London Calling? Agglomeration Economies in Literature since 1700

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Abstract

This paper utilises a unique, purpose-built dataset on significant literary artists in the UK and Ireland born 1700–1925 to estimate the gains associated with geographic clustering in terms of increased output. We find that the average author experiences productivity gains of 10.68% per annum when residing in London and show that these gains are not due to self-selection of high-productivity authors migrating to London. We also find evidence of gains from a learning process that persist over time, and we find heterogeneous effects by author quality.

Keywords: Geographic concentration, cities, mobility, productivity, urban history, literary artists

JEL Classifications: D24, J24, J61, N90, R11, Z11

1 Introduction

Learning mechanisms play a substantial role in the micro-foundations of agglomeration economies, both in terms of the development of agglomeration and the benefits such agglomeration produces. In particular, "proximity to individuals with greater skills or knowledge facilitates the

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acquisition of skills and the exchange and diffusion of knowledge" (Duranton and Puga, 2004). In theoretical models such as that outlined in Duranton and Puga (2004), the expected productivity gains from this skill exchange and corresponding learning process explain the migration of skilled and unskilled workers and the distribution of these workers across cities. While much has been theorised about the dynamics of the migration of workers and the agglomeration of industry in general, less is known empirically about these dynamics, particularly for cultural production and the self-employed in these sectors.

In the spirit of Davis and Dingel (2012), we propose productivity gains from agglomeration effects as both a by-product and driver of geographic clustering of cultural production, and we attempt to fill the gap in current research by empirically analysing the gains from agglomeration (we propose via knowledge creation and diffusion) of literary production in historical Britain and Ireland. Specifically, we utilise a unique, purpose-built dataset with information on the birth location and lifetime migration, productivity (in terms of number of publications), and demographic characteristics of 370 authors in the UK and Ireland since 1700. We analyse the migration and clustering of literary artists and then construct age-productivity profiles to determine the productivity gains (if any) associated with the geographic clustering of literary activity.

We find that the average author's output is significantly higher when the author resides in London, the only major literary cluster during the time period, and that these results are not driven by the self-selection of high-productivity authors migrating to London. The productivity gains from agglomeration peak at a one-year lag and persist three to five years into the future, suggesting that authors undergo an initial learning process and may receive persistent gains from learning. Furthermore, these results are heterogeneous by author quality, with high quality authors (top 50%) experiencing the greatest gains from agglomeration. Though, these gains diminish marginally with author quality.

The remainder of this paper is structured as follows. In the next section, we outline the theoretical framework, highlighting the relationship between geographic proximity and tacit knowledge and discussing agglomeration economies. Next, we discuss the data sources and descriptive statistics. Section 4 outlines the identification strategy, and results are presented in Section 5. Section 6 concludes.

2 Theoretical Framework

2.1 Geographic proximity and tacit knowledge

One of the earliest economic explanations of geographic clustering of industry was posited by Alfred Marshall:

> *"When an industry has thus chosen a locality for itself, it is likely to stay there long: so great are the advantages which people following the same skilled trade get from near neighbourhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas. And presently subsidiary trades grow up in the neighbourhood, supplying it with implements and materials, organizing its traffic, and in many ways conducing to the economy of its material."* (Marshall 1890, p. 225)

More formally, the geographic concentration of industry occurs because firms benefit from economies of scale via increased input-output linkages, labour market pooling, and technology spillovers (Krugman, 1991; Hanlon, 2012; Kelly and O'Hagan, 2007).

Duranton and Puga (2004) explore the micro-foundations of Marshallian agglomeration economies and divide them into broad types based on the mechanisms that drive their formation: sharing, matching, and learning. Duranton and Puga highlight several types of learning mechanisms (knowledge generation, diffusion, and accumulation) that are particularly relevant in the context of literary production. Their discussion of these mechanisms alludes to two important concepts – that of 'space of places' (the importance of location for learning and innovation) and that of 'space of flows' (the importance of networks in the transfer and diffusion of knowledge) (Ter Wal and Boschma, 2009). The relevance of these concepts becomes clear with a careful understanding of the difference between information and knowledge, particularly with regard to tacit knowledge.

Tacit knowledge is gained through an individual's perception of information through repeated interaction in a shared learning process; this contrasts with explicit knowledge, which is information that has been codified and stored in media such as an encyclopaedia or a textbook (Howells, 2012). Tacit knowledge is transmitted most efficiently between individuals in close proximity, so there are natural geographic boundaries to its flows and spillovers (Audretsch, 1998; Gertler, 2003). Thus, it is natural that "innovative activity should concentrate geographically in those industries where the direct knowledge-generating inputs are greatest and where knowledge spillovers are the most prevalent" (Audretsch and Feldman, 1996).

However, it is argued that geographic proximity is a necessary but not sufficient condition for the transfer of tacit knowledge (Boschma, 2005; Torre and Rallet, 2005). Torre and Rallet (2005) outline four additional types of proximity that, in combination with geographic proximity, provide a sufficient condition for tacit knowledge transfer: cognitive proximity (a shared knowledge base), social proximity (socially embedded relationships), institutional proximity ('common habits, routines, established practices, rules, or laws') and organisational proximity ('the ability of an organisation to make its members interact'). (Also see Mokyr, 2005; D'Este et al., 2013; Torre and Rallet, 2005; Boschma, 2005; Hellmanzik, 2013; Audretsch, 1998; Rallet and Torre, 1997.) Yet, these types of proximity are difficult to quantify, and historical data on an individual level is largely unavailable.

Nevertheless, it is reasonable to assume that authors are cognitively proximate by the nature of their profession, and it is likely a sample of authors will be socially or institutionally proximate if the sample is limited to a relatively small geographic region, as they are likely to share a common language and culture and interact with the same members of a wider literary-industrial complex (publishers, editors, critics, etc.) Thus, we argue that geographic proximity provides the potential for repeated interactions between actors that are cognitively, institutionally and socially proximate in our context.

2.2 Agglomeration economies and productivity

Studies on economic agglomeration consider not only the reasons for geographic concentration but also the nature of economic clusters and resulting agglomeration effects. Chatterji et al. (2013) find decreasing returns to such spillovers, while Ter Wal and Boschma (2009) warn

of cognitive lock-in – the risk of getting 'locked in' to established ways of thinking instead of continuing to develop new ideas increases as the density of a cluster increases (also see Boschma, 2005; Jones, 2009; Audretsch, 1998). Porter (2011) discusses how competition and rivalry due to geographic proximity increase overall standards and the probability competing firms or individuals will be considered 'prominent.' Kelly and O'Hagan (2007), however, suggest that the direction of the clustering/prominence relationship is not clear and may even be cyclical: some prominent agents may choose to cluster to reap the benefits of doing so, while others become prominent because of the gains they received from working in a cluster.

Furthermore, there have also been attempts to estimate the gains from economic clustering across the creative industries and understand how these dynamics change by field. Perhaps the most prevalent method of studying the gains from geographic proximity is by analysing the spatial clustering of patent registrations from R&D by private firms and universities. (See Carlino et al., 2007; Moser et al., 2014; Azoulay et al., 2010; Audretsch and Feldman, 1996, among others.) However, some recent literature have taken alternate approaches. Waldinger (2012a) evaluates the productivity losses (in terms of academic publications rather than patents) associated with the breakdown of research clusters (i.e. university science departments), utilising the dismissal of mostly Jewish scientists and the destruction of facilities by Allied bombing in Nazi Germany as exogenous shocks. He finds significant decreases in departmental productivity, due to both human capital and physical capital shocks. Waldinger (2012b, 2010) conduct similar studies on university mathematics and science departments in Nazi Germany, finding that higher cluster density and higher quality of peers within the cluster both increase the productivity of researchers and have a positive effect on the outcomes of the PhD students within their department. Overman and Helmers (2013) evaluate how the geographic distribution of science research is impacted by the construction of a scientific research facility in Oxfordshire, England in 2003. They find that the sitting of the Synchrotron Diamond Light Source created a highly localized cluster of related scientific research.

With regard to the arts, Borowiecki (2013) conducts a historical study examining the impact of geographic clustering on the productivity of classical composers. He finds that clustering has a positive and significant impact on composer productivity and finds heterogeneity of returns across clusters and composer quality. Borowiecki (2012) and Borowiecki and O'Hagan (2013) follow this by analysing the impact of war on clustering and life-cycle creativity. They find that

the share of composers drops during periods of conflict, composer productivity is negatively impacted by the presence of a conflict, and the outward migration of composers significantly reduces a country's long-term creative potential. The gains from the clustering of prominent visual artists is analysed by Hellmanzik (2010), who finds that the artwork of prominent visual artists is valued higher when produced in a creative cluster. She also finds heterogeneity of returns by cluster location and artist quality.

Any study regarding the relationship between the city, the diffusion of knowledge, and literary production would not be complete without consideration for those most involved in the creation, spread, and promotion of new ideas – namely, the author. However, it is reasonable to assert that not all authors have a significant impact or to question whether there even exists any significant relationship between the author and the city. The potential for gains from co-location is quite evident for capital-intensive industries; however, there are few capital requirements for authorship. Authors are also anecdotally described as solitary and independent workers, so it could be that authorship is an inherently individual process and thus authors would not benefit to the same degree (if at all) from agglomeration.

These questions are currently left unanswered both in economics literature and in literary studies. Literary studies are currently confined by their focus on the individual: the development of *individual* texts and the lives of the *individual* authors who write them. In discussing these limitations, St Clair (2004) implores: "Can we find explanations which apply to the print era as a whole? Can we begin to model the links between texts, books, reading, changing mentalities, and wider historical effects?" Economic theory has the tools to analyse the production and distribution of goods and knowledge on a broad scale, and economic literature includes studies on economic geography, agglomeration economies, and economic history. This paper contributes to the literature in this area by bringing these elements together. We argue that tacit knowledge spillovers are both a by-product and driver of geographic clustering, and we attempt to determine if such gains from geographic co-location exist for literary production and attempt to quantify this effect.

3 Data

This paper utilises a unique, purpose-built dataset combining location and biographical information of literary artists. This dataset was developed by collecting every individual associated with British or Celtic literature born between 1700–1925 with an entry in Encyclopaedia Britannica Online.[1] To be defined as a literary artist, an individual must have made at least one unique contribution to poetry or prose, which eliminated individuals whose contributions were strictly limited to translations, textbooks, songwriting, literary criticism, or publishing.

Individual-level data was collected from three online encyclopaedias: Encyclopaedia Britannica (2014), The Literary Encyclopaedia (2014), and Literature Online (2014). This data include age, lifespan, age at first publication, number of publications per annum, lifetime publications, career duration, gender, and location for every year of the author's life. We rely on observable measures of productivity (output per annum) for our analysis: output is measured in terms of number of known publications rather than number of works ever written.[2] Of the roster of 537 significant figures, only 370 have complete or near-complete lifetime location and publication information.[3] This sample of 370 authors is used in the econometric analysis in the following sections.

The Greater London Area is unrivalled in total births of literary artists, as 79 (or 21.35%) of the artists were born within this region. (See Table 6 in the Appendix.) We also evaluate spatio-temporal trends in lifetime movement to determine if authors tend to migrate and cluster in certain locations. As seen in Figure 1, clustering intensity is quite high throughout the sample. London[4] consistently emerges as the largest literary cluster, with over 30% of all authors in a

[1] Due to posthumous publishing and potential biases that may be associated with an increased interest and analysis in an author immediately following his or her death, living or recently deceased literary artists were not included. Thus, all literary artists in this dataset passed away before the year 2000.

[2] Total number of known publications includes any type of publication: novel, collection of poetry or short stories, anthologies, contributions to literary magazines, plays, memoirs, etc. All publications were given equal weight. We have no measure of the quality of individual publications.

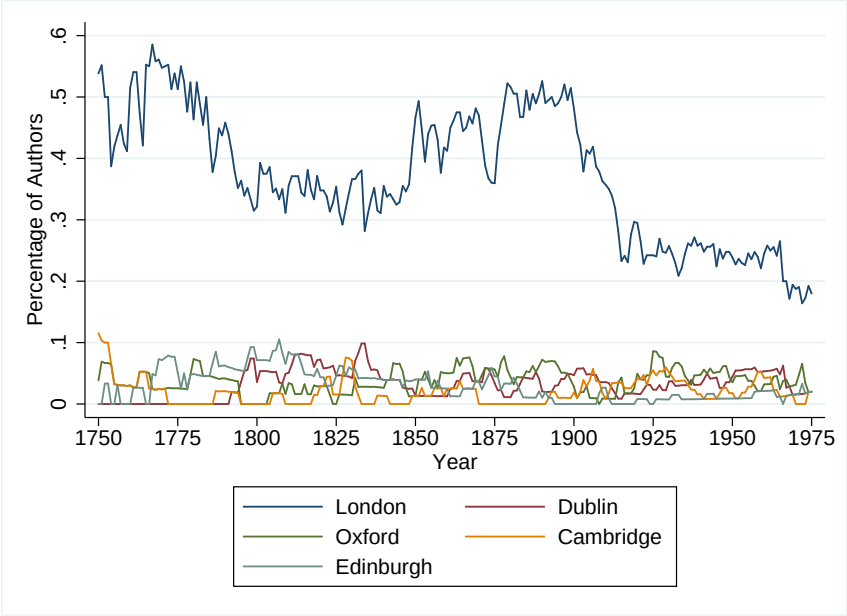
[3] The term 'near-complete' is used specifically in regard to lifetime location because it was not unusual for individuals to have an unknown location for less than 5 years of their life. Unknown locations were particularly common during periods of conflict for males participating in military service. Such individuals were kept in the sample. With regard to publications, authors either had a comprehensive bibliography listed in Literature Online or a few select works listed across all three online dictionaries. Authors who do not have a comprehensive bibliographical entry were not included in the sample.

[4] London is defined as the Greater London ceremonial county rather than the area within the official City of London limits, as sources often ambiguously report an individual as "moving to London" rather than specifying that person's exact location. Particularly in the latter part of the sample, the "London area" may refer to any part of the metropolitan area.

given year residing in London until the end of the 19th century.

At its peak, London was home to over 50% of all authors. It is notable that the clustering intensity of authors in London decreased from nearly 50% at the end of the 19th century to around 25% during the 20th century. This migration of authors out of London during this period was not accompanied by an increase in the clustering intensity in the minor literary clusters or a similar decrease in their clustering intensity. Dublin, Edinburgh, Oxford, and Cambridge emerge as the only other cities that see minor clustering of authors at any point in the sample. Due to the small sample sizes in these minor clusters (consistently fewer than 5 authors clustering in each city per annum), we define London as the only literary cluster for analysis in this study.

Figure 1: Share of Authors in Major Cities



We also investigate the variation in movement in and out of London, as a key concern is that London arises as a cluster only due to its role as a major location of birth. Of the sample of 370 authors, 71 authors never lived in London and only 4 authors never left London, indicating that approximately 80% of the sample spent at least some time living in London. Thus, the clustering intensity of London is not driven by the fact that London is a key birth location and is instead due migration in and out of London.

Summary statistics for the sample of 370 authors are presented in Table 1. Authors tend to be engaged in work-related activities for a great portion of their life, on average publishing their

first work at age 25 and continuing to work for just under 40 of their 66 years of life. Over the course of their careers, authors produce an average of 31 publications, publishing an average of 0.88 works per year. Over their lifetimes, authors spend around 21 years in London. There are some distinct gender differences, particularly with regard to total lifetime works with male authors publishing around 10 more works over the course of their lifetimes.

Table 1: Summary Statistics by Gender

		Median	Mean	Std. Dev.
Male	Lifespan	69.00	65.96	16.43
N = 300	Age at First Publication	26.00	26.46	7.27
	Years in London	15.00	20.83	20.80
	Lifetime Works	23.00	34.70	32.44
	Career Length	41.00	39.50	17.23
	Works per Annum	0.67	0.92	0.79
Female	Lifespan	70.50	68.56	15.58
N = 70	Age at First Publication	27.50	28.33	8.06
	Years in London	21.50	24.29	20.51
	Lifetime Works	18.50	27.00	30.84
	Career Length	43.00	40.23	17.43
	Works per Annum	0.55	0.68	0.56
Total	Lifespan	69.00	66.45	16.28
N = 370	Age at First Publication	26.00	26.81	7.45
	Years in London	16.00	21.48	20.76
	Lifetime Works	21.00	33.24	32.24
	Career Length	42.00	39.64	17.24
	Works per Annum	0.64	0.88	0.76

Figure 2 shows the total number of authors and total output (of all authors) per annum over time. There is no significant change in total production for the first 150 years, followed by a sharp and steady increase in total production from around 1850. It is notable that this is not accompanied by a corresponding dramatic increase in the total number of authors.[5] The dynamics of publishing are further detailed in Figure 3, which decomposes the total number of publications between those published by authors in London and those published by authors living in all other locations. Until the turn of the twentieth century, authors residing in London consistently produce at least as many publications as all authors in all other locations combined.

[5]This shift in total production could be due to invention and widespread of industrial printing press during this time or the continual increase in the total number of authors led to an increased competitiveness that manifested itself in increased total output. Perhaps, as well, this is due to rise in rise in literacy and the advent of the "penny dreadful" and "shilling shocker" in the mid to late 19th century. Most likely, it is some combination of all these

Figure 2: Total Authors and Output per Annum

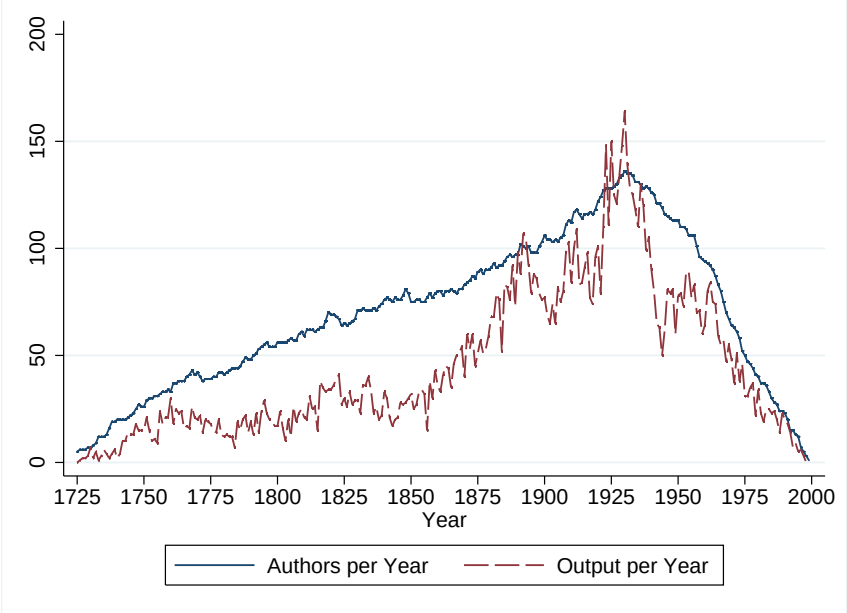
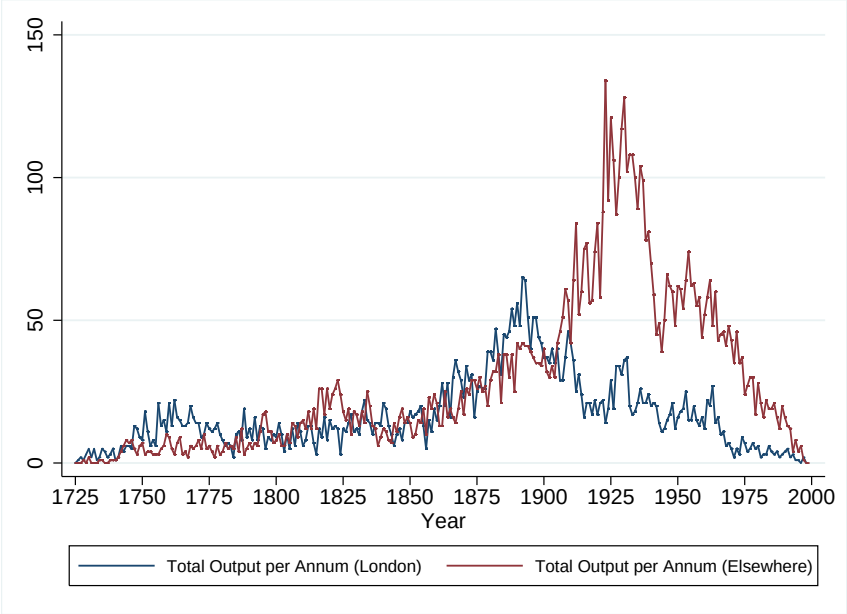


Figure 3: Total Output per Annum by Location



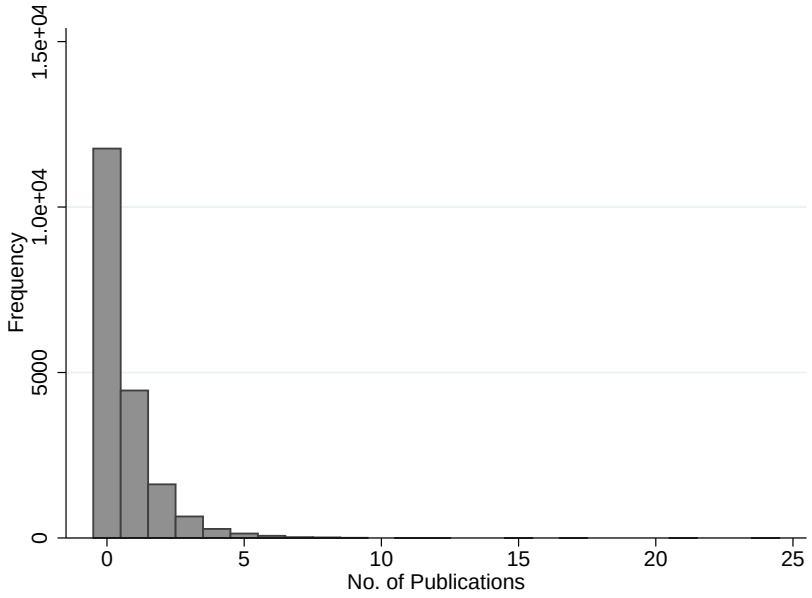
4 Empirical Approach

The aim of this analysis is to determine if living in a geographic cluster (London) results in an increase in productivity and to estimate these returns. We estimate the following equation:

$$output_{it} = \alpha + \beta_1 London_{it} + \beta_2 age_{it} + \beta_3 age_{it}^2 + \gamma_t + \gamma_i + \epsilon_{it} \quad (1)$$

where $output_{it}$ measures the number of known works by author i published in time t.[6] The variable of interest is $London_{it}$ is a binary variable equal to 1 if author i was living in London in time t. The variables age_{it} and age_{it}^2 control for author-specific life-cycle ageing effects, with the quadratic term allowing for productivity to diminish as a author's age increases. γ_t is a vector of time dummies to account for yearly changes in productivity that impact all authors in the same way. This estimating equation is likely to suffer from endogeneity caused by one or more omitted variables: productivity gains may be due to some unobserved individual-level, time-invariant characteristic (e.g. natural ability) that may also linked to an individual's likelihood of migrating to a literary cluster. Thus, we also include a full set of author fixed effects, given by γ_i, to control for this.

Figure 4: Frequency of Output Observations



factors (St Clair, 2004).

[6] We rely on observable measures of productivity for our analysis. As mentioned in the previous section, productivity is measured in terms of number of known publications rather than number of works written. We have no measure of the quality of individual publications.

Furthermore, there are many years in which authors do not publish at all. In years in which they do publish, most authors publish only a single work per year, with increasingly fewer having two, three, etc. publications per year, as seen in Figure 4. Therefore, we limit our study to potential active years, which we define as age 16 and older. This represents the lower bound for age at first publication. Additionally, many authors in our sample began university at age 17 or 18. Thus, potentially the first migration decision the authors made themselves would have been made around age 16 or 17. Because of this, the sample used in our analysis begins in 1725 (the first year with multiple observations) and ends in 1999 (when the last authors died). We also supplement our analyses with a negative binomial model, which is a more appropriate specification for over-dispersed count data.[7]

Empirically, establishing a causal link is a challenge due to the potential endogeneity of the propensity to cluster. This is moderated to some degree by the inclusion of author fixed effects; however, it is possible that there is a feedback effect between past output and the probability of migrating to London. In this case, the strict exogeneity assumption is violated, and the OLS estimates will be biased. The primary concern in this context is that high-productivity authors systematically migrate to London at higher rates than lower-productivity authors. In this case, the OLS estimates will be overestimates of the true effect. However, if lower-productivity authors systematically migrate to London at higher rates, then the estimates may be viewed as a lower bound. We explicitly address this issue by using a logit model to determine the role of past success (in terms of output) in the probability of migrating to London.[8]

Implicit to the baseline estimate is the assumption that the gains from co-location occur in the same year as the year of residence. Two issues arise from this assumption. First, there is potential issue of simultaneity – that authors who are successful in the beginning of the year may migrate to London later in the year. In this case, the weak exogeneity assumption is violated, and the OLS estimates will be inconsistent and upwardly biased. Second, the gains from clustering may not be immediate and instead occur one or more periods in the future: authors may experience a initial learning process during which they develop local social networks and industry-specific knowledge. In order to address these issues, we consider the effect of residence

[7] Although not reported, the conditional variance of the output variable is greater than the conditional mean; therefore, the data is over-dispersed.

[8] We use 25-year dummies rather than year dummies for the logit models to be parsimonious with the degrees of freedom.

in London in the current period on future output (i.e. output one, three and five years in the future.)

We also consider potential non-linearities in agglomeration effects with respect to author quality. It is likely that authors of different 'quality' also have proximal relationships of differing qualities, so it is possible that proximity is of greater importance to authors of higher quality. For example, Rosenthal and Strange (2008) found sharper rates of attenuation of human capital spillovers for workers with a university education compared to those with less than a university education. Although we do not have data on cognitive, social, institutional and organisational proximity, we do have information on author quality that we can exploit to explore these potential non-linearities.

5 Econometric Estimates

5.1 Main Results

As our baseline result, we estimate the equation from the previous section. These estimates are presented in Table 2. Column (1) shows the pooled OLS relationship between locating in the London cluster and the number of publications in a given year. Column (2) includes author fixed effects. Column (3) includes the coefficient for the negative binomial, and Column (4) provides the respective incident rate ratios. In all four models, robust standard errors are clustered on the author level.

These results show that authors do, in fact, experience significant productivity gains from locating in a geographic cluster. As seen in the OLS model with author fixed effects in Column (2), authors residing in London experience productivity gains of up to 0.094 additional works per annum compared to those living elsewhere. Given the mean output per annum is 0.88, this translates to 10.68 % increase in annual productivity. The negative binomial incident rate ratios (NB IRR) reported in Column (4) indicate that authors who live in London see a 24.3% increase in the probability of publishing in a given year. In all specifications, age has a positive but diminishing effect, which is consistent with general findings in the literature on individual productivity. (See, for example, Levin and Stephan (1991).)

Table 2: Main Results

	(1) OLS	(2) Fixed Effects	(3) Negative Binomial	(4) NB IRR
Age	0.0766***	0.0870***	0.149***	1.160***
	(0.00511)	(0.00549)	(0.00468)	(0.00542)
Age-Squared	-0.000728***	-0.000738***	-0.00157***	0.9984***
	(0.0000510)	(0.0000492)	(0.0000426)	(0.0000425)
London	0.0331	0.0944***	0.218***	1.243***
	(0.0528)	(0.0364)	(0.0322)	(0.0400)
Constant	-1.232***	-1.562***	-2.143***	0.117***
	(0.134)	(0.158)	(0.266)	(0.031)
Time Dummies	Yes	Yes	Yes	Yes
Author FE	No	Yes	Yes	Yes
R^2	0.103	0.120		
No. Authors	370	370	370	370
Observations	19022	19022	19022	19022

Robust standard errors are clustered on the author level and are reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

There are a few elements of the baseline results worth further mention. There is a distinct difference between the magnitude and significance of the London coefficient in the pooled OLS results in Column (1) and the OLS model with author fixed effects in Column (2): the coefficent is relatively small and not statistically significant in the former and is larger and highly significant in the latter. This indicates that much of the variation in production between individuals is due to individual unobservable, time-invariant characteristics. Without controlling for these unobservables, location does not explain much of the differences between individuals' productivity. However, once these characteristics are controlled for, location does explain a significant amount of the remaining variation in production between people.

The R-squared value of the fixed effects model is also notable: 12% of the variation in productivity can be explained by only four variables (age, London, and time and author fixed effects). Creative production is often anecdotally viewed as a highly ethereal process – one that is organic and impalpable, beyond quantification. Yet, a substantial amount of literary production can be explained by a simple life-cycle production process and geographic proximity, not so dissimilar to the production processes of R&D researchers. (See Levin and Stephan (1991).)

5.2 Potential Self-Selection in Migrating to London

One potential issue is an endogenous self-selection process in the decision to migrate to London. In particular, the results will be upwardly biased if high-productivity authors systematically migrate to London at higher rates. For example, authors who experience some degree of success (in terms of number of publications) while residing elsewhere may choose to move to London due to the expectation of higher wages. In this case, the effect of being in London is not due to gains from agglomeration but is instead capturing the fact that those who chose to migrate have a history of successful publishing.

In Table 3, we present logit regressions predicting the probability of migrating to London to examine the role of past success in determining migration. In Column (1), we use the previous year's output to examine if immediate past success increases the probability of migration. In Column (2), we use the total output to date to determine if cumulative success increases the probability of migration.

Table 3: Probability of Migrating to London

	(1)	(2)
	Output Last Year	Total Output to Date
Age	0.968*	0.967*
	(0.0167)	(0.0166)
Age-Squared	1.000	1.000
	(0.000187)	(0.000183)
Output	0.993	0.997
	(0.0552)	(0.00603)
Time Dummies	Yes	Yes
Author FE	Yes	Yes
No. Authors	265	265
Observations	14040	13769

Logit odds ratios reported. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In both specifications, previous success has no statistically significant impact on the probability of migrating to London. The coefficients on both output measures are negative, suggesting that greater past success would have a negative effect on the probability of migrating if these esti-

mates were more precisely estimated. We repeat these specifications by quality level (low/high[9]) and by century of birth to determine if these results are being driven by a particular cohort. In both specifications, the results are consistent (see Tables 7 and 8 in the Appendix, respectively). Thus, we conclude that our results on the gains from the geographic clustering of literary activity in London are not driven by the systematic self-selection of high-productivity authors.

5.3 Learning and the Persistence of Gains

Our main econometric estimates make the implicit assumption that the gains from clustering occur in the same year as the year of residence. Therefore, these results may to suffer from the issue of reverse causality in that an individual may publish early in the year and then migrate to London later in the same year because of that success. In this case, the main econometric estimates would overestimate the true effect.

On the other hand, there could also be a delay in the gains from clustering. It could be the case that individuals go through a learning process in the first year (or more) of residence in London, during which time they develop their human capital by gaining valuable social connections and develop knowledge of the surrounding industry and better skills to take advantage of it. In this case, the main econometric estimates would underestimate the true effect.

In either case, it is unlikely that an individual's future output has any causal effect on an individual's decision to migrate to or from the London cluster in time t, and looking at future output also allows us to analyse the existence of a learning process and any persistence of gains. We repeat our original models again with output in t+1, with output in t+3, and again with output in t+5 in order to account for these possibilities.

These results are presented in Table 4. Columns (1) - (3) show the results of an OLS model with author fixed effects, and Columns (4) - (6) show the incidence rate ratios of a negative binomial model. These results do not seem to suggest the main econometric estimates are overestimates of the productivity gains. The coefficient for London using output in t+1 in the OLS model is 0.120, and the respective negative binomial incident rate ratio is 1.287. Both

[9]See Section 5.4 for a detailed discussion of the quality variable.

Table 4: Impact on Future Output

	OLS with Author FE			Negative Binomial IRR		
	(1)	(2)	(3)	(4)	(5)	(6)
Output in:	1yr	3yrs	5yrs	1yr	3yrs	5yrs
Age	0.0779***	0.0749***	0.0713***	1.149***	1.127***	1.107***
	(0.00530)	(0.00543)	(0.00557)	(0.00539)	(0.00535)	(0.00528)
Age-Squared	-0.000741***	-0.000747***	-0.000737***	0.998***	0.998***	0.998***
	(0.0000507)	(0.0000536)	(0.0000566)	(0.0000429)	(0.0000438)	(0.0000451)
London	0.120***	0.103***	0.102***	1.287***	1.225***	1.193***
	(0.0367)	(0.0366)	(0.0375)	(0.0413)	(0.0381)	(0.0362)
Constant	-1.538***	-1.308***	-1.213***	0.1315***	0.335***	0.542**
	(0.169)	(0.167)	(0.174)	(0.037)	(0.091)	(0.159)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Author FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.114	0.100	0.086			
No. Authors	370	370	370	370	370	370
Observations	18654	17914	17176	18654	17914	17150

Robust standard errors are clustered on the author level and are reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

estimates are higher than the respective coefficients in the baseline specifications (0.094 and 1.160) , suggesting that the authors may undergo an initial learning process. The coefficients for both models using output in t+3 and t+5 indicate that there is some persistence to these gains, suggesting that learning may have a lasting positive effect on productivity three and five years into the future.

5.4 Heterogeneity of Returns by Author Quality

It is possible that certain individuals receive greater gains from clustering, as those who are (ex post) high-quality individuals may have the (ex ante) skills to develop stronger local networks and better knowledge and access to local resources. Therefore, we investigate these results further by evaluating the heterogeneity of returns by author quality.

Following the methodology of Murray (2003) and Verboord (2003), we utilise a purpose-built index of author quality or impact, as defined as the amount of contemporary critical attention given to one author relative to her peers. This index is constructed from two components: an indexed measure of the total words designated to an author from the three biographical sources mentioned in Section 3[10] and an indexed measure of the total number of citations within literary criticism as listed in Literature Online (2014). These measures carry equal weight in the index.

These OLS estimates on the heterogeneity of returns by author quality are presented in Table 5. Columns (1) shows the results for the bottom quartile of authors. Columns (2) through (4) show the results for the second, third, and fourth quartile of authors, respectively. Column (5) shows the results for the top 10% of authors. All estimates include time controls, author fixed effects, and cluster-robust standard errors. Results are likely be less precisely estimated due to the relatively small sample sizes and large number of years, but they can provide some insight.

High-quality authors receive significant gains in productivity from residing in London, while clustering in London does not appear to have a substantial or statistically significant effect on the productivity of authors of below-average quality levels. Those ranking in the third and fourth quartiles see productivity gains of 0.175 and 0.174 additional works per annum, respectively. Authors in the top 10% see productivity gains of 0.146 additional works per annum. This

[10]These include: Encyclopaedia Britannica Online, Literature Online, and The Literary Encyclopedia.

Table 5: Heterogeneity of Returns by Author Quality

	(1) Bottom Quartile	(2) Second Quartile	(3) Third Quartile	(4) Top Quartile	(5) Top 10%
Age	0.0201	0.0961***	0.0833***	0.107***	0.0719***
	(0.114)	(0.0132)	(0.00964)	(0.0113)	(0.0162)
Age-Squared	-0.000455***	-0.000842***	-0.000750***	-0.000969***	-0.000830***
	(0.0000794)	(0.000126)	(0.0000936)	(0.000105)	(0.000136)
London	0.0684	0.00360	0.175**	0.174***	0.146
	(0.0776)	(0.0669)	(0.0779)	(0.0632)	(0.107)
Constant	-0.0595	-2.186***	-1.728***	-1.704***	-1.051***
	(2.480)	(0.353)	(0.302)	(0.365)	(0.379)
Time Dummies	Yes	Yes	Yes	Yes	Yes
Author FE	Yes	Yes	Yes	Yes	Yes
R^2	0.099	0.179	0.161	0.199	0.223
Mean Output per Annum	0.56	0.92	0.85	1.15	1.16
No. Authors	91	94	93	92	37
Observations	4683	4867	4740	4732	1821

Robust standard errors are clustered on the author level and are reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

compares to gains of 0.094 works per annum for the average author in the baseline results, suggesting that the baseline results underestimate the potential for gains from co-location.

While the third and fourth quartiles of authors receive similar productivity gains in terms of works per annum, these gains are diminishing with respect to author quality in terms of percentage increases in annual productivity. Authors in the third quartile produce an average of 0.85 works per annum, so the increase of 0.175 works per annum translates to a 20.58% increase in annual productivity. Authors in the fourth quartile, who produce an average 1.15 works per annum, experience annual productivity gains of 15.13%, and the top 10% of authors, who produce an average of 1.16 works per annum, experience annual productivity gains of 12.85%.

It is likely that high-quality authors have stronger local networks and better skills and knowledge to utilise local resources compared to low-quality authors, and this result that the high-quality authors see the greatest returns to clustering is consistent with previous findings. Waldinger (2010) find the greatest gains for PhD students at the top 10 universities, and similarly Borowiecki (2013) finds the top 10 composers receive the highest productivity gains from geographic clustering of Western classical composers. The diminishing effect for high-quality authors could be because individuals of increasing quality benefit marginally less from a process of learning, gaining skills, becoming inspired from interactions with other high-quality individuals. However, further research is needed to confirm the mechanisms and channels (development of human capital vs economies of scale) through which all authors receive these gains.

6 Conclusion

In this paper, we contribute to current research by empirically analysing the gains from agglomeration of the publishing industry in historical Britain and Ireland. Specifically, we utilise a unique, purpose-built dataset with information on the birth location and lifetime migration, productivity (in terms of number of publications), and demographic characteristics of 370 authors in the UK and Ireland since 1700. We analyse the migration and clustering of literary artists and found that London was the major literary cluster throughout the sample. We then construct age-productivity profiles to determine the productivity gains associated with the ge-

ographic clustering of literary activity.

We find that authors who reside in London experience productivity gains of 10.68% per annum compared to their peers living elsewhere. We find that these results are not driven by self-selection of high-productivity authors in migrating to London. The productivity gains from agglomeration peak at a one-year lag and persist three and five years into the future, suggesting that authors undergo an initial learning process and receive lasting gains from learning. Furthermore, these results are heterogeneous by author quality, with high-quality authors receiving the substantial gains from agglomeration.

We propose productivity gains from agglomeration effects as both a by-product and driver of geographic clustering of cultural production, as the geographic concentration of creative workers is certain to have played an important role in the transfer and diffusion of knowledge, as well as the generation of new knowledge and ideas. In the context of this paper, authors in London likely have access to stronger and more advantageous social networks, in terms of increased connections with their peers (other authors), individuals with influence within the publishing industry (agents, publishers, critics,), and those a part of the intellectual and cultural elite (artists, musicians, wealthy patrons). Authors in London also likely took advantage of the related economic infrastructure and gained from the resulting economies of scale, allowing for a more efficient transformation of ideas into physical book-form. However, we conclude that further research is needed to fully understand channels through which authors receive these gains.

References

Audretsch, B. (1998). Agglomeration and the location of innovative activity. *Oxford Review of Economic Policy*, 14(2):18–29.

Audretsch, D. B. and Feldman, M. P. (1996). R&D spillovers and the geography of innovation and production. *The American Economic Review*, pages 630–640.

Azoulay, P., Zivin, J. S., and Wang, J. (2010). Superstar extinction*. *Quarterly Journal of Economics*, 125(2):549–589.

Borowiecki, K. J. (2012). Are composers different? Historical evidence on conflict-induced migration (1816–1997). *European Review of Economic History*, 16(3):270–291.

Borowiecki, K. J. (2013). Geographic clustering and productivity: An instrumental variable approach for classical composers. *Journal of Urban Economics*, 73(1):94–110.

Borowiecki, K. J. and O'Hagan, J. W. (2013). Impact of war on individual life-cycle creativity: Tentative evidence in relation to composers. *Journal of Cultural Economics*, 37(3):347–358.

Boschma, R. (2005). Proximity and innovation: a critical assessment. *Regional studies*, 39(1):61–74.

Carlino, G. A., Chatterjee, S., and Hunt, R. M. (2007). Urban density and the rate of invention. *Journal of Urban Economics*, 61(3):389–419.

Chatterji, A., Glaeser, E. L., and Kerr, W. R. (2013). Clusters of entrepreneurship and innovation. Technical report, National Bureau of Economic Research.

Davis, D. R. and Dingel, J. I. (2012). A spatial knowledge economy. Technical report, National Bureau of Economic Research.

D'Este, P., Guy, F., and Iammarino, S. (2013). Shaping the formation of university – industry research collaborations: What type of proximity does really matter? *Journal of Economic Geography*, 13(4):537–558.

Duranton, G. and Puga, D. (2004). Micro-foundations of urban agglomeration economies. *Handbook of regional and urban economics*, 4:2063–2117.

Encyclopaedia Britannica (2014). `www.britannica.com`.

Gertler, M. S. (2003). Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of economic geography*, 3(1):75–99.

Hanlon, W. (2012). Industry connections and the geographic location of economic activity. *Available at SSRN 2143419*.

Hellmanzik, C. (2010). Location matters: Estimating cluster premiums for prominent modern artists. *European Economic Review*, 54(2):199–218.

Hellmanzik, C. (2013). Democracy and economic outcomes: Evidence from the superstars of modern art. *European Journal of Political Economy*, 30:58–69.

Howells, J. (2012). The geography of knowledge: Never so close but never so far apart. *Journal of Economic Geography*, 12(5):1003–1020.

Jones, B. F. (2009). The burden of knowledge and the death of the renaissance man: Is innovation getting harder? *The Review of Economic Studies*, 76(1):283–317.

Kelly, E. and O'Hagan, J. (2007). Geographic clustering of economic activity: The case of prominent Western visual artists. *Journal of Cultural Economics*, 31(2):109–128.

Krugman, P. (1991). Increasing returns and economic geography. *The Journal of Political Economy*, 99(3):483–499.

Levin, S. G. and Stephan, P. E. (1991). Research productivity over the life cycle: Evidence for academic scientists. *The American Economic Review*, pages 114–132.

Literature Online (2014). `www.lion.chadwyck.co.uk`.

Marshall, A. (1890). *Principles of Economics*. Macmillan, London.

Mokyr, J. (2005). Mobility, creativity, and technological development: David hume, immanuel kant and the economic development of europe. *Northwestern University, unpublished manuscipt*.

Moser, P., Voena, A., and Waldinger, F. (2014). German jewish émigrés and us invention. *The American Economic Review*, 104(10):3222–3255.

Murray, C. A. (2003). *Human Accomplishment: The Pursuit of Excellence in the Arts and Sciences, 800 BC to 1950*. HarperCollins New York.

Overman, H. and Helmers, C. (2013). My precious! The location and diffusion of scientific research: Evidence from the Synchrotron Diamond Light Source. In *ERSA Cnference Papers*, number ERSA13p654. European Regional Science Association.

Porter, M. E. (2011). *Competitive advantage of nations: creating and sustaining superior performance*. Simon and Schuster.

Rallet, A. and Torre, A. (1997). On geography and technology: The case of proximity relations in localized innovation networks.

Rosenthal, S. S. and Strange, W. C. (2008). The attenuation of human capital spillovers. *Journal of Urban Economics*, 64(2):373–389.

St Clair, W. (2004). *The Reading Nation in the Romantic Period*. Cambridge University Press.

Ter Wal, A. L. and Boschma, R. A. (2009). Applying social network analysis in economic geography: Framing some key analytic issues. *The Annals of Regional Science*, 43(3):739–756.

The Literary Encyclopaedia (2014). `www.litencyc.com`.

Torre, A. and Rallet, A. (2005). Proximity and localization. *Regional studies*, 39(1):47–59.

Verboord, M. (2003). Classification of authors by literary prestige. *Poetics*, 31(3):259–281.

Waldinger, F. (2010). Quality matters: The expulsion of professors and the consequences for PhD student outcomes in Nazi Germany. *Journal of Political Economy*, 118(4):787–831.

Waldinger, F. (2012a). Bombs, brains, and science: The role of human and physical capital for the creation of scientific knowledge. Technical report, Competitive Advantage in the Global Economy (CAGE).

Waldinger, F. (2012b). Peer effects in science: Evidence from the dismissal of scientists in Nazi Germany. *The Review of Economic Studies*, 79(2):838–861.

7 Appendix

Region	1700–1724	1725–1749	1750–1774	1775–1799	1800–1824	1825–1849	1850–1874	1875–1899	1900–1925	Total Authors per Region
Connacht	0	0	0	1	0	0	3	0	1	5
East Midlands	1	2	1	1	4	3	0	3	1	16
East of England	2	1	4	0	6	5	0	3	3	24
Greater London	3	5	7	7	13	11	9	15	9	79
Leinster	0	2	1	6	2	1	4	4	4	24
Munster	1	0	0	1	1	1	0	0	2	6
North East England	1	0	0	0	1	0	0	1	0	3
North West England	0	0	1	3	3	1	3	2	3	16
Rest of Europe	0	2	0	1	0	1	5	1	1	11
Rest of World	0	0	0	0	1	2	4	6	5	18
Scotland	3	3	7	6	2	4	7	5	4	41
South East England	3	2	1	4	6	7	7	8	7	45
South West England	3	2	4	3	3	5	1	3	2	26
Ulster	0	0	0	0	0	0	1	4	2	7
Wales	0	1	0	0	0	1	3	0	5	10
West Midlands	2	1	0	0	2	1	3	6	6	21
Yorkshire and the Humber	0	0	0	0	3	1	1	4	5	14
Unknown	1	1	1	0	0	0	0	0	1	4
Total Authors per Period	20	22	27	33	47	44	51	65	61	370

Table 6: Number of Authors Born from 1700–1925, by Birth Location

Table 7: Probability of Migrating to London Based on Quality (High/Low)

	Low Quality		High Quality	
	(1)	(2)	(3)	(4)
	Output Last Year	Output To-Date	Output Last Year	Output To-Date
Age	0.948**	0.949*	0.982	0.982
	(0.0256)	(0.0255)	(0.0225)	(0.0226)
Age-Squared	1.000	1.000	1.000	1.000
	(0.000296)	(0.000293)	(0.000248)	(0.000241)
Output	1.066	1.002	0.944	0.992
	(0.0874)	(0.0102)	(0.0671)	(0.00809)
Time Dummies	Yes	Yes	Yes	Yes
Author FE	Yes	Yes	Yes	Yes
No. Authors	82	82	134	134
Observations	6986	6873	7054	6896

Logit odds ratios reported. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Probability of Migrating to London by Century of Birth

	18th Century		19th Century		20th Century	
	(1)	(2)	(3)	(4)	(5)	(6)
	Output Last Year	Output To-Date	Output Last Year	Output To-Date	Output Last Year	Output To-Date
Age	1.001	1.015	0.970	0.968	0.978	0.992
	(0.0371)	(0.0391)	(0.0238)	(0.0235)	(0.0416)	(0.0422)
Age-Squared	0.999	0.999	1.000	1.000	1.001	1.000
	(0.000426)	(0.000417)	(0.000275)	(0.000276)	(0.000455)	(0.000444)
Output	0.888	0.971*	1.013	1.005	1.144	0.992
	(0.105)	(0.0162)	(0.0704)	(0.00731)	(0.168)	(0.0162)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Author FE	Yes	Yes	Yes	Yes	Yes	Yes
No. Authors	75	75	150	149	82	82
Observations	3683	3683	8163	7892	2194	2194

Logit odds ratios reported. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$