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ABSTRACT

Multipliers from a Major Public Sector Relocation: The BBC Moves to Salford*

This paper considers the impact of a major public sector relocation: the British Broadcasting Corporation's partial move from London to Salford, Greater Manchester starting in 2011. We identify effects of the move using synthetic control methods applied to plant-level data at Local Authority and Travel to Work Area level. Each BBC job creates on average 0.33 additional jobs in the creative industries, rising to 0.55 additional jobs by 2017, and the relocation had an impact on sectoral and firm composition. We find no significant effect on total employment but a small positive effect on Local Authority average wages.

JEL Classification: H70, R12

Keywords: cities, public employment, local multipliers, relocation, creative industries, policy evaluation

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1. Introduction

Relocating public sector workers from richer to poorer places is one way that governments try to tackle spatial disparities in employment and wages. The economic impact of relocations depends on the local multiplier – the extent to which a move creates additional jobs in the local economy. Policymakers also need to consider how impacts differ between incumbent and new firms, and across income groups. In some relocations, general equilibrium effects on house prices and wages may also matter. Ex-ante cases for relocation often make strong assumptions about these impacts. [1] However, there is little ex-post evidence on the size of these effects. We especially lack evidence on the 'anchor institution' moves at the centre of policy debates. [2]

We provide such evidence using the partial relocation of the British Broadcasting Corporation (BBC) from London to Salford, Greater Manchester. Between 2011 and 2012, the BBC – a public sector organisation with secondary commercial operations – relocated several key functions, and 1,700 medium and high-skilled jobs, to the MediaCity site in Salford Quays. As we discuss below, this is one of the largest one-off public sector relocations in UK history. It is also a rare example of an anchor institution relocating to support a cluster of knowledge-intensive activity. Further hiring has followed – the BBC now employs around 4,000 at Salford Quays. We evaluate the causal impact of the relocation on local jobs within and outside affected sectors; on firm numbers, size and survival; and on local wages and property prices.

Public sector relocations typically have two aims: to cut property and salary costs by moving jobs to cheaper locations, to stimulate local economies, or both (Nickson, Thomas et al. 2020). Typically, relocations involve back-office roles that require less locally specialised labour. Stimulus comes directly via transferred activity, and indirectly via multipliers from transferred worker spending power and supply chain links (Moretti, (2010). In theory multipliers affect both local services and tradable activity. Tradables may also gain through knowledge spillovers. Spillovers are most likely if local tradables are related to what is relocated, or exhibit increasing returns through clustering. Manchester's creative economy plausibly meets both

[1] In theory, major locations may also influence productivity in incumbent firms, through a mix of knowledge spillovers, supply chain linkages and labour mobility. These channels are especially plausible when large numbers of skilled jobs are involved, as here. Future research should explore the existence and extent of these channels for the BBC case.

[2] An anchor institution is one that, alongside its main function, plays a significant and recognised role in a locality by making a strategic contribution to the local economy (UK Commission for Employment and Skills 2015).

conditions. Increased labour market competition can offset these positive channels. This potentially crowding out incumbent firms. If the relocation shock is sufficiently large, there may also be wider impacts through the property market, and on the local labour market.

Using the BBC relocation to estimate these impacts means addressing several identification challenges. The biggest of these is specifying the counterfactual. We cannot use a runner-up location because both historical evidence, and accounts from participants, suggest that *only* locations in Greater Manchester were considered, with no other city ever in contention. The BBC's move thus differs from recent high-profile 'relocation competitions', such as those for Amazon's HQ2 in the US or Channel 4's second HQ in the UK. Selecting control locations on the basis of observable characteristics is also problematic. This is because UK creative industries are heavily concentrated in a few cities, notably London and Greater Manchester (Tether 2019). London cannot serve as a counterfactual because it is affected by the move. And even with a suitable control group, we only have one treated unit.

Given these constraints, we use the synthetic control method (Abadie and Gardeazabal 2003, Abadie, Diamond et al. 2010, Abadie, Diamond et al. 2015, Gobillon and Magnac 2016, Athey and Imbens 2017, Abadie 2021) as our preferred research design. Using firm-level panel data from 1997 to 2017 on all Local Authorities excluding Greater London and Greater Manchester (the places directly impacted by the relocation) we construct a 'synthetic Salford' that resembles actual Salford as closely as possible in creative and non-creative firms and jobs in the pre-treatment period. We compare changes in these outcomes between actual Salford and synthetic Salford to identify the causal effect of the relocation.

After the BBC move, we find a creative industry local employment multiplier of around 0.33. That is, for each BBC job moved to Salford in 2012, there are on average 0.33 additional creative industry jobs in Salford between 2012 and 2017. The multiplier rises to 0.55 – around 2,000 additional creative jobs – by 2017, the end of our study period. These magnitudes are broadly comparable with existing estimates of UK public sector multipliers over similar timeframes. Faggio and Overman (2014) find a public to private sector multiplier of 0.21, and Faggio (2019) finds a private sector services multiplier of 0.55 from a national programme of small-scale relocations. Studies that use long time-frames find much larger public sector multipliers on local services: 0.8 for Spain over 20 years (Jofre-Monseny, Silva et al. 2020) and 0.86 for Germany over 30 years (Becker, Heblich et al. 2021). Comparing to studies from

across the OECD, our results are also on the lower end of the range of 0.48 – 1.6 new jobs in the non-tradable sector for each job in the tradable sector, and some way below that of 2.5 for high-skilled jobs (What Works Centre for Local Economic Growth 2019).[3]

Rises in publishing and broadcasting jobs – the activities closest to relocated functions – explain the shift in creative jobs. We also find evidence of localized clustering. Salford's share of employment in creative industries over total employment increases by 5.3 percentage points. But multipliers for tech industry activity, an 'adjacent' sector, are only marginally significant. Multipliers for total employment are insignificant.

Turning to creative firms, we find a significant positive impact of the relocation on counts, and on the average size of firms. Excluding the BBC, the relocation added over 220 creative businesses to Salford between 2012 and 2017. Average firm size in Salford is 1.59 employees larger post-treatment. Effects on firms are predominantly driven by new entrants and movers, though we also find a positive effect on incumbent survival. Notably, the BBC announcing the move – as well as the relocation – helps explain effects on firms (but not jobs). This is consistent with industrial gentrification driven by commercial and office landlords. Overall, the relocation both raises creative industry employment, and shifts industry/firm composition. We also find a small positive impact on average wages in Salford.

Our research makes three main contributions. First, we exploit the natural experiment of a large, one-off relocation of an anchor institution. The four closest academic papers are Quigley et al (2004) on the impacts of 11 new universities in Sweden in the late 1970s; Faggio (2019), on the impact of the Lyons Review, a programme of UK government relocations, consisting of small moves to multiple sites; Becker et al (2021), who evaluate the relocation of the German federal government from Berlin to Bonn after the Second World War and Faggio et al (2019) who evaluate the return of public sector jobs from Bonn to Berlin in 1999.[4] Our methodological approach is closest to Becker et al. who use synthetic control and difference in differences estimators. Our focus on an anchor institution brings us close to Quigley et al. However, we expect the effects of the BBC move to be quite different to new universities in the 1970s.

[3] Van Dijk (2018) finds an even higher multiplier of 1.91 but this is using county-level data instead of MSAs.
[4] Schweiger et al (2022), who look at the long-term effects of Soviet-era Science Cities, explore similar issues but in a very different political / economic context.

Second, existing literature estimates multipliers for three kinds of employment – tradable, tradable high tech and public sectors. See What Works Centre for Local Economic Growth (2019) and (2023) for recent reviews. At the time of writing, there remains very little evidence for firm outcomes other than employment. Our paper offers new evidence to inform this debate.

Third, our paper contributes to the specific understanding of public sector relocation as a policy tool. The two existing ex-post studies of the BBC move – Forth (2017) and Piazza and Swinney (2017) – both have constraints. Forth uses a two-period difference-in-difference design at the Work Area level. He finds a significant impact on productivity – using turnover per worker as a proxy – in publishing and broadcasting. However, he does not cover other impacts or general equilibrium effects. The diff in diff design also has limitations, as set out above. Piazza and Swinney describe post-move employment changes, but do not evaluate causal impacts. By focusing on a tight ring around the site, their spatial scale is also arguably too small to capture the full treatment effect.

The rest of the paper runs as follows. The next section describes the relocation. Section 3 sets out the data and methodology and Section 4 the research design. Section 5 reports our main employment results. Section 6 looks at firm outcomes in the creative industries. Section 7 looks at the impact on other industries such as technology, publishing and broadcasting and tradables. We consider price effects in section 8 and robustness tests in section 9. Section 10 concludes.

2. The BBC and its move to Manchester

The British Broadcasting Corporation (BBC) is the largest broadcaster in the world, with over 20,000 members of staff. The BBC is mainly a public sector organisation, although it also undertakes commercial activities, subject to certain constraints.[5]

[5] The status of the BBC is established by Agreements between the BBC and the Secretary of State for Culture, Media and Sport as well as by Royal Charters (last agreed in 2017) http://www.bbc.co.uk/corporate2/insidethebbc/managementstructure/bbccharterandagreement, accessed 6 February 2019.

In 2004, the BBC committed to moving some its public sector activities from London to 'The North'. As summarised by the UK's National Audit Office (NAO), the 'Project North' relocation plan reflected public and commercial goals: to better serve audiences by decentralising activity, including external commissioning; to leverage new technology and new ways of working, and to bring economic benefits to 'the region' (National Audit Office 2013).[6]

The process to choose the target city was opaque. There was no public competition, unlike Amazon's HQ2 competition in the US, or Channel 4's in the UK. The NAO report does not cover the BBC's thinking about city or site selection, and neither does the most detailed account of the MediaCity development (Schulze Bäing and Wong 2018). Extensive conversations by the authors with stakeholders in the BBC, Greater Manchester (GM) and the UK Department of Culture, Media and Sport suggest that *only* GM was ever considered, even though the BBC had regional centres in other major northern UK cities, for example in Leeds and Newcastle, and these cities also had clusters of creative activity. GM was specifically favoured based on its large, visible mass of creative industries, and plausibly on other unobservables, such as perceptions of strong local government leadership.[7]

The BBC shortlisted four possible sites in GM: two in Salford Local Authority District (LAD) and two in the City of Manchester LAD, one of which was already a small BBC office (NAO, 2013). In July 2006, the BBC took its decision and leased three buildings on the MediaCity site in Salford. The BBC appears to have chosen the site based on its size and ability to handle future expansion, rather than just value for money.[8] Indeed, the larger size of the MediaCity site *increased* the total cost of the BBC's real estate portfolio compared to costs pre-move (National Audit Office 2013). Figure A1 shows the BBC's Salford site and previous BBC site in nearby Oxford Road.

The MediaCity site is part of Salford Docks, see Figure A1 in Appendix A. Schulze-Baeing and Wong (2018) set out the site's history in detail. Established in the 19th Century, the Docks

[6] The BBC's planning does not include a clear definition of the treatment geography, sometimes referring to 'Greater Manchester' (a city-region of 10 local authorities), sometimes to 'the region' (the North West) and sometimes to the whole of 'The North'.

[7] Compared to other Northern UK cities with a creative industries presence, such as Liverpool, Newcastle or Leeds, Manchester has had notably visible and stable political leadership (Peck and Ward, 2002, Houghton et al, 2016). Alongside the presence of the existing cluster, this less tangible factor appears to have influenced the choice of Manchester over potential competitors.

[8] https://www.manchestereveningnews.co.uk/whats-on/film-and-tv/bbc-director-why-we-chose-salford-1039936, accessed 6 February 2019.

shed over 25,000 jobs during the 1970s and 1980s, finally closing in 1982. The Docks were bought by Salford Council in 1984. In the next 15 years major environmental and physical improvements followed, including land remediation, restoring canals and re-opening waterfront walking routes. By the 1990s a cinema, hotel, water sports centre, and a first tranche of housing and offices had appeared. A Metrolink tram network extension opened in 1999, substantially improving links between the Quays and the city centre. In 2000 the Lowry Art Gallery opened, followed by the Imperial War Museum North in 2002. In the same year the Quays hosted some Commonwealth Games events, and by 2005 hosted a second cinema, shopping centre, and more housing, mainly luxury flats.

The MediaCity hub was intended to be a major extension of this culture-led regeneration approach. The site developer, Peel Holdings, paid for further public realm improvements and for a further extension of Metrolink to the site, as a condition of winning planning permission. In addition, some European Regional Development Funding was used to co-fund the MediaCity redevelopment. There were no cash incentives for firms to move to MediaCity.

The BBC relocation is notable both for its size and the mix of functions and roles involved. In the UK, public sector relocations over the last 50 years have typically involved moves of a few hundred staff or less. The closest comparator to the BBC relocation is the move of 1,000 Office for National Statistics staff from London to Newport, Wales – around half the BBC total. Similarly, past relocations typically involved low or medium skill roles, often in back-office functions. In contrast, the BBC move involved relatively large numbers of core functions and medium to high skills jobs (Centre for Cities, 2017). Relocated departments included BBC Breakfast, BBC Sport, Children's programming, BBC Learning, marketing and audience research, 5 Live radio, and Future Media / Tech / BBC Academy functions. A Freedom of Information (FoI) request by the Guardian (The Northerner 2012) revealed that the BBC hired from a range of locations and that more than 60% of those jobs were for relatively senior roles (Grade 7 and above). For existing employees, the BBC offered a range of relocation packages, including some large pay packages.

From April 2011 to June 2012, 1,699 people relocated to Salford. 1,061 people were relocated from London to Salford and 638 staff were relocated within GM from the BBC's Oxford Road site (NAO, 2013). In addition, the BBC recruited 583 new staff from outside the BBC. The

relocations and additional recruitments added up to 2,282 employees working at Salford site as of June 2012. As of 2020, the BBC has around 4,000 employees at the Salford Quays site.[9]

3. Data

Our main data source is plant-level microdata from the 9th edition of the Business Structure Database (BSD) (Office of National Statistics 2017). The BSD provides data for almost all business organisations in the UK. It is derived primarily from the Inter-Departmental Business Register (IDBR), which is a live register held by HM Revenue and Customs and constructed via Value Added Tax (VAT) and Pay As You Earn (PAYE) records. The IDBR data are supplemented with data from Office of National Statistics (ONS) business surveys. If turnover exceeds the VAT threshold or at least one employee is registered for the PAYE tax collection system, then the business will appear on the IDBR (and hence in the BSD). The ONS estimates that the businesses listed on the BSD accounted for almost 99 per cent of economic activity in the UK.[10] Note that a given year in the BSD corresponds to the financial year leading up to that date. For example, BSD year 2012 covers the end of March 2011 to the end of March 2012. Given that the main job reallocations began in April 2011, and all but BBC Breakfast had moved by April 2012, we define the treatment year as BSD year 2012 (from April 2011 to April 2012).

Only very small businesses – such as sole traders – are outside the BSD. This raises an issue in our context because 35% of creative industry workers are self-employed (compared with 15% across the workforce as whole) and many of these are sole traders.[11] While the majority of the UK's self-employed creatives are based in London, the BSD may still understate overall creative industry employment effects. To deal with this we also look at self-employment outcomes via the Annual Population Survey (APS) (Office of National Statistics 2020). The APS starts in 2004, so we use 2004-2017 data in these tests.

[9] BBC source, February 2020. Figure A1 shows the MediaCity and Oxford Road sites.

[10] https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/methodologies/annualbusinesssurveyqmi, accessed 7 March 2024.

[11] https://www.creativeindustriesfederation.com/statistics, accessed 6 February 2019.

We aggregate the BSD plant-level data at the Local Authority District (LAD) level for all 391 LADs in the UK,[12] and for all industries at the 4-digit SIC 2003 level giving a panel that includes employment and firm variables by LAD and 4-digit sector for each year from 1997 to 2017.[13] The choice of geographical unit is important. As we discuss in Section 2, the BBC was unclear about whether they expected effects to occur at city, regional or pan-regional scale. In theory impacts could be highly localised around the MediaCity site. Creative industries typically co-locate in urban locations, and clusters tightly within those locations (Bloom, Camerani et al. 2020). For example, Arzaghi and Henderson (2008) explore design, advertising and marketing clusters across a few neighbourhoods in Lower Manhattan. Conversely, effects might be more dispersed across creative firms in the city-region or beyond, since the BBC sought to use the move to increase external commissioning across 'the North'. Our choice of LAD level represents a compromise between the desire to look at small enough spatial scales to be able to detect effects, and a large enough spatial scale that we capture the indirect effects on employment and prices. Looking at smaller spatial scales would require the arbitrary aggregation of spatial units to allow for general equilibrium effects. And, as our results for Travel to Work area show, using spatial units bigger than local authority leaves us unable to detect affects.[14]

To look at the average multiplier over our period, and whether the multiplier is larger at the end of our period, we need to know how total BBC employment developed over time. For statistical disclosure reasons we cannot directly identify the BBC in our data. Since we do not have BBC employment figures throughout our post-treatment period, we linearly interpolate them, estimating around 3,800 BBC jobs in Salford Quays by 2017. This means that, on average, BBC employment in Salford Quays between 2012-2017 was around 2,800 jobs. We use the average and final employment to compute employment multipliers.

BBC employment is classified as public sector, but the jobs are part of the 'creative industries'. We look at the impacts of the relocation on both the creative and non-creative industries using

[12] We use the ONS Local Authority Districts (LAD) definition from 2011.
[13] We use SIC2003 codes to generate a time-consistent series. Industry codes in the BSD are validated by the ONS against detailed information from firms' tax returns. This minimises the chances that firms are classified incorrectly or that industry information is missing.
[14] Results at the Travel to Work Area (TTWA) level, in Section 9.3, suggest that this is generally too broad a unit to detect effects. This is perhaps unsurprising given that the Greater Manchester TTWA has a population of 2.7 million (in 2016), and the BBC relocation only amounted to 3,800 jobs by the end of our period.

definitions from the UK Department for Culture, Media and Sport.[15] Creative industries comprise activities in advertisement and marketing, architecture, crafts, design, film, TV, radio, video and photography, IT, software and computing services, publishing, museums, libraries and galleries and music, performing and visual arts. Table A1 of the Appendix shows all creative industries and their associated SIC codes.[16] We refer to 'creative industries' and 'the creative sector' interchangeably. In robustness checks we use an adjacent set of high-tech industries, based on Tech Nation's definition (Tech Nation 2018). These are shown in Table A2.

To look at impacts on wages, we use the Annual Survey of Hours and Earnings (ASHE). ASHE is based on 1% sample of employee jobs registered with HM Revenue and Customs' (HMRC's) Pay As You Earn (PAYE) records (Office of National Statistics 2019). To look at impacts on house prices, we use transaction-level microdata from the Land Registry PricePaid database (HM Land Registry 2024).

4. Research design

We want to estimate the causal effect of the BBC relocation on employment and firm outcomes for the creative and the non-creative sectors in Salford. As explained above, the nature of the relocation makes it difficult to find a suitable control group for use in a difference-in-differences strategy. Synthetic controls attempt to solve this problem by generating the counterfactual unit as a weighted average of non-treated units. This allows researchers to estimate 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" (Abadie 2021) (p3). In our setting, the BBC relocation affects a small number of LADs, and we are interested in the impacts on employment and firm activity at the LAD level.

Constructing the synthetic control group requires definition of a donor pool of LADs and a weight for each LAD. Weights range between 0 and 1 and sum to 1. Weights are chosen to

[15] https://www.gov.uk/government/collections/dcms-sectors-economic-estimates, accessed 6 February 2019. Creative industries are defined on the basis of having a high share of workers in 'creative occupations', where these are assessed using a typology of tasks.
[16] The DCMS definition uses SIC2007 codes. We convert these to SIC2003 codes using ONS crosswalks.

make the synthetic control group behave similarly to the treatment group on a set of pre-treatment outcomes. As in difference-in-differences, the intuition is that, in the absence of treatment, places that are alike in pre-treatment outcomes should have similar trends post-treatment. If the synthetic control group behaves similarly to the treatment group in the pre-treatment period, differences between the two groups in post-treatment outcomes are attributed to the intervention.

Given a vector $\mathbf{X_1}$ of pre-treatment outcomes for the treated location, and a matrix $\mathbf{X_0}$ with the same outcomes for J control locations, optimal weights $\mathbf{W}^*$ are chosen to minimize $\| \mathbf{X}_1 - \mathbf{X}_0\mathbf{W} \|_\mathbf{V} = \sqrt{(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})' \ \mathbf{V}(\mathbf{X}_1 - \mathbf{X}_0\mathbf{W})}$, where $\mathbf{V}$ is some symmetric, positive semi-definite matrix that denotes the weights, or relative importance of pre-treatment characteristics $\mathbf{X}$.[17] There are three main approaches for choosing $\mathbf{V}$: a subjective assessment of the predictive power of the pre-treatment outcomes, a data-driven approach to maximise predictive power, or giving equal weights to all pre-treatment outcomes by setting $\mathbf{V}$ as an identity matrix (Gobillon and Magnac (Gobillon and Magnac 2016). Abadie et al. (2010) provide a good review of the trade-offs of each method.

An unbiased estimator of $\alpha_{1,t}$ – the difference between the observed outcome in the treated and synthetic control units – is given by:

$$\alpha_{1,t} \ = \ Y_{1,t} - \sum_{j=2}^{J+1} w_j^* \, Y_{j,t} = Y_{1,t} - Y_{W^*,t}$$

In the synthetic control setting, there is no observed distribution of controls, so traditional inference is not possible. Following the literature, for inference we use falsification tests based on permutation techniques. Specifically, we estimate placebo treatment effects by applying the synthetic control method iteratively to every non–treated unit in the donor pool, then calculating the ratio of post–treatment to pre–treatment goodness–of fit. Comparing goodness–of–fit ratios across treatment and donor pool units gives us a test statistic that can be interpreted like a *p*–value. See Appendix A for further detail.

[17] Abadie and L'Hour (2019) propose adding a set of penalty terms that depend on discrepancies between the characteristics of the affected unit and that of the individual units included in the synthetic control to reduce interpolation biases. We add no penalty terms here.

4.1 / Application

To construct the synthetic control, we exclude all LADs within GM and Greater London from the donor pool because they are either directly impacted by the relocation – receiving or losing employment – or could be affected by multiplier or displacement effects given their proximity to the treatment areas. This reduces our sample from 391 LADs to 348.

We construct a weighted average of these 348 LADs that best reproduces pre–treatment data across the whole of the area's employment and industry mix. Specifically, the synthetic control matches pre–treatment a) creative industries employment counts, b) creative firm counts, c) non–creative industries employment counts and d) non–creative firm counts in Salford from 1997 to a specific year before the move – the choice of which we discuss in the next section.

Given we have no strong priors on the predictive power of pre-treatment outcomes, we can choose **V** using the data-driven approach or set it equal to the identity matrix. In our application, the LAD weights barely change between the two methods so the same LADs are picked as synthetic control for Salford, and the *RMPSE* is almost identical. To simplify estimation, we therefore set **V** equal to the identity matrix.[18]

Our focus, consistent with much of the literature, is on estimating the average effect on outcomes of interest across the post-treatment period (2012-2017). Given the policy objectives, it is also useful to look at long differences to see the cumulative effect over time. From a methodological perspective, using long-differences has the further advantage that we difference out time-invariant unobservables, so the synthetic control only has to match changes over time. The disadvantage is that we have fewer long differences in contrast to using levels, which means year-specific shocks unrelated to treatment may increase estimator variance.

We run the analysis on several outcomes. For each outcome, we construct the control group using the same pre-treatment outcomes **X** – creative and non-creative sector employment and

[18] Kaul et al. (2017) raise concerns about the use of all lagged outcome values as separate pre-treatment outcomes when adopting the data driven approach to the choice of **V** because they show that this renders other pre-treatment outcomes irrelevant. As we set **V** to be the identity matrix each covariate has the same weight and we avoid the problem they outline.

firm counts – so that the weights **W*** (and thereby the control group) do not change across outcomes. Becker et al. (2021) use a similar approach. For extensions using APS and ASHE data, the different datasets generate different weights **W***, and we show these in Appendix tables.

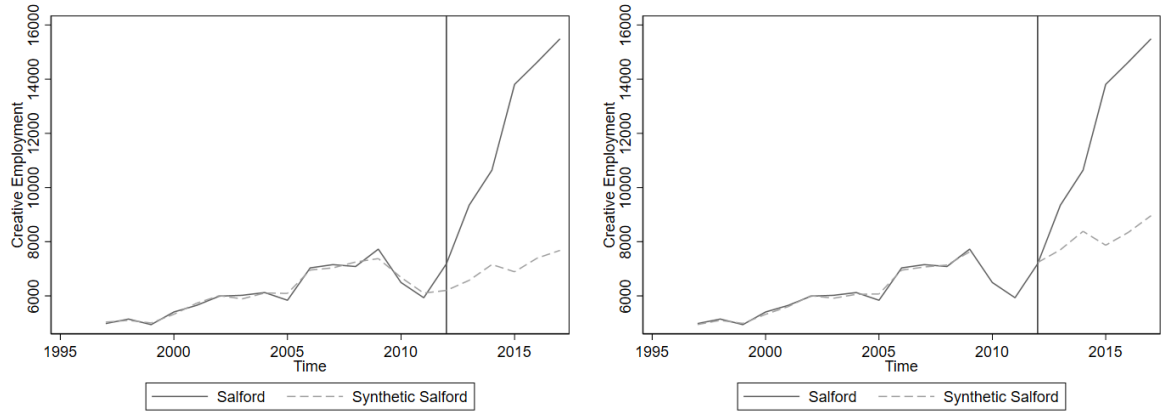
4.2 / Pre-treatment periods

The left-hand panel of Figure 1, below, shows the time series of total creative employment in Salford (solid lines) against the synthetic control (dashed lines) constructed using pre-treatment outcomes from 1997 to 2011. Overall, Synthetic Salford matches pre-treatment outcomes well. In particular, the gap between real and Synthetic Salford never approaches more than a fraction of the estimated treatment effect, allowing us to use the 'regular' synthetic control estimator rather than bias-corrected alternatives (Abadie 2021, Ben-Michael, Feller et al. 2021). However, creative jobs in real Salford exhibit a notable deviation from the pre-trend in 2010 and 2011, recovering just before the BBC move in 2012.[19] Table B1 shows the time-series in detail. The synthetic control closely tracks the resulting dip in total employment in 2010 and 2011, and this influences post-treatment outcomes – Synthetic Salford starts from a lower level than real Salford in 2012.

[19] Our data is annual, so the dip occurs in years 2010 and 2011 (Table A3) but appears as a line from 2009-2012 inclusive on Figure 1.

Figure 1. Creative industries employment in Salford and synthetic Salford, 1997-2017

L: synthetic control, 1997-2011 **R: synthetic control, 1997-2009**



Source: BSD. The figure shows the trends in creative employment over total employment between actual Salford (solid line) and synthetic Salford (dashed line). The treatment year is 2012, indicated by the vertical line. The left panel shows the original dataset, with all pre-treatment years used for the synthetic unit. The right panel shows our preferred specification, with dip years 2010 and 2011 dropped from the analysis for both treated and control units. For visual comparison only, here we show the full time series for the treated unit.

There are three possible explanations for the dip. First, it may reflect creative sector-wide shocks – related to the 2008 crisis. Second, analogous to an Ashenfelter Dip (Ashenfelter 1978), it may be wholly or partly related to the MediaCity development – for example due to disruption which forced firms to temporarily relocate. Third, it may represent errors in the data that specifically affect Salford. Sector-wide shocks should be controlled for by the synthetic control estimator – in which case we would correctly attribute the difference between 2012 employment for real Salford and Synthetic Salford to the impact of the BBC. But if the problem is due to an Ashenfelter Dip or data error this will bias estimates of the BBC's impact.

Figure B1 plots creative industries job counts for all 10 GM LADs between 2009 and 2015, using ONS-generated BSD aggregates which closely approximate our microdata. Salford and three other local authorities with large creative employment counts exhibit a dip, but it is not common across the whole of the city-region. However, looking at the Salford micro data in detail suggests a pattern of large firms with similar characteristics moving in and out of the LAD in consecutive years before the move. Either this is due to disruption or to data issues specific to Salford. Our solution is to take a conservative approach and remove the years 2010 and 2011 from our data. As the right-hand panel of Figure 1 makes clear, this results in 2012 employment for Synthetic Salford that is much closer to that of real Salford. This higher 2012 starting point and faster growth for Synthetic Salford constructed when removing the years

2010 and 2011 reduces the estimated effect size, relative to robustness checks which include the 'dip years' in the pre-treatment period.

Using this adjusted pre-treatment period, we construct synthetic controls using levels and long differences. The levels specification uses 1997 to 2009 as the pre-treatment period and 2011 to 2017 as post treatment. The long differences specifications use two pre-treatment periods, 1997-2003 (pre-announcement) and 2004-2009 (post-announcement, pre-relocation) and the difference from 2011 to 2017 as post-treatment. We allow the weights matrix **W*** to change across the levels and long-differences specifications but use the same matrix across different outcomes for each specification as discussed above.

4.3 / Balancing tests

Table 1 reports the summary statistics, for the pre-treatment period, for the four LAD level pre-treatment variables used to construct the synthetic control and for the post-treatment outcomes of interest. Creative employment in Salford pre-relocation is 6,400, already above the national average. The same pattern holds for non-creative employment, creative and non-creative firms.

Table 1. Balance tests of employment and firm activity, 1997-2009

Outcome	Salford	Donor pool		Synthetic Salford		Obs
		Control	Difference	Control	Difference	
Total jobs	102,448	58,654	-43,7934**	102,223	-225	349
Creative jobs	6,085	3,428	-2,657**	6,061	-24	349
Non-creative jobs	96,363	55,227	-41,136**	96,161	-202	349
Creative / all jobs (%)	5.92	5.57	-0.354	6.06	0.136	349
Creative firms	734	649	-85	733	-1	349
Non-creative firms	6,619	5,081	-1,538	6,606	-13	349
Ave creative firm size	8.27	5.19	-3.076***	8.08	-0.185	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, non-creative employment, creative firms, non-creative firms.

The table provides two important pieces of supporting evidence for our design. First, on many dimensions Salford's 'creative economy' is significantly different to the average across all LADs in the donor pool, highlighting the problems of using a difference-in-difference

estimator. Second, shifting from the average across the donor pool to a synthetic Salford renders all these differences non-significant.

5. Employment effects and the local multiplier

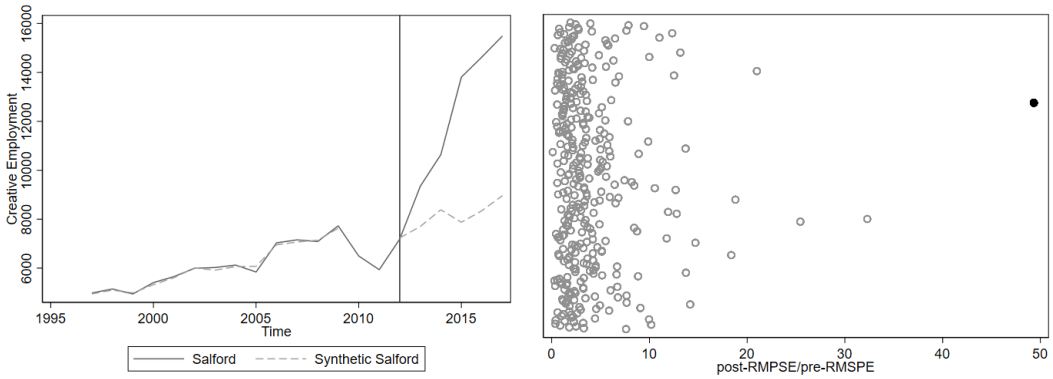
Figure 2 summarises results graphically. The left-hand panels show trends in Salford (solid line) and Synthetic Salford (dashed line), for creative employment (Panel A), creative employment share (Panel B) and total employment (Panel C). For Salford, the trendline covers the whole period. For Synthetic Salford, we omit 2010 and 2011 as discussed above. The treatment year is 2012.

For creative employment (panel A) and the share of creative employment (panel B) there is clear divergence between treated and control units, much less so for total employment (panel C). The right-hand panels show the statistical significance of these differences in levels, via the distribution of goodness-of-fit ratios (RRMSPEs) for Salford (black dot) and all other donor pool units (grey circles). The key consideration is whether Salford's RRMSPE for Salford lies far on the right-hand side of the x-axis, at the extreme of the overall distribution.[20] We can see that creative employment and creative job share effects are significant, while total employment effects are not.

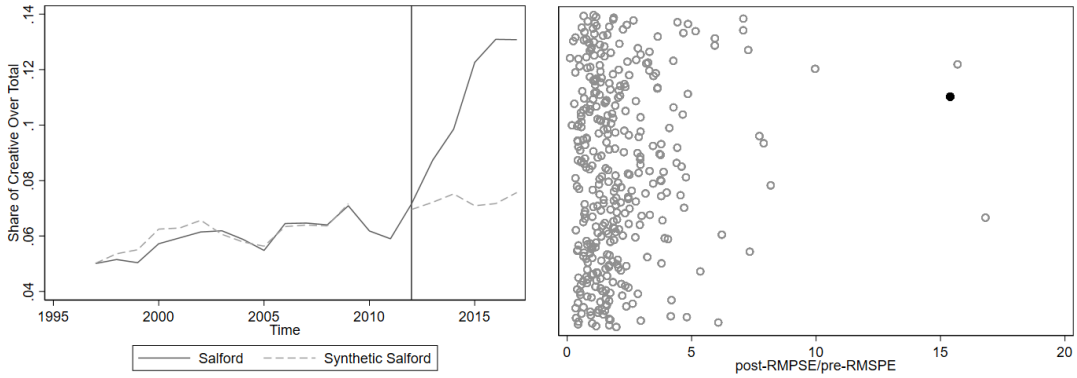
[12] The ordering on the y-axis is irrelevant, as we list LADs alphabetically based on their ONS area code. There are 349 dots plotted in each right-hand side panel of Figure 2, so to be significant at the 1% level requires the RRSPME for Salford to have one of the 35 highest values.

Figure 2. Summary of employment effects and significance.

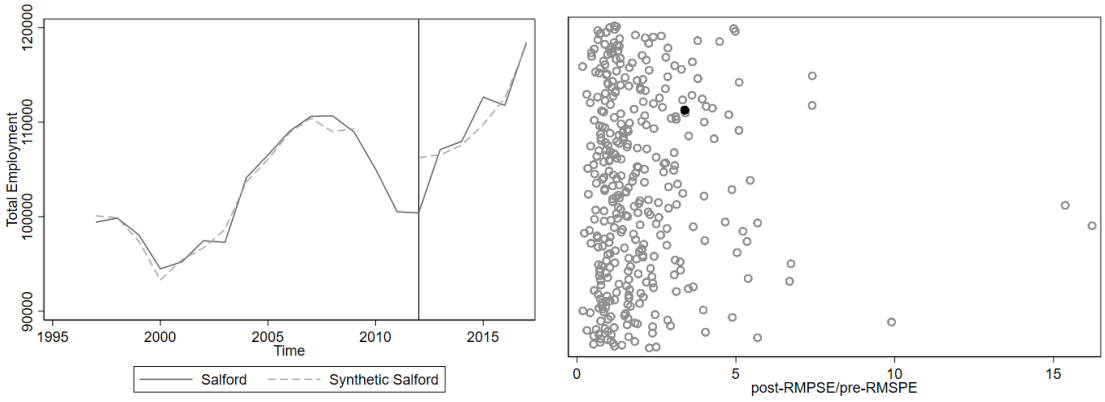
A. Creative employment



B. Creative employment share



C. Total employment



Source: BSD. Notes: for each outcome, left hand graphs show outcomes for treated and control units (solid and dashed lines, respectively). Right hand graphs show goodness of fit ratios (*RRMPSE*s) for Salford (black dot) and donor pool LADs (grey circles).

We are interested in the both the average change over the post period, and the cumulative changes by 2017. Table 2, below, reports the effect sizes and significance levels for each outcome: columns show results for the whole post-treatment period ('levels') and for the

change over the period (long differences). Table B2 in the Appendix gives the LADs and weights used to construct the synthetic control.

Table 2. Employment effects in detail.

Specification	Period of impact	Period of predictors	Levels	Long Diff	Obs
Creative employment	2012-2017	1997-2009	3,743.99*** (0.000)	5888.90*** (0.006)	349
Share of creative over total employment	2012-2017	1997-2009	0.036*** (0.006)	0.053*** (0.006)	349
Total employment	2012-2017	1997-2009	-651.44 (0.117)	4308.91 (0.381)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, employment, non-creative employment, creative firms, non-creative firms. The *p*-values of the point estimate are in parentheses under each point estimate.

5.1 / Creative employment

In Table 2, the first row of column 3 shows that the BBC relocation is estimated to increase creative employment by 3,744 on average over the post-treatment period 2012-2017. As described in Section 2, BBC employment at the MediaCity site was around 2,800 on average over this period. Netting out employment at the BBC gives a net effect of 944. We thus find that each BBC job created roughly 0.33 additional jobs in local creative industries.

This estimate is above the OECD mean public sector multiplier of 0.25 (What Works Centre for Local Economic Growth 2019) and above the 0.2 multiplier estimated by Faggio and Overman (2014) for the UK public sector over a similar timeframe. This is consistent with the relocated activities, which involved significantly more medium and high-skill roles than the typical public sector move (see Section 2).[21] However, our results are well below the 1.6 multiplier found by Moretti (2010) for the US tradable sector.

Figure 1 suggests that the effect on creative employment has grown larger over time – the long difference results in Table 2 suggest an increase of 5,889 creative sector jobs by 2017. To figure

[21] Our effect sizes are substantially lower than the public sector multipliers of 0.8 for Germany (Becker et al 2021) and 1.3 for Spain (Jofre-Monseny et al 2020). However, these explore post-treatment periods of 35 years and 20 years respectively, compared to five years in our case. Becker et al also explore short term impacts over 10 years, finding a multiplier of 0.49, much closer to our estimates.

out the longer-term multiplier we need to know how many jobs the BBC re-located to Salford between 2012 and 2017. Again, we do not have these figures, but we have estimated them using linear interpolation (see Section 3). According to this, the BBC had around 3,800 jobs by 2017. Therefore, netting out these from the estimated increase of 5881 jobs by 2017, we get a longer-term multiplier of 0.55.

As discussed in the data section, one concern about using the BSD to capture the effect on creative industry employment is that it ignores self-employment and that this may be particularly important in the creative industries. To check whether this is the case, we use workplace-based figures from the Annual Population Survey 2004-2017 to estimate the effect on self-employment. We find that the effect on the number of creative self-employed jobs (as main job or secondary job) is positive but not significant (Table B3, for APS weights see Table B4).

5.2 / Creative employment shares

The second row in Table 2 reports the increase in the share of creative employment in total employment in Salford. On average, as reported in column 3, the share of employment in creative industries is 3.6 percentage points higher after the BBC move. By 2017, column 4 shows that the share is 5.3 percentage points higher, rising from 5.9% to 11.2%.

5.3 / Total employment

A 5.3 percentage point increase in creative industry share between 2012 and 2017 is quite a large structural shift over a relatively short time. Looking at estimates for total employment in Salford relative to the synthetic control helps interpret this result. Table 2 shows that relocation has no significant effect on total employment in the borough. In principle this could be due to the rise in creative employment directly crowding out other jobs or to it accelerating longer-term compositional shifts within Salford's non-creative sectors. We cannot directly assess these possibilities – although Appendix Figure B2 shows that the long-term decline in manufacturing jobs, and a rise in business services, both predate the relocation.

All in all, the BBC move to Salford resulted in roughly 0.33 additional jobs in the creative industries between 2012 and 2017, for each BBC job moved. The longer-run multiplier is estimated to be slightly larger, at 0.55 additional jobs in the creative industries by 2017. Consistent with these increases, the share of creative employment over total employment grew by 5.3 percentage points in six years. That is quite a large structural shift mainly driven by the fact that creative industry employment increases, while total employment does not change significantly.

6. Firm adjustment

We now turn to effects on creative firms. Figure 3 shows trends in the number of creative firms (left) and average creative firm size (right) between 1997-2017. For statistical disclosure reasons, we include the BBC in the left-hand plot and exclude it in the right-hand plot.[22] As in Figure 2, the solid line denotes Salford, the dashed line Synthetic Salford, and the vertical line denotes the relocation. The dip discussed above is especially pronounced in the right-hand plot, further supporting our decision to drop these years. Figure B3 plots the associated RRMSPEs. Table 3 gives detailed results.

[22] We are unable to export results from the UKDS Secure Lab that disclose individual firms in our data. The size of the BBC relative to other creative industries firms in Salford means that it would be straightforward to see in the right-hand plot.

Figure 3. Effect on the number and average size of creative firms.

L: Number of creative firms **R: Average creative firm size**

Source: BSD. Notes: the left panel shows the trends in the number of creative firms between actual Salford (solid line) and synthetic Salford (dotted line). The right panel shows the trends in the average size of creative firms between actual Salford and synthetic Salford.

Table 3. Firm effects in detail.

Specification	Period of impact	Period of predictors	Levels	Long Diff	Obs
Number of creative firms (including BBC)	2012-2017	1997-2009	224.21** (0.011)	235.59 (0.395)	349
Average size of creative firms (excluding BBC)	2012-2017	1997-2009	1.59** (0.029)	1.99 (0.052)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, non-creative employment, creative firms, non-creative firms. The *p*-values of the point estimate are in parentheses under each point estimate.

The left plot of Figure 4 shows that the number of creative firms increases in both Salford and the synthetic control, but the growth is faster in Salford. Consistent with this, the first row of Table 3 reports an increase of around 224 firms, on average, after the BBC move. The long difference change is larger, but insignificant, reflecting the fact that we get less precision with estimates based on only one long difference post-treatment. With both employment and the number of firms increasing it is not clear what this implies for average firm size in the creative sector. The right plot in Figure 4 and the second row of Table 3 provide the answer. Figure 4 shows an increase in firm size in Salford relative to the counterfactual. Excluding the BBC,

average firm size in Salford was 1.59 employees larger after the move. Again, long difference results are not significant.

Overall, these results suggest the BBC relocation increased the number of creative firms and their average size. As with creative jobs, the estimated effect increases over time, but in this case the change is not statistically significant.

6.1 / Effects on incumbent firms

The average effects of the relocation on creative firms in Salford may hide important differences between incumbents (i.e. present in 2011), movers (from somewhere else in the UK), and new firms.

Table B5 shows changes in the counts of these three groups between 2011 and 2017. The number of new creative firms in each year trebled from 20 in 2011 to 60 in 2017. The number of creative movers is much greater, and doubles from 177 in 2011 to 364 in 2017. Creative incumbents, the biggest group, fall by over half from 877 to 410. At face value, this suggests that much of the change is driven by entry (either of new firms or by movers). But it is still possible that the BBC move increased the survival rates of incumbents, even if their overall numbers are falling.

Table 4 explores this, showing synthetic control results in levels for the set of creative firms present in Salford in 2011.[23] We find a small, significant positive effect of the relocation on employment in these firms; a significant increase in firm counts, and a non-significant decline in firm size. Employment coefficients turn negative and non-significant when out-movers who returned after 2012 are excluded (Table B6), implying this subset of incumbents drive our main results. Firm counts stay significant, suggesting a robust effect of the relocation on incumbent firm survival.

[23] Incumbents fall into one of three groups: present in 2011 and stayed in Salford; present in 2011 and moved out / exited, present in 2011, moved out and then returned to Salford. We run sensitivity checks excluding this last group: employment results are highly sensitive to their inclusion (see Table B5).

Table 4. Impact of relocation on incumbent firms.

Specification	Period of impact	Period of predictors	Levels	Obs
Creative employment	2012-2017	1997-2009	55.01** (0.043)	349
Creative firms	2012-2017	1997-2009	27.98*** (0.003)	349
Ave creative firm size	2012-2017	1997-2009	-0.909 (0.309)	349

Source: BSD.. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, non-creative employment, creative firms, non-creative firms.

Combining the results from Tables 3 and 4, we see that increased incumbent survival rates accounts for around 13% of the overall effect on creative firm numbers (28 / 228). Entrants and movers account for the remainder. Overall, this suggests that the positive impact on existing firms was minor. Table B6 shows that 477 incumbents exited post-BBC relocation: our results suggests that this would have been just over 500 in the absence of the relocation. This is consistent with qualitative evidence that the BBC was slow to establish strong supplier relationships with existing media firms in the local area (Cook and Johns 2011, Johns 2016). The BBC relocated entire programme-making divisions, which it was hoped would lead to more commissioning in GM. In practice the switch from London seems to have happened less and more slowly than anticipated.

We do not attempt to disentangle effects on entrants and movers given the small numbers in the creative sector in Salford results in noisy estimates and statistical disclosure issues when implementing synthetic controls.

7. Understanding adjacent industry impacts

So far, we have focused on the impact on employment and firms within the creative industries. We have also shown that there is no impact on total employment. However, the re-location may have effects on other 'adjacent' industries that have strong supplier relationships with the BBC, as well as on levels of non-tradable activity.

To investigate the first channel, we run synthetic controls on Publishing and Broadcasting, the sub-sectors within the overall creative industries space that include the BBC.[24] Results are given in Table 5, Panel A. The BBC re-location results in 3,873 additional jobs in the Publishing and Broadcasting sub-sector in the post-location period. Netting out the BBC average employment in 2012-2017 – i.e. assuming all the 2,800 BBC jobs belonged to this sub-sector – we get an average multiplier of 0.38 for the period 2021-2017. Employment in publishing and broadcasting accounts for all the overall creative multiplier, and all the increase in creative industries.

The number of publishing and broadcasting firms is around 41 higher (significant at the 10% level), while the average size of firms is around 28 employees higher. On this basis, changes in publishing and broadcasting firms account for around 18% of the overall increase in creative firms, and all the increase in creative firm size.

[24] We also run sensitivity checks looking at the relocation effect on other DCMS creative industry groups. None of these show significant impacts. Results available on request.

Table 5. Summary of results in related industries.

Specification	Period of predictors	Levels	Observations
A. Publishing and broadcasting			
Publishing and Broadcasting employment	1997-2009	3873.32*** (0.003)	349
Share Publishing and Broadcasting over total	1997-2009	0.034*** (0.003)	349
Number Publishing and Broadcasting firms	1997-2009	40.66* (0.097)	349
Av Firm size in Publishing and Broadcasting	1997-2009	28.03** (0.032)	349
B. Technology			
Technology employment	1997-2009	1091.90* (0.077)	349
Share Technology over total employment	1997-2009	0.011* (0.052)	349
Number Technology firms	1997-2009	11.03 (0.244)	349
Average size of Technology firms	1997-2009	17.85 (0.891)	349
C. Tradables			
Tradables employment	1997-2009	-888.64 (0.123)	349
Share tradadables over total employment	1997-2009	-0.003 (0.221)	349
Number tradadables firms	1997-2009	-19.22 (0.619)	349
Average size tradable firms	1997-2009	-0.330 (0.330)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, Creative employment, non-creative employment, creative firms, non-creative firms. Publishing and broadcasting definition from DCMS (2016), technology from Tech Nation (2018), tradables from Gutierrez-Posada et al (2023).

We next turn to activities in adjacent sector space. We focus on technology sectors, which as defined by Tech Nation (2018) have some overlap with the creative industries, for example in software and computer games production.[25] Multiplier effects – through knowledge spillovers, I-O links and labour pooling / moves – could show up in tech sectors as well. Panel B gives

[25] https://technation.io/insights/report-2018/methodology/ , accessed 20 January 2020. This definition excludes the BBC SIC codes but includes two creative SIC codes (58.21 and 58.29, Table A.1 in the Annex). Other definitions by UK Government departments and the UK Office of National Statistics are very similar.

results. Effects are not large in practice – we find marginally significant results for technology employment and employment shares, but no significant results on firm counts or size.

Finally, we consider all tradable sectors, defined using locational Gini coefficients taken from Gutierrez-Posada et al (2023). Panel C summarises results. We find no significant impacts on employment or firm margins.

In Table 6 we look at the effects on non-tradables, defined using the same Gini coefficients. These effects may occur directly as BBC workers spend locally and the BBC buys from local suppliers or indirectly through the additional jobs created through the multiplier effects on creative industries documented above. Creative industries span tradable activities (such as advertising, design and computer games) as well as highly localised activities (such as museums and galleries), so we show results both including and netting out creative sectors.

Table 6. Effects on non-tradable activity.

Specification	Period of predictors	Levels	Obs
Non-tradables employment	1997-2009	237.20 (0.321)	349
Number non-tradable firms	1997-2009	588.29** (0.034)	349
Non-tradable employment, less creative	1997-2009	-3506.79 (0.312)	349
Number non-tradable firms, less creative	1997-2009	364.08* (0.069)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, employment, non-creative employment, creative firms, non-creative firms. Definition of non-tradables from Gutierrez-Posada et al (2023).

We find non-significant effects on non-tradable employment, which are highly sensitive to whether creative activities are included. We find more robust increases in non-tradable firm counts, though these are only marginally significant once we exclude creative activities.

Overall, these results provide strong evidence that multiplier effects are narrowly focused on the creative industries, and specifically on the creative activities most overlapping with the relocated BBC activities. We find generally weak impacts on tech, the most adjacent activities, and non-significant effects on wider tradables and total employment.

8. General Equilibrium effects

Positive demand effects from the BBC move may generate general equilibrium effects, for example through changes in wages, housing costs, and the costs of local services. At the same time, employment and firm gains in Salford may be due to activity displaced from neighbouring local authorities. We consider these issues in this section, continuing to focus on the LAD level for reasons discussed in Section 3.

8.1 / Wage and house price effects

We use the UK Annual Survey of Hours and Earnings (ASHE) to look at wage changes. We focus on average wages at the LAD level and construct the synthetic control using the same pre-treatment variables as we did when estimating the effect on employment.[26] Given results so far, we might expect changes in wages to be concentrated in creative employment but we cannot consider this because the 1% sample in ASHE means small sample sizes for creative employment in Salford and other LADs.

Table 7. Effects on hourly and weekly earnings, 2012-2016.

Outcome	Period of predictors	Treatment effect	Obs
LAD base hourly earnings (£)	1997-2009	0.736	337
		(0.113)	
LAD base weekly earnings (£)	1997-2009	32.81*	337
		(0.077)	

Source: ASHE. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, employment, non-creative employment, creative firms, non-creative firms.

Table 7 reports the results providing the average effect on wages 2012 to 2016 (the last year for which we have ASHE data at the time of writing). Table B7 gives the ASHE weights. We find no significant effect on hourly wages, and a marginally significant effect on weekly wages of around £33 per week. Compared to the pre-treatment Salford mean of £350/week, this is an increase of 9.4%.

[26] In contrast to the BSD, the ASHE dataset does not cover the 11 LADs in Northern Ireland. As some of these appear in the synthetic control for creative employment the ASHE analysis cannot use the same synthetic control (see the weights of the synthetic control group in Table A6 in the Appendix).

In the UK, pay in the lowest paid roles is typically given by the hour, and pay in better-compensated jobs is given by the week or year. The results are therefore consistent with the type of BBC jobs relocated, as discussed in Section 2: more than 60% of these were for relatively senior roles (Grade 7 and above). However, this raises the challenge of disentangling the direct compositional effect of higher paid BBC jobs from any general equilibrium wage effects in Salford.

To do this, we use the fact that we know the wage for 690 new BBC hires between 2009 and 2012, via the Guardian newspaper's 2012 FoI request (The Northerner 2012). These new hires have an average wage 28% higher than the full-time average wage of Salford. In the absence of any other information, we assume this same wage premium applies for all 2,800 BBC jobs over the whole period.[27] On average these BBC jobs account for 2.6% of Salford employees post-treatment (average total employment in Salford from 2012 to 2017 is 109,721). Under these assumptions, the wages of BBC employees in Salford alone would increase the total wage bill by 0.71%. By this back of the envelope calculation, the impact of the relocation on weekly earnings, netting out the direct effect of BBC wages, falls from 9.4% to 8.69%. This is still a substantial increase in wages being paid for jobs located in Salford. Of course, this effect could be purely compositional given the increase in creative industry share if creative industry jobs pay more than the average Salford wage.

8.2 / Property price effects

We look at house prices using yearly UK land registry data and do not find evidence of significant changes (Figure B4). This is consistent with the picture painted by our employment and wage results. Jobs impacts are concentrated in the creative industries, with minimal effects on adjacent sectors and no significant impact on total employment in the area. Wage impacts are small and only marginally significant. The resulting shifts to area incomes are unlikely to be large enough to generate economically or statistically significant changes in housing demand.

[27] http://salfordstar.com/article.asp?id=2777 , accessed 20 January 2020, which suggests wages are 28% higher than average Salford jobs in 2012

8.3 / Displacement effects

Moving away from the effect on wages, we are also interested in possible displacement effects on the rest of GM. We test for displacement by iteratively running the synthetic control method using the same predictors, on all nine other LADs in Greater Manchester. The LADs contiguous to Salford are Bolton, Bury, City of Manchester, Trafford and Wigan. Of these, Trafford shares the closest border with Salford Quays, and the City of Manchester contained the most creative jobs and firms pre-move. Table B8 gives results. The overall pattern of effects is not clear-cut, and none of the impacts are statistically significant.

9. Robustness tests

In the spirit of Ferman et al (2020), we run a range of sensitivity checks on our main estimations. Our main results are robust to different specifications of predictor weights **V**, different specifications of area weights **W** derived using cross-validation methods from Cavallo et al (2013), and using more recent SIC2007 industry codes. Results are available on request.

In the rest of this section, we report results from three more substantive exercises: using an alternative pre-treatment period, testing for anticipation from the BBC announcement, and running results at the city-region (Greater Manchester) level rather than at Salford level.

9.1 / Alternative pre-treatment period

As discussed in section 4, our main specifications remove two 'dip years' from the pre-treatment period because we cannot rule out that the dip and recovery are correlated with the BBC move or due to a data issue specific to Salford.

We show the effect of this decision in Table B9. The table reproduces our main employment results (Panel A), and corresponding results where we keep the full pre-treatment period, 1997-2011 (Panel B). Dropping the dip years alters the trajectory of the synthetic control in the post-treatment period, and substantially reduces the size of the treatment effect. Without this adjustment, effects on levels for creative employment are 31% higher and on shares are 36%

higher in levels. For long differences, the effects are 26% and 13% respectively. In both cases effects on effects on total employment remain insignificant.

9.2 / Anticipation effects

Our estimates may be biased if economic agents react in advance of the policy intervention, for example by moving to Salford in advance of the BBC move. Table 8 gives results. Panel A summarises our main results for jobs and firms from Sections 5 and 6. Panel B shows results that check for pure anticipation effects from the site announcement by using 2007 as the treatment year and 2007-2009 as the post-treatment period. Panel C shows results that capture the cumulative effect of anticipation plus relocation by using 2007 as the treatment year and 2007 to 2017 as the post-treatment period.

Panel B shows small anticipation effects for creative employment. The announcement led to just under 390 additional creative jobs between 2007-2009, around 10% of our main effect; we find no significant effects on creative job shares or on total employment. By contrast, there appear to be strong anticipation effects on smaller firms - the announcement led to a loss of over 250 creative firms from Salford and an increase in the average size. This is consistent with industrial gentrification, where landlords signing multi-year commercial leases increase rents in anticipation of future demand – pushing out smaller firms (Yoon and Currid-Halkett 2014).

Panel C explores the cumulative effect over the post-announcement and the post-relocation periods, 2007-2017. Our headline employment results are similar to the main results in Panel A, consistent with the finding that anticipation effects for total employment are small. Cumulative results for firm numbers and size reflect the substantial anticipation effects reported in panel B. Changes from the date of announcement increased average creative firm *size* in Salford, as in our main results, but the overall effect on creative firm *counts* is now slightly negative, driven by changes in the post-announcement, pre-relocation period that outweigh those seen post-relocation.

Table 8. Summary of anticipation effects.

Specification	Impact period	Predictor period	Levels	Obs
A. Main results				
Creative employment	2012-2017	1997-2009	3743.99*** (0.000)	349
Share of creative firms	2012-2017	1997-2009	0.036*** (0.006)	349
Creative firms (including BBC post-move)	2012-2017	1997-2009	224.21** (0.011)	349
Ave. creative firm size (excl BBC post-move)	2012-2017	1997-2009	1.59** (0.029)	349
Total employment	2012-2017	1997-2009	-651.44 (0.281)	349
B. Anticipation effects				
Creative employment	2007-2009	1997-2006	389.00** (0.040)	349
Share of creative firms	2007-2009	1997-2006	0.005 (0.464)	349
Creative firms	2007-2009	1997-2006	-287.75** (0.006)	349
Ave. creative firm size	2007-2009	1997-2006	1.58*** (0.000)	349
Total employment	2007-2009	1997-2006	759.09 (0.616)	349
C. Cumulative effects				
Creative employment	2007-2009 + 2012-2017	1997-2006	3298.06*** (0.000)	349
Share of creative firms	2007-2009 + 2012-2017	1997-2006	0.031** (0.012)	349
Creative firms (incl BBC post-move)	2007-2009 + 2012-2017	1997-2006	-9.33** (0.012)	349
Ave. creative firm size (excl BBC post-move)	2007-2009 + 2012-2017	1997-2006	1.62*** (0.009)	349
Total employment	2007-2009 + 2012-2017	1997-2006	-65.80 (0.335)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, non-creative employment, creative firms, non-creative firms.

9.3 / Travel to Work Area level results

As we discuss in Section 4, the choice of spatial scale is important. The BBC's planning documents are unclear about the intended geography of impact (Salford, Greater Manchester

or further afield). Piazza and Swinney (2017) find creative activity shifts in a very tight one-mile radius around Salford Quays. Here we conduct a sensitivity check working in the opposite direction, looking at impacts at the Greater Manchester Travel to Work Area (TTWA) scale.[28] Table B10 summarises the results for creative jobs and firms: only the impact on average creative firm size is statistically significant. This suggests that the impacts of the relocation are localised within the conurbation and provides further support for working at local authority district level.

10. Conclusion

We use the relocation of the BBC from London to Salford in 2011 as a natural experiment to estimate public sector relocation multipliers. Comparing Salford to a synthetic control, we find that the relocation of public sector jobs had an average multiplier effect of 0.33 on creative industries jobs in Salford, rising to 0.55 jobs by 2017. In its original planning application, Salford City Authority suggested that up to 15,000 jobs could be created over the 'medium to long term' (Salford City Council 2006)) but we find no effect on overall employment.[29]

We find considerable effects on firm composition within the creative sector and some evidence that the relocation increased average weekly earnings. We provide further evidence that only a small share of the affects are accounted for by incumbent firms, with the remainder due to relocation or new entry (we do not distinguish between these two channels). We find little evidence of displacement effects from the rest of Greater Manchester.

Overall, our results provide strong evidence that the multiplier effects induced by the BBC relocation are narrowly focused on the creative industries, and specifically on the creative activities most overlapping with the relocated BBC activities. We find generally weak impacts on the technology sector which host the most adjacent activities, and non-significant effects on employment in non-tradables (once we exclude creative industries) and in wider tradables. One possible reason for these weak effects on adjacent sectors, is that the BBC has been relatively slow to shift supply chain relationships to firms in Salford. Another is that the BBC's

[28] Working at TTWA scale means using a different set of weights; only Birmingham and Slough & Heathrow have non-zero weights in these results.
[29] We assume that this number includes BBC jobs.

programme-making ‘production function’ did not change during this period in a way that would have required substantive new inputs from outside publishing and broadcasting.

This paper carries four wider lessons for the policy debate on public sector relocations. First, public sector relocations in a specialised activity may have “localised” multiplier effects at the sector-LAD level, and these may be focused on the activities most related to the relocated industry. Second, public sector relocations of medium and high skilled jobs can lead to additional medium to high skilled jobs in the Local Authority (assuming that this characterises the jobs we see created in the creative sector). Third, spillovers of public sector firm relocation can benefit both incumbent and new firms and positive spillovers to the local economy can be mitigated or slowed down by centralised procurement. Fourth, given no effect on overall employment, the relocation may have distributional effects given that the employment effects appear to be concentrated on medium and high skilled jobs.

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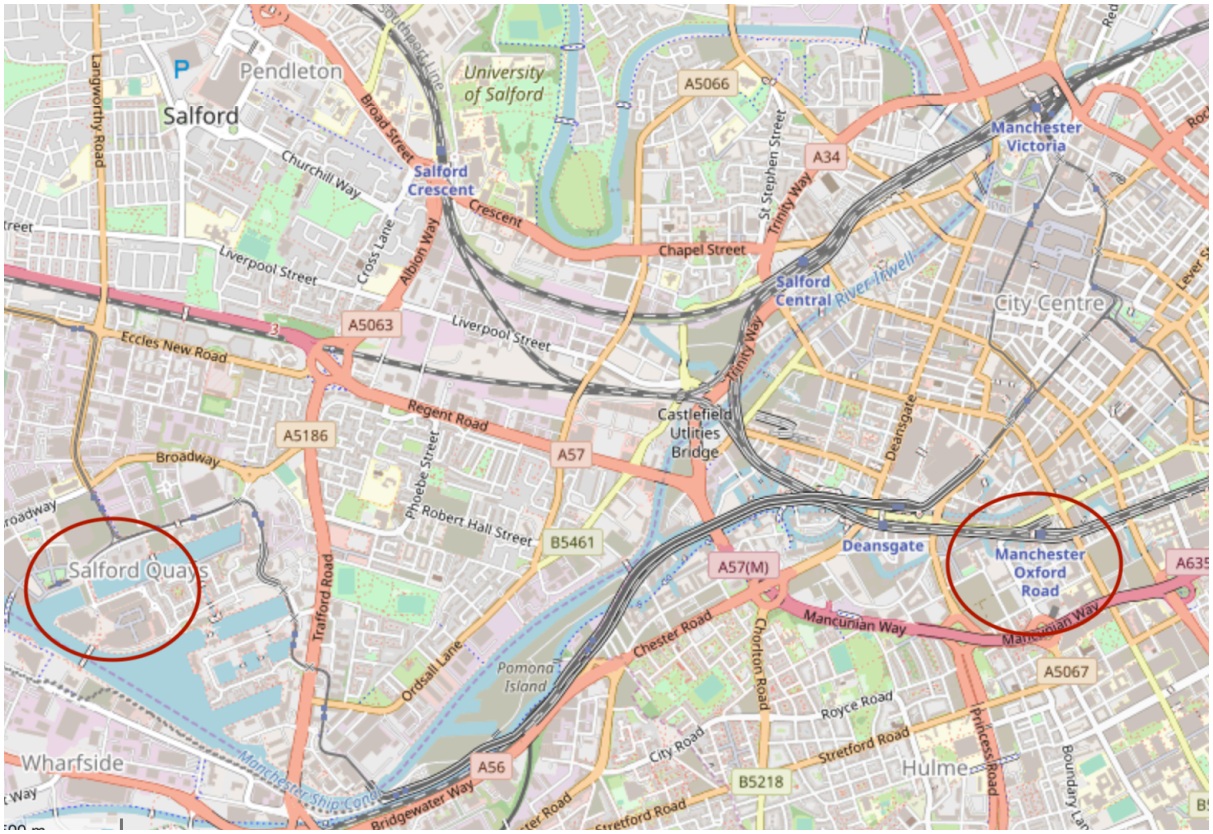
Multipliers from a major public sector relocation: the BBC moves to Salford

Online Appendix

Appendix A / Background

Background figures

Figure A1. Salford and Manchester Oxford Road offices



Source: OpenStreetMap. Notes: Red circles denote MediaCity in Salford Quays (left) and former BBC Oxford Road site (right).

Background tables

Table A1. Creative industries SIC codes (DCMS, 2016)

Group	SIC(2007)	Description
1. Advertising and marketing	70.21	Public relations and communication activities
	73.11	Advertising agencies
	73.12	Media representation
2. Architecture	71.11	Architectural activities
3. Crafts	32.12	Manufacture of jewellery and related articles
4. Product, graphic and fashion design	74.10	Specialised design activities
5. Film, TV, video, radio and photography	59.11	Motion picture, video & TV programme production activities
	59.12	Motion picture, video & TV programme post-production
	59.13	Motion picture, video & TV programme distribution activities
	59.14	Motion picture projection activities
	60.10	Radio broadcasting
	60.20	Television programming and broadcasting activities
	74.20	Photographic activities
6. IT, software and computer services	58.21	Publishing of computer games
	58.29	Other software publishing
	62.01	Computer programming activities
	62.02	Computer consultancy activities
7. Publishing	58.11	Book publishing
	58.12	Publishing of directories and mailing lists
	58.13	Publishing of newspapers
	58.14	Publishing of journals and periodicals
	58.19	Other publishing activities
	74.30	Translation and interpretation activities
8. Museums, galleries and libraries	91.01	Library and archive activities
	91.02	Museum activities
9. Music, performing and visual arts	59.20	Sound recording and Music publishing activities
	85.52	Cultural education
	90.01	Performing arts
	90.02	Support activities to performing arts
	90.03	Artistic creation
	90.04	Operation of arts facilities

Table A2. Technology industries SIC codes (Tech Nation, 2018)

Group	SIC(2007)	Description
1. Manufacturing	26.20	Manufacture of computers and peripheral equipment
2. Telecommunication activities	61.11	Wired telecommunications activities
	61.20	Wireless telecommunications activities
	61.30	Satellite telecommunications activities
	61.90	Other telecommunications activities
3. IT and computer activities	**58.21**	**Publishing of computer games**
	58.29	**Other software publishing**
	62.01	Computer programming activities
	62.02	Computer consultancy activities
	62.03	Computer facilities management activities
	62.09	Other IT & computer service activities
4. Data and Web activities	63.11	Data processing, hosting and related activities
	63.12	Web portals
5. Repair	95.11	Repair of computers and peripheral equipment

Inference

In the synthetic control setting, there is no observed distribution of controls, so traditional inference is not possible. Following Abadie et al (2010, 2015) and others, for inference we use falsification tests based on permutation techniques. Specifically, we estimate placebo treatment effects by applying the synthetic control method iteratively to every non-treated unit in the donor pool, then calculating the ratio of post-treatment to pre-treatment goodness-of fit. Comparing goodness-of-fit ratios across treatment and donor pool units gives us a test statistic that can be interpreted like a *p*-value.

Goodness of fit is measured by the root mean squared prediction error (*RMSPE*) of the outcome variable. For treatment at T_0 and a donor pool of *J+1* units, *RMSPE* is given by:

$$RMSPE = \left((T - T_0)^{-1} \sum_{t=T_0+1}^{T} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2 \right)$$

For each non-treated LA $j \in \{1, \ldots, 348\}$, we estimate "treatment" using the synthetic controls then compute the ratio of post-treatment *RMSPE* to pre-treatment *RMSPE* given by:

$$RRMSPE_j = \frac{\left((T - T_0)^{-1} \sum_{t=T_0+1}^{T} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2 \right)^{1/2}}{\left((T_0 - T_1 + 1)^{-1} \sum_{t=T_1}^{T_0} \left(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \right)^2 \right)^{1/2}} = \frac{Post - period\ "fit"}{Pre - period\ "fit"}$$

Once we compute the $RRMSPE_j$ for each LAD $j \in \{1, \ldots, 348\}$ in our donor pool, we calculate statistical significance by estimating how often we find other places in the donor pool to have similar or higher *RRMPSE*s than the one observed for our actual treatment. In our case, the probability of having a higher *RRMSPE* than the treatment $RRMPSE_T$ is given by the indicator function $\mathbb{I}$ taking the value of 1 when a LAD *j* in the donor pool has *RRMSPE* greater than or equal to the *RRMPSE* for the treated LAD (Salford):

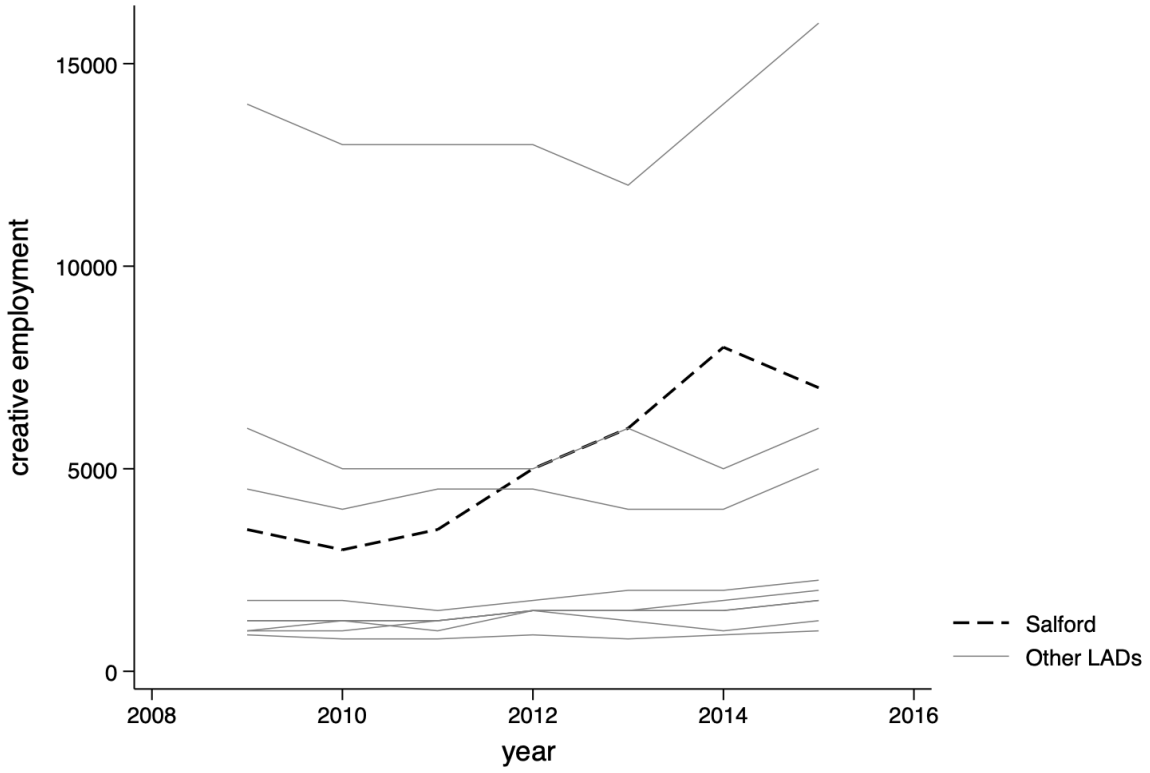
$$p = \frac{\sum_{j=2}^{J+1} \mathbb{I}\left[RRMPSE_j \geq RRMPSE_T \right]}{348}$$

When more than 10% of the placebos have a higher *RRMSPE* than that of the treatment, we say our effects are not statistically significant. This inference strategy implicitly assumes that any LAD has the same probability of being treated. A possible critique of this method is that some LADs should be excluded if they have poor pre-treatment fit (LADs whose pre-intervention *RMSPE* is far greater than the treated LAD) because placebo studies for those LADs are not informative about the relative rarity of the treatment effect (Abadie et al., 2010; Abadie et al., 2011). However, Firpo et al., (2017) compare this inference procedure to test statistics typically used in other methods and demonstrated in a Monte Carlo experiment that the *RMSPE* and *RRMSPE* statistics have good properties with respect to size, power and robustness.

B/ Additional results

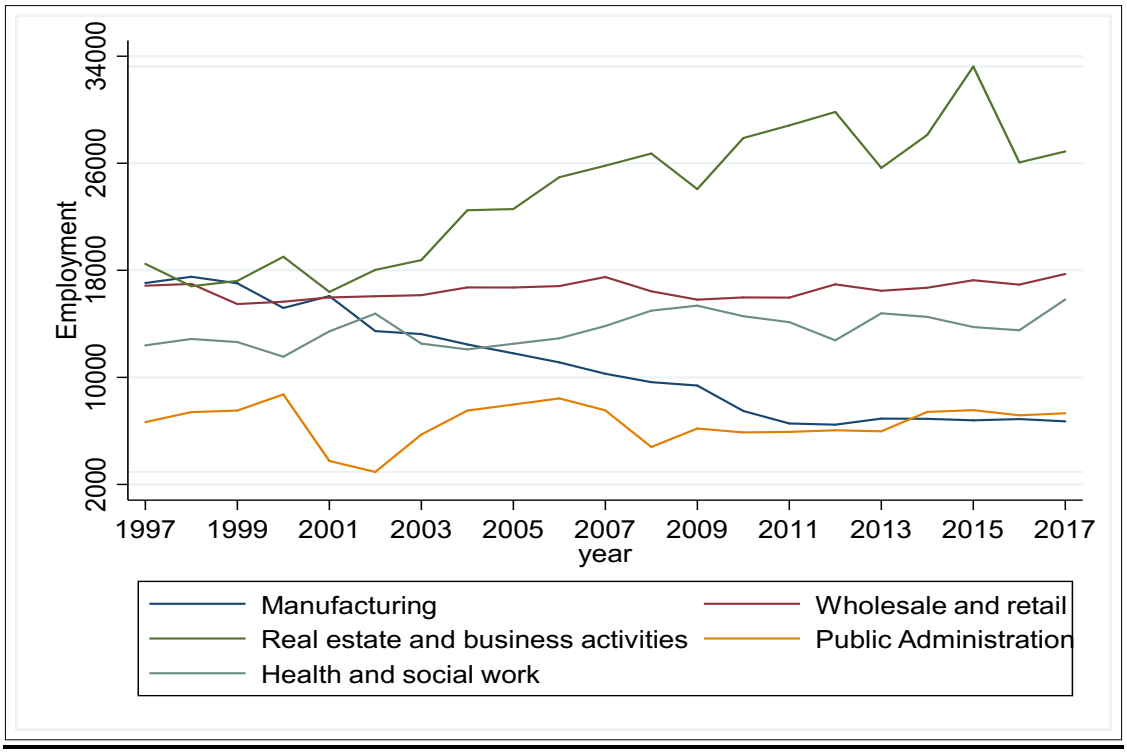
Additional figures

Figure B1. Creative industry employment shares for local authorities in Greater Manchester, 2009-2015.



Source: Business Register and Employment Survey (BRES), accessed via Nomis. Note: BRES data are ONS-generated aggregates of IDBR plant-level data. They approximate our microdata but do not reproduce it exactly.

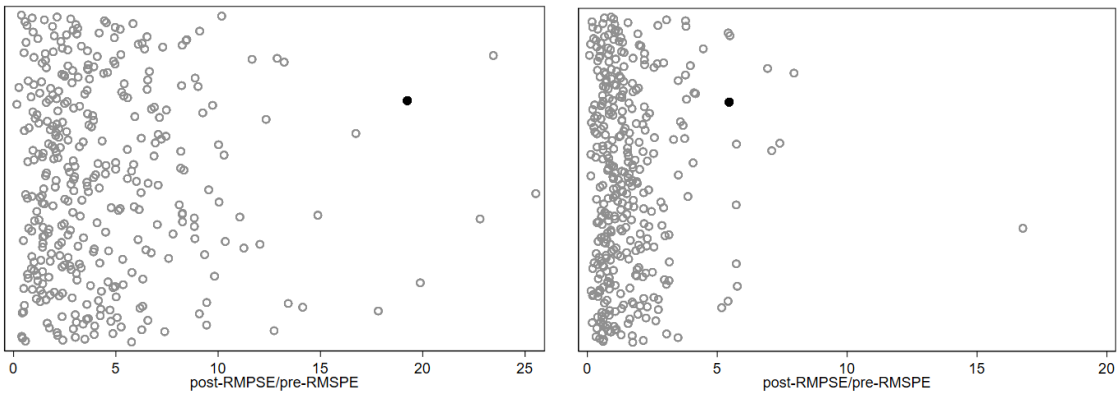
Figure B2. Sectoral job change in Salford, 1997-2017.



Source: BSD. 1-digit SICs.

Figure B3. Effect on the number and average size of creative firms. Placebo plots.

L: Number of creative firms **R: Average creative firm size**



Source: BSD.

Figure B4. Salford house prices versus neighboring local authorities (i) and versus synthetic controls.

Source: PricePaid. Notes: the left panel shows the trends in house prices in Salford, it's greater region Greater Manchester and nationally. The right panel depicts the house prices in Salford versus the local authorities picked by the synthetic control group. Weights available on request.

Additional tables

Table B1. Creative/non-creative employment and firm counts, Salford, 1997-2017.

Year	Creative employment	Creative firms	Non-creative employment	Non-creative firms
1997	4980	666	94441	6564
1998	5146	646	94715	6618
1999	4941	641	93128	6451
2000	5407	647	89085	6537
2001	5651	665	89576	6421
2002	5991	660	91468	6284
2003	6022	735	91276	6355
2004	6124	766	98038	6691
2005	5840	771	100691	6714
2006	7034	798	102020	6743
2007	7154	810	103476	6953
2008	7086	869	103582	6969
2009	7727	874	101226	6746
2010	6494	869	98522	6635
2011	5932	877	94595	6354
2012	7188	963	93209	6340
2013	9347	1073	97763	6700
2014	10639	1216	97335	6757
2015	13809	1373	98842	6824
2016	14633	1462	97137	6953
2017	15490	1769	102939	8300

Source: BSD.

Table B2. Synthetic control weights, main analysis

Levels

Local authority district (LAD)	Synthetic control weight
Halton	0.082
Derby	0.012
Telford and Wrekin	0.111
Southend-on-Sea	0.055
Slough	0.005
Wokingham	0.014
Southampton	0.050
Copeland	0.001
Rushmoor	0.002
Rossendale	0.041
Lincoln	0.040
South Oxfordshire	0.039
Waveney	0.127
Worthing	0.018
Liverpool	0.104
Sefton	0.001
Newcastle upon Tyne	0.019
Sandwell	0.076
Leeds	0.034
Wakefield	0.011
Antrim and Newtownabbey	0.002
Belfast	0.093
Dundee City	0.061

Long differences

Local authority district (LAD)	Synthetic control weight
Southend-on-Sea	0.11
Solihull	0.10
Leeds	0.10
Kingston upon Hull	0.07
Broxbourne	0.04
Sefton	0.03
Rotherham	0.02
Bradford	0.01
Dudley	0.01

Source: BSD.

Table B3. Creative self-employment results using Annual Population Survey (APS) data, 2004-2017.

Specification	Period of predictors	Main predictors	Self employment predictors	Obs
Creative self-employment	2004-2009	103.96 (0.675)	132.13 (0.994)	337
Total self-employment main job	2004-2009	33.32 (0.791)	2971.07 (0.955)	337

Source: APS. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: creative employment, non-creative employment, creative firms, non-creative firms. 'Main predictors' results use all workers in APS for predictors. 'Self-employment predictors' use only self-employed workers in the APS for predictors.

Table B4. Annual Population Survey (APS) weights for synthetic control.

Main predictors		Self-employment predictors	
Local authority district	**Synthetic control weight**	**Local authority district**	**Synthetic control weight**
Leicester	0.082	Stoke-on-Trent	0.039
Telford and Wrekin	0.212	Central Bedfordshire	0.047
Wycombe	0.01	Canterbury	0.017
Northampton	0.071	Hambleton	0.356
Epsom and Ewell	0.128	Suffolk Coastal	0.039
East Hertfordshire	0.092	Chichester	0.007
Liverpool	0.025	St. Helens	0.164
Sefton	0.002	Sheffield	0.072
Rotherham	0.093	Newcastle upon Tyne	0.212
Newcastle upon Tyne	0.031	South Lanarkshire	0.047
Sunderland	0.042		
Birmingham	0.008		
Sandwell	0.172		
Leeds	0.019		
City of Edinburgh	0.002		
Cardiff	0.012		

Source: APS.

Table B5. Creative incumbents, movers, new firms in Salford 2011-2017.

Year	Incumbent firms	New firms	Movers
2011	877	19	177
2012	729	26	208
2013	631	22	242
2014	542	29	297
2015	474	52	328
2016	430	55	307
2017	410	69	364

Source: BSD. Notes: Incumbents are defined as firms in Salford in 2011.

Table B6. Incumbents sensitivity check: incumbents defined as dropping firms that leave and return to Salford after relocation.

Specification	Period of impact calculated	Period of predictors	Levels	Obs
Creative employment	2012-2017	1997-2009	-145.49 (0.206)	349
Creative firms	2012-2017	1997-2009	16.59*** (0.006)	349
Average creative firm size	2012-2017	1997-2009	-1.16 (0.238)	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: Creative employment, non-creative employment, creative firms, non-creative firms.

Table B7. Annual Survey of Hours and Earnings (ASHE) weights for synthetic control.

Local authority district (LAD)	Synthetic control weight
Halton	0.07
Derby	0.00
Nottingham	0.00
Telford and Wrekin	0.14
Southend-on-Sea	0.03
Slough	0.01
Wokingham	0.01
Southampton	0.04
Carlisle	0.01
New Forest	0.01
East Lindsey	0.02
Oxford	0.01
Suffolk Coastal	0.12
Elmbridge	0.02
Reigate and Banstead	0.01
Chichester	0.01
Mid Sussex	0.07
Knowsley	0.10
St. Helens	0.00
Sheffield	0.02
Dudley	0.08
Kirklees	0.05
Leeds	0.06
Eilean Siar	0.02
Moray	0.01
Shetland Islands	0.08

Source: ASHE

Table B8. Summary of displacement effects.

Local authority	Creative jobs	Share creative jobs	Creative firms	Average firm size	Obs
Bolton	803.30 (0.819)	0.014 (0.407)	-111.10 (0.490)	1.633 (0.516)	349
Bury	400.92 (0.539)	0.0028 (0.814)	42.05 (0.415)	0.510 (0.880)	349
Manchester City	7638.62 (0.215)	0.151 (0.871)	519.94 (0.301)	0.489 (0.450)	349
Oldham	433.49 (0.716)	0.0049 (0.633)	-35.47 (0.621)	0.937 (0.507)	349
Rochdale	26.53 (0.934)	0.0021 (0.642)	-30.93 (0.682)	0.087 (0.814)	349
Stockport	-548.82 (0.418)	-0.0014 (0.656)	-144.96 (0.713)	0.228 (0.885)	349
Tameside	-318.72 (0.530)	-0.0025 (0.430)	-48.55 (0.507)	-0.163 (0.470)	349
Trafford	1579.73 (0.745)	0.007 (0.923)	-40.51 (0.994)	1.412 (0.699)	349
Wigan	-457.56 (0.481)	-0.003 (0.481)	-32.71 (0.880)	-0.219 (0.496)	349

Source: BSD.. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: Creative employment, non-creative employment, creative firms, non-creative firms. Period of predictors 1997-2009.

Table B9. Results for alternative predictor period 1997-2011.

Panel A. Main results					
Specification	**Period of impact**	**Period of predictors**	**Levels**	**Long Diff**	**Obs**
Creative employment	2012-2017	1997-2009	3,743.99***	5888.90***	349
Share of creative over total employment	2012-2017	1997-2009	0.036***	0.053***	349
Total employment	2012-2017	1997-2009	-651.44	4308.91	349
Panel B. Alternative pre-treatment period					
Specification	**Period of impact**	**Period of predictors**	**Levels**	**Long Diff**	**Obs**
Creative employment	2012-2017	1997-2011	4,918***	7,441***	349
Share of creative over total employment	2012-2017	1997-2011	0.049***	0.060***	349
Total employment	2012-2017	1997-2011	1,495	1,078	349

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: Creative employment, non-creative employment, creative firms, non-creative firms.

Table B10. Travel to Work Area level results.

Specification	Period of predictors	Levels	Obs
Creative employment	1997-2009	13431.68 (0.454)	227
Share Creative over total	1997-2009	.0074 (0.700)	227
Number Creative firms	1997-2009	-1073.02 (0.863)	227
Average creative firm size	1997-2009	1.022** (0.0176)	227
Total Employment	1997-2009	29769.31 (0.612)	227

Source: BSD. Notes: * significant at 10% level, ** significant at 5% level, *** significant at 1% level. Predictors: Creative employment, non-creative employment, creative firms, non-creative firms.