no substantial evidence to reject our null hypothesis and cannot conclude the DEC has had a substantive impact on average wages in Darlington. This is somewhat supported by the Interim review's finding that the setting-up of the DEC created well-paying jobs in Darlington (HMT, 2024). However, it may be that this trend did not continue once the DEC was well-functioning, or that Darlington was subject to substantive negative impacts on pay external to the DEC.

Analysis of Unemployment

In comparison to those of pay or GDP per capita, the size of the ATT for unemployment is much larger (-1.32). In Figure 3, we observe a substantive narrowing of the gap between Darlington and its synthetic area, and indeed by 2023, Darlington had a lower rate of unemployment than its synthetic counterfactual. We have strong evidence to reject the null hypothesis at both 95% and 99% confidence levels, with the low p-value and the confidence interval not including 0. We therefore conclude that the introduction of the DEC led to the unemployment rate in Darlington being 1.32 percentage points lower than what it would have been in the absence of the DEC, according to the synthetic. Unlike the results for average pay, unemployment shows a sustained decrease in Darlington following the introduction of the DEC, therefore we have more confidence in the estimation showing continuing trends in unemployment.

Discussion and conclusion

This report used panel data for around 350 unitary/lower-tier authorities in the UK to study the agglomeration effects of the DEC's operation in Darlington on unemployment, pay and productivity. This focus directly aligns with HMT's Interim Report and broader Levelling Up agenda.

Our analysis provides evidence suggesting a significant positive causal relationship between the DEC's establishment and a reduction in local unemployment rates. Darlington's unemployment rate fell to a lower level than the synthetic region by the end of the three-year post-treatment

period, after being more than 1pp higher in the pre-treatment period. Whilst we observed no statistically significant impact on aggregate pay or productivity, there is some evidence of an immediate and transient positive impact on Darlington's average pay post-treatment, potentially due to large hiring initiatives, either by the DEC or otherwise. However, this effect appears to cool off or unwind in the following year, evidenced by a fall in average pay.

Limitations and Future Research

The generalisability and full interpretation of these findings are, however, subject to several important limitations. As the DEC represents an evolving, long-term intervention intended to expand as the government meets its commitment to relocate Civil Service roles outside of London, the full extent of its effects - particularly on indicators that typically manifest with lags like productivity and wages - is unlikely to be captured within our limited three-year post-treatment period. Access to wider and more granular data would also provide more fruitful analysis to be undertaken, for example looking at labour force participation as an outcome variable, or analysing differencing impacts on the richest and poorest members of society.

Furthermore, our analysis period coincided with significant idiosyncratic shocks, including Brexit, Covid-19, and the cost-of-living crisis. While the SCDID method does try to control for this through fixed effects, these widespread external stressors may have disproportionately affected North-East areas and thus masked or diminished the positive effects of the DEC in the short term. The difficulty in isolating the DEC's impacts is compounded by its implementation in a real-world context, where multiple initiatives may happen at the same time, leading to a compounding of results. Furthermore, whilst we have excluded areas around Darlington to avoid spill-over effects, the positive externalities created by the DEC across the North-East will be important to understand the successes of the DEC.

Given these factors, our findings are not necessarily generalisable to other public sector hub initiatives. For transparency and robust, accurate policy evaluation, we recommend that this study be replicated when more data becomes available in the coming years. Additional years of data would not only allow for a more robust evaluation of the DEC's evolving impact but also enable the incorporation of lagged treatment effects within the DID specification.

To comprehensively evaluate DEC's success, both qualitative and quantitative results are required. Our quantitative analysis helps achieve this by complimenting the qualitative analysis provided by HMT's interim report. However, beyond these first-order economic impacts, it is also important to study any second-order impacts - both positive and negative. For example, increasing wages and productivity might benefit the status of public services, such as health, education and transport. Understanding broader externalities is important for a complete assessment of levelling-up initiatives.

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