More than STEM: Spillovers from Higher Education Institution Infrastructure Investments in the Arts

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Abstract

Higher education institutions (HEIs) represent an enormous density of investment and resources, concentrating infrastructure spending and creating high human capital citizens and knowledge spillovers increasingly seen as critical to advancing regional quality of life. While HEIs' prominent role in promoting regional economic growth, innovation, and attractiveness receives considerable research attention, most of that attention is paid to aspects of HEIs that are directly related to STEM activity. There are various theories that suggest spillovers from non-STEM activity at HEIs as well, specifically in the arts. This study examines whether spillovers occur for HEIs' large capital investments in the arts. Specifically, we focus on HEI investments in arts physical infrastructure and whether these investments have any effects on regional-level business activity, including jobs and firms. To analyze HEI spillovers of physical arts infrastructure on regional jobs and firms, we use construction starts data on building projects from Dodge Analytics, Inc. and data from the Integrated Postsecondary Education Data System (IPEDS), which include administrative data for every college, university, and technical/vocational institution that participates in the federal student financial aid programs. We couple these data with public data on regional-level socioeconomic indicators from the U.S. Census Bureau's Zip-code Business Patterns data. We employ a quasi-experimental propensity-score matching design in order to control for a host of HEI and regional-level characteristics in examining the impact of infrastructure investments. The results suggest strong and consistent spillover effects (i.e. overall and specifically in the arts industry) for regions with HEIs that make these investments.

Keywords

Spillovers, higher education institutions, cultural infrastructure, arts

Declarations

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Conflicts of interest

There are no conflicts of interest related to the conduct of this research to report.

Availability of data and material

The datasets generated during the current study are not publicly available because they include proprietary data. The data are available from the corresponding author on reasonable request.

Code availability

Stata code is available from the corresponding author upon request.

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Introduction

Higher education institutions (HEIs) represent an enormous density of investment and resources, concentrating infrastructure spending and creating high human capital citizens and knowledge spillovers increasingly seen as critical to advancing regional quality of life. While HEIs' prominent role in promoting regional economic growth, innovation, and attractiveness receives considerable research attention, most of that attention is paid to aspects of HEIs that are directly related to STEM activity. There are various theories that suggest spillovers from non-STEM activity at HEIs as well, specifically in the arts. Florida's (2002) creative class theory posits that graduates in creative fields who remain in a region to work may boost regional productivity and help attract firms and other high-skilled workers. Cultural capital theory (Bourdieu 1977) and social capital theory (Putnam 2000) would predict similar effects as a result of arts activity on campuses.

This study examines whether the high-cost capital investments that HEIs host and help provide are limited to STEM fields, or whether spillovers occur for HEIs' large capital investments in the arts. Specifically, we focus on HEI investments in arts physical infrastructure and whether these investments have any effects on regional-level business activity, including jobs and firms. While other studies have analyzed regional spillover effects of arts physical infrastructure (e.g., Woronkowicz, Bradburn, Frumkin, Gertner, Joynes, Kolendo and Seaman 2012; Grodach 2010; Woronkowicz 2015), this is the first study to our knowledge that examines potential spillovers from HEIs. This is also the first study in the HEI spillovers literature, to our knowledge, that uses a rich dataset containing construction starts (i.e., building projects) to examine questions surrounding physical infrastructure investments.

To analyze HEI spillovers of physical arts infrastructure on regional jobs and firms, we use construction starts data on building projects from Dodge Analytics, Inc. and data from the Integrated Postsecondary Education Data System (IPEDS), which include administrative data for every college, university, and technical/vocational institution that participates in the federal student financial aid programs. We couple these data with public data on regional-level socioeconomic indicators from the U.S. Census Bureau's Zip-code Business Patterns data. We employ a quasi-experimental design known as propensity-score matching (PSM) in order to control for a host of HEI and regional-level characteristics in examining how outcomes differ between 'treated' and 'untreated' observations. The results suggest strong and consistent spillover effects (i.e. overall and specifically in the arts industry) for regions with HEIs that make these investments.

The remainder of this paper is as follows. In the first section, we review the literature on infrastructure and knowledge spillovers, and related theories and studies on spillovers in the arts, to present a series of testable hypotheses. In the next section, we describe the empirical analyses, including how we comprised the sample, information on the PSM model, and included variables. We analyze model results in the following section, and the paper concludes with understanding the results in the context of the potential for HEIs to contribute to their regions with campus activity in non-STEM fields.

Literature Review and Hypotheses

Two substantial literatures in economics suggest that HEI investments in arts infrastructure may benefit surrounding communities. First, a substantial literature on public infrastructure

investments has shown that these investments have a positive impact on local economic growth (e.g., Aschauer 1989; Easterly and Rebelo 1993; Sanchez-Robles, 1998). However, the impact of these investments varies due to the type of infrastructure or the context of the investment. For example, in his seminal paper on public infrastructure investments, Aschauer (1989) finds a distinction between nonmilitary and military capital, with non-military investments in core infrastructure, such as transportation, showing the strongest connection to productivity. On the other hand, Garin (2019) found that transportation spending in the American Recovery and Reinvestment Act had a limited impact on local employment. Much of the infrastructure investment literature has bundled HEI investments in arts infrastructure with other types of non-core infrastructure. Yet, the literature hints that HEI investments in arts infrastructure may hold promise, as empirical evidence suggests that public investments in HEIs (e.g., Moretti 2004) and arts infrastructure (e.g., Noonan 2013) have positive economic impacts on surrounding regions. Further, unlike prior studies that examine only public infrastructure investments, our analysis includes the substantial share of arts infrastructure investments by private HEIs, which may also impact local economic growth.

Second, there is a robust literature that both theorizes and empirically tests the effects of HEIs on regional economic development, primarily through their contribution of human capital and knowledge (Audretsch, Lehman and Warning 2005). These types of "knowledge spillovers" are not unlike those theorized of studies in regional economics, economic geography, and technology transfer that emphasize the importance of networks to create nuclei of specialized knowledge in various locales (Camagni 1991; Feldman 1994; Jaffe, Trajtenberg and Henderson1993; Nelson 1993; Nelson and Nelson 2002). For HEIs, prior literature has focused on the transfer of human capital and knowledge to regional economies predominantly through the form of commercialization of research (e.g., patents, licenses, and spinout firms) (Scott 1979; Minshall, Druilhe and Probert 2006), industry-university partnerships (Leten, Landoni and Van Looy 2007; Muscio 2013, Muscio and Pozzali 2013; Carboni 2013; Fantino, Mori and Scalise 2012; Cardamone, Pupo and Ricotta 2012, 2014), as well as more informal sharing of research expertise (Etzkowitz and Leydesdorff 1997; Goddarrd and Chatterton 1999).

Most of the literature on HEI spillover effects, however, has focused on knowledge sharing via STEM fields, as opposed to fields in the arts. Some empirical evidence suggests heterogeneous spillover effects based on the potential conduit for the spillover and the discipline (Audretsch, Lehmann and Warning 2004). HEI investments in arts infrastructure investments may generate knowledge spillovers that operate through different mechanisms than the more often-studied STEM knowledge spillovers. For instance, research on freelancers, a group populated with many artists, are more likely to report higher leisure and work satisfaction, suggesting a different way of work and life that may offer alternative channels for knowledge spillovers to influence local conditions (van der Zwan, Hessels, and Burger 2020). Artists have distinctive patterns of clustering to achieve spillovers (e.g., Markusen and Schrock 2006; Breznitz and Noonan 2020). Work on the creative class, cultural capital, and social capital in relation to the arts and HEI all suggest different paths for knowledge spillovers in this research context.

In the sections that follow, we elaborate on the distinct nature of HEI investments in arts infrastructure and their impact on local economic growth. We first consider the ways these investments may benefit the local economy more broadly, before considering the narrower impact these investments may have on the arts sector. We also consider the differential impact of

arts infrastructure investments in college towns, where the HEI likely has an outsized influence on local economic conditions.

HEI Arts Infrastructure and Local Economic Growth

There are various theories that suggest arts activities on campus may benefit regional economies. Florida's (2002) widely referenced creative class theory posits that the presence of creative workers in a region helps attract firms and adds to the overall level of productivity (Tomusk 2011). Thus, we might believe that an HEI with arts programs contributes to a region's economy through the production of graduates in these programs, especially if these graduates choose to live in the region post-graduation.

Second, cultural capital theory (Bourdieu 1977), which partly concerns the symbolic value of higher education and engagement in the arts as a marker of social status, would predict that college graduates in the arts achieve a higher level of economic capital (relative to others) through their position in the labor force. Similar to creative class theory, if HEIs with a focus on the arts help confer jobs to graduates, then the regional economy could benefit as a result.

Finally, HEIs with arts infrastructure may also help regional economies grow through building social capital among networks of like-minded individuals (Putnam 2000) who go on to create new economic pursuits (Florida 2003). These social capital effects on regional economies are not unlike the efforts Breznitz and Feldman (2016) detail in their work about HEIs' social and community engagement efforts. The arts are often pointed to as a mechanism for social capital creation, especially in their ability in "strengthening friendships, helping communities to understand and celebrate their heritage, and providing a safe way to discuss and solve difficult social problems" (Putnam 2003). Additionally, HEI arts infrastructure might aide in creating relationships between urban political, economic, and cultural entrepreneurs (Strom 2002) leading to new partnerships and economic enterprises.

These forces combined – knowledge spillover effects, the production and retention of creative class workers, and the transfer of cultural and social capital to the economic landscape – point to the potential of arts investments on campus to stimulate regional economies, and lead us to our first hypothesis:

Hypothesis 1: Regions with HEIs with a greater level of physical arts infrastructure investments will see more firms and higher levels of employment overall.

HEI Arts Infrastructure and Growth in the Local Arts Sector

The same forces that suggest campus arts infrastructure investments are positively associated with regional economic growth (i.e., firms and jobs) also lead us in the direction of hypothesizing more targeted effects on the arts industry. Both creative class and cultural capital theories are concerned specifically with individual-level effects of graduates working in the arts. In other words, if HEIs' efforts in producing more graduates in creative fields transfer to more workers trained for creative sector jobs, then one would expect that the number of jobs and firms in the regional arts economy to respond, especially if the region is able to retain these graduates. Hale and Woronkowicz (2019) find evidence that HEIs' investments in arts programming disproportionately benefit arts majors as opposed to non-majors. Nevertheless, the few studies that exist on artists suggest that these workers are in general a relatively 'footloose' occupation (Markusen 2013); thus, regions might not benefit in terms of their economies from HEIs investing in arts infrastructure.

Additionally, HEIs' efforts in cultivating an arts infrastructure on campus has wider-reaching effects in the regional economy through the networks these efforts create in the arts among creative individuals. Studies of creative production processes emphasize the importance of an intricate web of artist workers in producing creative goods and services (Becker 2008; Currid 2007). Arts workers are part of a "network of people whose cooperative activity, organized via their joint knowledge of conventional means of doing things, produces the kind of art works that art world is noted for" (Becker 2008, p. X). HEIs can play a critical role in seeding and contributing to these networks through their arts infrastructure. For example, students in the arts not only play a part of the university arts network through their classes and extracurriculars, but many also embed themselves in the region's larger arts sector by working for arts firms. Moreover, arts physical infrastructure, like facilities and technology, can serve regional arts workers. This sort of blending of arts infrastructure on campus and in surrounding regions helps fuel the production of goods and services in the regional arts industry.

Overall, the theoretical evidence relating HEI arts infrastructure investments to regional economic growth suggests a positive relationship, which leads us to our second hypothesis:

Hypothesis 2: Regions with HEIs with a greater level of arts infrastructure investments will see more firms and higher levels of employment specifically in the arts.

HEI Arts Infrastructure and the College Town

In addition to human capital effects, there are also plausible effects on regional economies from HEIs investing into physical arts infrastructure. We can draw hypotheses about the effects of physical arts infrastructure investments on campus from reviewing the evidence concerning arts economic development through amenities building and place-based investments effects overall.

In terms of the former, there is a lengthy literature theorizing and debating the ability of the arts to stimulate regional economic development (Ashley 2015; Seaman 2011, 2020); in particular, the role of physical arts infrastructure. Previous work on arts districts finds evidence that these centralized arts-focused geographies have the ability to stimulate regional wealth measures, such as housing prices (Noonan 2013), and when coupled with HEIs, increase the level of employment and innovation (i.e., patents) in the digital media regional economy (Breznitz and Noonan 2014). Arts economic development initiatives have also long emphasized using facilities to help stimulate tourism and boost local economies (Grodach 2010), though the evidence surrounding this strategy is murky at best (Ashley 2015, Woronkowicz et al. 2012).

Physical arts infrastructure on campus can also serve as place-based investments that help revitalize regions and make them attractive to people to live. This type of amenities-driven arts economic development (Ashley 2015) has been widely used in regions as revitalization efforts (Ladry, Bianchini, Ebert, Gnad and Kunzman 1996; Carnegie Foundation for the Advancement of Teaching 2012), as well as in efforts to attract workers who value arts amenities (Eaton and Bailyn 1999). Campus arts infrastructure working as place-based investments likely depend on the size of campuses (and their investments) relative to the region. For example, while art facilities on campus may serve as attractors for students enrolling at an HEI (Reynolds 2007), for arts facilities on campus to act as tools for area revitalization and to serve as attractors for tourists, the campus should be relatively large in population compared to the region. This leads us to our third and final hypothesis:

Hypothesis 3: College towns with a greater level of arts infrastructure investments will see more firms and higher levels of employment inside and outside of the arts industry.

Empirical Analysis

Data

We combine several data sources to examine HEI physical arts infrastructure spillovers. To identify investments in arts infrastructure, we draw on a comprehensive dataset of construction starts from Dodge Analytics, Inc. To our knowledge, this dataset has not yet been used in the HEI spillovers literature to examine questions surrounding physical infrastructure investments. The data are at the project level and categorized by project type, allowing us to identify construction projects for arts infrastructure, including auditoriums, museums, and theaters. The data also contain ownership information, permitting us to identify projects owned by HEIs. To draw a comparison group of HEIs that do not invest in physical arts infrastructure, we rely on the Integrated Postsecondary Education System (IPEDS), a mandatory annual survey of institutional characteristics for Title IV-eligible HEIs in the United States. The IPEDS data, combined with the construction starts data, define our population and the "treatments" – which school receives a new building project in which year.[1]

To identify spillovers, we join the IPEDS (school) and construction project addresses to socioeconomic indicators at the zip-code level, including key outcomes of jobs and establishments from the Zip Codes Business Patterns (ZBP) data from the U.S. Census Bureau. Conducting the analysis at the zip-code level helps mitigate the possibility that effects will be diluted across larger geographies like counties.[2] We also use relevant state-level finance measures and school attributes for all treated and control observations. We use this extensive array of regional and school-level observable characteristics to implement a quasi-experimental (matching) design to estimate the effect of HEI arts-infrastructure investments on jobs and firms in a region. In the sections that follow, we detail our data on construction starts, dependent variables, and observable characteristics.

Sample

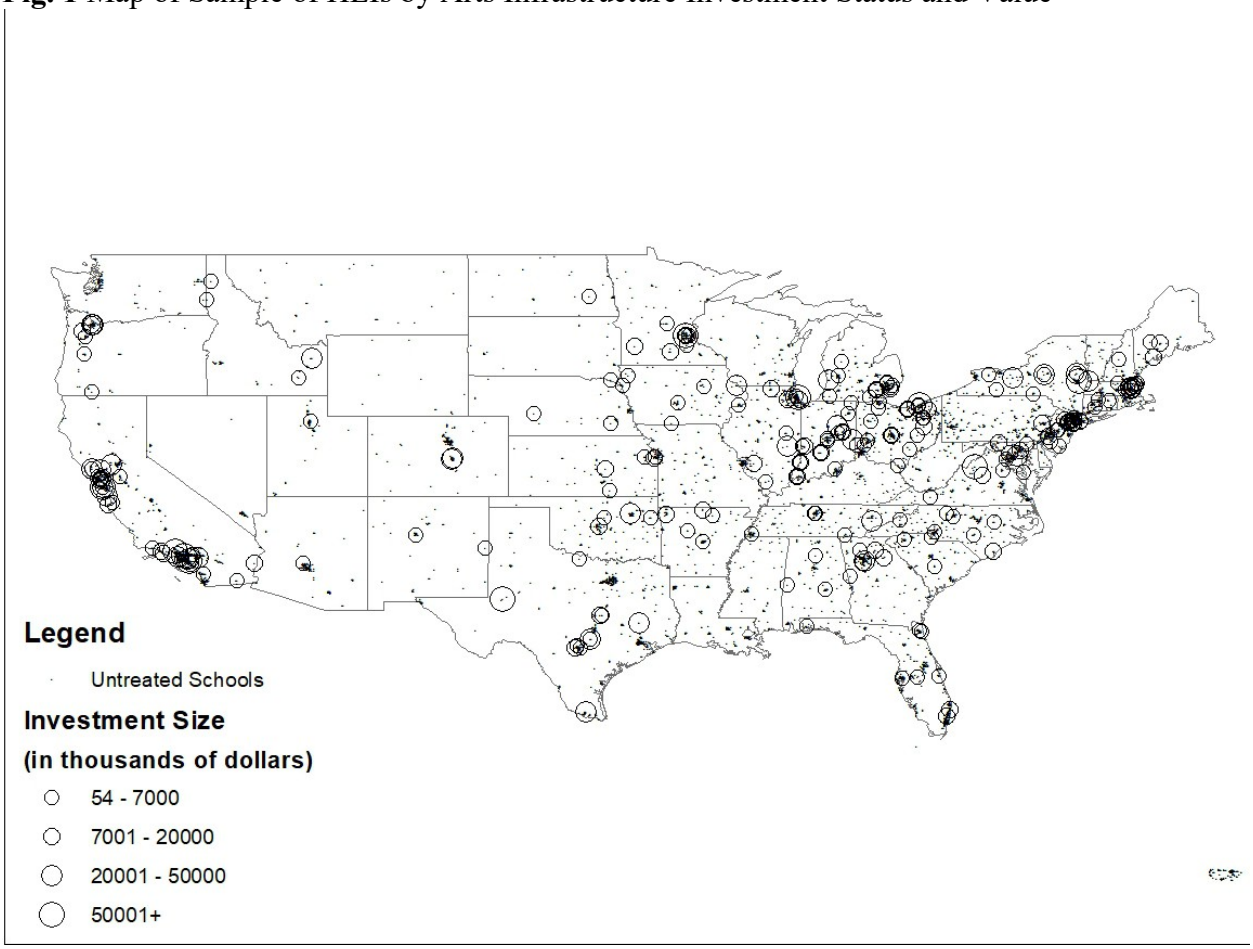
We define the sample by identifying the population of "treated" locations—zip codes where an HEI invests in a physical arts infrastructure project. For this task, we draw upon Dodge Analytics, Inc.'s construction starts data, a comprehensive compilation of building permits for construction projects in the United States, including those categorized as auditoriums, museums, and theaters. The construction starts data has wide coverage. In addition to projects that are competitively bid, the data also include projects sourced by other arrangements, such as negotiated contracts. The dataset includes a variable recording project ownership, which enables us to distinguish investments made by HEIs from other types of organizations. The dataset also includes the address of the project, allowing us to pinpoint the precise location for potential spillovers.

1 In the very few instances where an institution records multiple investment projects in the same year, we consider this as a single 'treatment' and sum the value of those projects as if it were one single, large project. We use the zip-code of the largest project as the location of the treatment in that year.

2 We also perform the same analysis using the County Business Patterns (CBP) data from the US Census Bureau. Our analysis at the county level demonstrates this diluted effect over larger geographies. We find that county-level trends for all establishments can run counter to the zip-code level trends. The county-level results are available upon request.

Our data include construction starts from 1996 to 2015. Arts infrastructure projects include new buildings, such as performing arts centers or auditoriums, and renovations to existing spaces. We provide a map of the projects included in our data in Figure 1.

Fig. 1 Map of Sample of HEIs by Arts Infrastructure Investment Status and Value



We also identify the population of "untreated" observations, which we define as zip codes that have HEIs that did not invest in a new arts infrastructure project in a given year. We rely upon the IPEDS data, an annual survey of postsecondary institutions that is mandatory for all Title IV-eligible HEIs in the United States. The IPEDS data contain a primary address for each institution reporting any data for the year, permitting us to identify zip codes for all HEIs without new arts infrastructure investments in that year. To identify matching institutions, we restrict our analysis to HEIs that share key characteristics with those investing in arts infrastructure: public or non-profit, eligible for Title IV status in the project year, offering two-year degrees or higher, and operating on a standard academic calendar system for IPEDS reporting. As a result, our sample comprises fully of mandatory reporters for the IPEDS data. We include a range of types of HEIs, including two-year community colleges and research-intensive universities, as well as large state schools and small private colleges. Our final sample consists of 44,891 institution-years from 1996 to 2015 that have a full set of covariates defined below.

Methodology

To estimate the effect of arts infrastructure projects on growth in jobs and firms, we employ a quasi-experimental design known as propensity-score matching (PSM). This kind of approach is warranted in our context because we expect significant selectivity to occur in siting these building projects. Even casual inspection of the panel of HEIs indicates that these projects ("treatments") are hardly randomly distributed. (See Table A3 for a full set of descriptive statistics for treated and untreated observations.) We can control for a host of HEI and regional characteristics in examining how the outcome (i.e., job or firm growth) differs between the treated and untreated HEI-year observations.[3] By using observable control variables to match treated observations to comparably likely controls, the PSM technique allows us to identify the treatment effects.

In our analysis, the outcome variables are all measured as growth rates (i.e., increase in outcome *X* from year *t* to year *t*+1 divided by *X* in year *t*). The set of control variables consists of HEI variables (e.g., public or private, number of degrees, enrollment, distance to closest downtown), state-level variables (e.g., wealth, educational spending, capital spending), regional variables (e.g., location in a college down, county population density), regional socioeconomic variables (e.g., population, share of population with college degrees, unemployment rates at the zip-code level), year, and baseline level of the outcome variable at the zip-code level. All of the control variables are measured for year *t*, with the sole exception of the control for the baseline level of the outcome measure – which is measured in year *t*-1. Thus, the analysis examines how future job or firm growth rates vary depending on whether a big arts infrastructure investment was made in the current year while controlling for school and regional-level characteristics in the current year and also the level of jobs or firms in the prior year.

Our main results report the "treatment effect on the treated" (ATT), which provides an estimate of the effect of the building project for those observations that received such a project.[4] We report the ATT results to reflect our interest in the experience of those HEIs and regions that actually made investments in an arts infrastructure project.[5] We estimate the ATT using a matching technique that selects the one nearest-neighbor match observation for each treated observation. These nearest neighbors represent control observations that are most similar to the treated observations based on the observable characteristics of the school and its community. By focusing our attention on the most comparable observations, the PSM technique balances the covariates to mitigate biases from estimating treatment effects by examining the experiences of very different schools and regions. We discuss the effectiveness of this balancing effort in the Results section below.

Variables

3 An alternate approach would be to estimate an ordinary least squares (OLS) regression for each of our outcome measures, using our rich set of controls, to identify the effect of the treatment. A limitation of this approach, however, is that the vast majority of the institution-year observations might reasonably not be considered 'comparable' to the observations that received treatments. The assumed linear parameters in OLS to control for differences between treatment and control observations can be quite limiting, especially when a large portion of the data points have minimal likelihood of receiving a treatment. Our OLS results indicate insignificant effects of the treatment across the board – we cannot reject zero effect for each of our outcome variables measured at various time lags. These results are available upon request.

4 An alternative estimate, the average treatment effect (ATE), shifts our attention to average effects across all observations. These results are available upon request.

5 The ATT can be expressed as $E[(y_{1i} - y_{0i}) \mid D_i = 1]$ for outcome y for observation i receiving a treatment (y_{1i}) compared to if had not received the treatment (y_{0i}) restricted to observations receiving treatments of $D_i = 1$.

HEI Spillovers

To assess the spillover effects of HEI investments in arts infrastructure, we examine growth in the number of firms (*%Δfirms*) and number of jobs (*%Δjobs*) in relevant industry sectors using Zip Codes Business Patterns (ZBP) datasets from the U.S. Census Bureau. This includes the one-year growth rate for *all* firms, those directly and indirectly related to arts sectors (*wide*), and those more directly involved in arts production and consumption (*narrow*).[6] We also calculate analogous measures for job growth in these same three categories. These six outcome measures are also calculated for three- and five-year growth rates.

The ZBP data are matched using the zip code of the investment project *or* of the school itself if it is in the control group.[7] At the zip-code level, the business patterns dataset reports jobs only as binned data (e.g., number of establishments with 1-4 employees, number with 5-9 employees, etc.). We use the robust Pareto midpoint estimator described in von Hippel and Powers (2019) to estimate the jobs count for each zip code for each category.[8]

Table 1 provides descriptive statistics for the key outcome variables for our matched sample and treated observations. The number of treated observations (N_B) declines for certain industry-specific counts of firms or jobs because of suppression in the source data. Table 1 reveals the rarity of arts infrastructure investment projects. But more importantly, the basic descriptive statistics illustrate how very different the business growth patterns are for zip codes hosting HEI new investments and those just hosting other HEIs. Although arts firm growth rates tend to outpace overall business growth rates among all zip codes in our sample, this pattern does not hold among those zip codes receiving HEI arts-infrastructure investments. The 'treated' zip codes experience vastly greater establishment and job growth rates following investments.

6 Both the *wide* and *narrow* arts categories have been used elsewhere (Arikan, Clark, Noonan and Tolley 2019, Patterson and Silver 2015), which helps connect to the prior work on arts impacts on regional economic development. This prior work informs the crosswalk to identify comparable categories using the Standard Industrial Classification (SIC) system for pre-1997, and the North American Industrial Classification System (NAICS) post-1997. To further mitigate inconsistencies between outcome measures in the SIC and the NAICS eras, we drop 1997 observations from the analysis. As 1997 is the first year of NAICS-based jobs and establishments measures, controls for the prior year's level of jobs or establishments may not be comparable in 1997 as it would in other years. See Table A1 for a list of industry codes included in each category.

7 In some cases, an HEI invested in an "off campus" building project in a different zip code from the school itself. We also estimated effects using only the firms and jobs in the school's zip code, regardless of where the project is located. We expect to see weaker or no effects using this approach, because the investments occurred elsewhere, although we might still see effects if the off-campus investment displaced on-campus business activity. The results, available on request, show only insignificant effects when ignoring the location of the project itself. This provides some validation of our estimator and suggests that campus-related displacement may not be a major factor.

8 Eckert, Fort, Schott and Yang (2020) offer an advanced approach to improving job-count imputations in the business patterns at the county level, although their work is not available at the zip-code level. Applying our midpoint-based imputation technique to county-level data yields correlations with the Eckert et al. estimates of 0.994, 0.979, and 0.987 levels for all jobs, wide arts jobs, and narrow arts jobs, respectively. We expect that our imputations for zip-code level data thus reasonably proxies for business activity at that level.

Table 1. Descriptive statistics for final sample and treated observations

1-year growth rate						
	N_A	N_B	$Mean_A$	$Mean_B$	$S.D._A$	$S.D._B$
investment	44891	278	0.006	1	0.078	0
%Δfirms, all	44891	278	0.032	1.156	1.433	8.497
%Δfirms, wide	43230	264	0.036	0.210	0.434	1.551
%Δfirms, narrow	37499	236	0.045	0.058	0.505	0.591
%Δjobs, all	44891	278	0.056	1.158	2.897	9.368
%Δjobs, wide	43230	264	0.132	0.228	1.565	1.388
%Δjobs, narrow	37499	236	0.230	0.622	3.001	4.503

3-year growth rate						
	N_A	N_B	$Mean_A$	$Mean_B$	$S.D._A$	$S.D._B$
%Δfirms, all	39176	239	0.050	1.359	1.755	9.230
%Δfirms, wide	37690	229	0.820	0.213	0.599	1.598
%Δfirms, narrow	32624	205	0.094	0.097	0.787	0.712
%Δjobs, all	39171	239	0.127	1.423	7.016	10.588
%Δjobs, wide	37692	229	0.301	0.299	2.826	1.436
%Δjobs, narrow	32642	205	0.471	0.818	6.293	5.001

5-year growth rate						
	N_A	N_B	$Mean_A$	$Mean_B$	$S.D._A$	$S.D._B$
%Δfirms, all	33600	192	0.074	1.028	2.943	8.050
%Δfirms, wide	32263	186	0.143	0.324	0.718	1.615
%Δfirms, narrow	27862	167	0.143	0.217	0.878	0.962
%Δjobs, all	33600	192	0.181	0.818	12.652	6.492
%Δjobs, wide	32269	186	0.487	0.514	3.658	2.229
%Δjobs, narrow	27868	167	0.659	1.182	5.979	5.375

Notes: Subscript A refers to the untreated HEI-years in the sample and subscript B refers to the treated HEI-years in the sample. See Table A2 for variable definitions and data sources for these variables and others used in the analysis.

Control variables

To this panel dataset, we add controls for HEI and regional characteristics. From the IPEDS data, we draw a rich set of observable characteristics that may influence both the likelihood that an HEI will invest in arts infrastructure in a given year and also the HEI's spillover effects for the surrounding region. At the HEI-year level, these measures include several variables to characterize the primary mission of the HEI, which may shape investment priorities and the nature of the HEI's connections to regional economic development. We also include several controls for the presence of other amenities or services on campus, which signal an HEI's willingness to invest in arts infrastructure. We also include measures for the HEI's size and the size of relevant degree programs, which may influence the HEI's ability to invest in arts infrastructure or impact regional economic conditions.

Additionally, we match a variety of socioeconomic variables at the zip-code, county, and state-level to each observation based on the location of the HEI or its arts infrastructure investment. At the zip-code level, we add variables measuring total population, shares of

population in different subpopulations (i.e., all college-age, all age 25+, those lacking a high-school diploma, and those with college degrees), median earnings, and unemployment rates. At the county-level, we add variables capturing population, population density, and unemployment rates. To mitigate problems arising from missing values in the county and zip-code variables, we linearly interpolate for those variables' instances where data are missing from the source data. We also add a set of state-level measures to capture the role of state support for higher education and state fiscal indicators in explaining the likelihood of these arts infrastructure projects. Finally, we include a dummy variable to indicate whether the HEI is in a "college town" (as defined by Gumprecht, 2003), a year time-trend, and the lagged level of the outcome variable. Altogether, this panel dataset of HEIs contains a wealth of HEI-level and regional-level attributes, a treatment variable for new arts infrastructure projects, and business activity outcomes at the zip-code level.[9] The HEIs that invested in arts infrastructure are very different from those that did not invest in myriad ways, as Table A3 will attest.

Results

We begin our analysis by reporting the results of the first step of our analysis. The base PSM model estimates in Table 2 use the full set of controls in a probit model to estimate the propensity to receive the building project treatment. Table 2's estimates refer to the probit for the *%Δfirms, all* (one-year growth) outcome. Different outcome variables and longer growth rates affect the sample and thus yield different probit results. Collectively, the control variables explain a substantial portion of the variation in terms of which observations received an arts infrastructure project in a given year. Several individual factors stand out as particularly strong predictors of treatment. For instance, the propensity to receive an HEI arts infrastructure investment rises with tuition, enrollment, the presence of dorms, and lower population densities. HEIs in states with greater higher-education spending and enrollment in public universities experience greater propensities to have arts infrastructure projects.

Next, we present the baseline ATT effects across the set of outcome variables. Table 3 shows these results across each column for six outcome measures: growth in firms and growth in jobs, each for *all* industries, *wide* arts industries, and *narrow* arts industries. The top, middle, and bottom panels in Table 3 contain results for one-, three-, and five-year growth rates, respectively. Note that, as the outcome measures longer-lag growth rates, the set of treated observations declines because recent investments near the end of the data timespan must be dropped. Thus, comparing among the panels in Table 3 involves changes in the timing of the growth and the set of projects included among the treatments.

9 Details on the full set of variables, including definitions, data sources, and descriptive statistics, can be found in tables A2 and A3.

Table 2. Probit results for baseline *all* firms model

Variable	Coef.	Std. Err.	z	P>|z|
4-year	-2.836	(136.033)	-0.02	0.983
research	0.099	(0.093)	1.06	0.289
public	0.278	(0.084)	3.32	0.001
HBCU	0.057	(0.149)	0.39	0.700
postsecondary	-0.024	(0.215)	-0.11	0.910
metro	0.142	(0.064)	2.20	0.027
occupational	-0.040	(0.086)	-0.46	0.646
continuing	-0.094	(0.07)	-1.35	0.176
recreational-avocational	0.138	(0.077)	1.79	0.074
remedial	0.137	(0.096)	1.43	0.151
secondary	-0.104	(0.137)	-0.76	0.450
1-yr certificate	0.122	(0.07)	1.74	0.082
1-2-yr certificate	-0.157	(0.083)	-1.88	0.060
assoc	-0.014	(0.066)	-0.21	0.834
2-4-yr certificate	-0.027	(0.081)	-0.33	0.744
4-year	2.888	(136.033)	0.02	0.983
masters	0.186	(0.09)	2.07	0.039
other degree	0.333	(0.265)	1.26	0.209
doctoral	-0.007	(0.079)	-0.09	0.927
abroad	0.069	(0.07)	0.99	0.321
student services	-0.045	(0.065)	-0.68	0.493
career	0.307	(0.154)	1.99	0.046
dorms	0.195	(0.084)	2.33	0.020
placement	0.013	(0.087)	0.15	0.884
daycare	0.117	(0.059)	1.98	0.047
library	0.115	(0.235)	0.49	0.623
no-credit	-0.233	(0.235)	-0.99	0.321
arts degrees	0.001	(0.023)	0.06	0.952
degrees	0.026	(0.032)	0.81	0.418
enrollment	0.016	(0.007)	2.30	0.021
tuition total	188.256	(42.446)	4.44	0.000
downtown dist	0.006	(0.029)	0.22	0.827
college town	0.120	(0.098)	1.22	0.221
pop density$_C$	-0.008	(0.004)	-2.04	0.042
population$_C$	-0.038	(0.019)	-2.03	0.043
unemployment$_C$	0.082	(1.783)	0.05	0.963
firms, all$_{Zt-1}$	0.00002	(0.00005)	0.41	0.681
constant	-2.365	(2.562)	-0.92	0.356
State-level controls	Yes			
Zip-code level controls	Yes			
N	45,076			
chi^2	556.7560			
p	<0.0001			
r^2	0.165			
log likelihood	-1413.458			

Beginning with the 1-year change estimates, we see that arts infrastructure investments by HEIs have positive and significant impacts on *all* firms and jobs, as well as on our *narrow* category of arts jobs. For *all* firms, the ATT effect is an increase in the growth rate by 115.7 percentage points in the following year. Referring back to the average growth rates reported in the descriptive statistics in Table 1 for the treatment group, we see that the average growth rate for treated zip codes was 115.6 percent indicating that the rapid growth in zip codes with arts infrastructure investments is nearly entirely attributable to the treatment effect. We see a similar large impact in the category of *narrow* arts jobs. The average growth rate for *narrow* arts jobs in the treated units is 62.2 percent, as reported in the descriptive statistics in Table 1. In the baseline results in Table 3, the expected treatment effect of those arts infrastructure investments (i.e., 51.8 percentage points) accounts for nearly all of the high-growth rate in the *narrow* jobs category. This positive treatment effect for *narrow* arts jobs, however, is estimated with sizable confidence intervals. The ATT estimates for the other arts-related firms and jobs outcome variables also show imprecise estimates, making it difficult to reject the hypothesis of no treatment effect. Overall, it appears that robust growth in the total number of firms (less so jobs) follows these arts infrastructure investments, and some jobs in the arts may tend to follow these investments, but compelling evidence of positive effects on the growth of arts firms and jobs is lacking.

A longer time-lag might be needed before consistent business activity impacts become visible. Examining longer lags, however, allows for more intervening factors to influence the results and inevitably drops some more recent investments from the analysis. As the time from the investment increases, the one-year impacts remain positive and significant. For *all* firms, the magnitude of the impact changes over time to 125.2 percentage points in the three-year time span to 98.8 percentage points in the five-year timespan. The estimated impact for the *narrow* category of arts jobs grows larger, to an 85.1 percentage-point growth, and more precisely estimated in the five-year range.

Over longer timelines, we also see the impact of arts infrastructure broadens to include a significant and positive impact for growth in the *narrow* category of arts firms in the three-year time range, with a 6.1 percentage point increase that grows to 13.1 percentage points in the 5-year period, as well as in the *wide* category in the five-year time range, with an 18.5 percentage point increase. Note that the longer timeline has fewer cases, which gives the analysis less power. The increasing impacts over longer time frames may result from treatment effects that take time to manifest or from heterogeneity in the treatments if projects in the earlier years of the study period were stronger than more recent projects.

Taken together, these results support hypotheses 1 and 2. In support of hypothesis 1, results for the *all* firms and jobs demonstrate that regions with HEI investments in arts infrastructure see more firms and jobs. Note that the presented results are the average treatment effect on the treated; these results do not estimate the expected impact of an arts infrastructure investment for other zip codes in the sample. However, they show strong and consistent spillover effects for regions with HEIs that make these investments. In line with hypothesis 2, the results also suggest that these investments grow the arts sector, with an initial impact on jobs that directly produce or distribute the arts. This initial growth in arts jobs is followed by firms that specialize in the direct production or distribution of the arts in the three-year time frame. In the five-year time frame, the growth in the *narrow* category of jobs and *firms* is complemented by growth in the *wide* category of arts firms. As expected, growth in firms providing indirect support for arts production or distribution follows growth in firms that directly produce or distribute arts.

Table 3. Baseline Treatment Effect Estimates

	All Firms	Wide Firms	Narrow Firms.	All Jobs	Wide Jobs	Narrow Jobs
% Δ 1-yr						
ATT	1.157***	0.126	0.031	0.873*	-0.180	0.518*
	(0.367)	(0.090)	(0.037)	(0.526)	(0.273)	(0.295)
p	0.002	0.161	0.409	0.097	0.509	0.080
untreated	44606	42956	37247	44603	42953	37248
treated (on)	278	264	236	278	264	236
N	44884	43220	37483	44881	43217	37484
% Δ 3-yr						
ATT	1.252***	0.044	0.061*	1.286**	0.057	0.474*
	(0.460)	(0.109)	(0.037)	(0.622)	(0.109)	(0.262)
p	0.007	0.688	0.095	0.039	0.603	0.071
untreated	38937	37461	32419	38932	37463	32437
treated (on)	239	229	205	239	229	205
N	39176	37690	32624	39171	37692	32642
% Δ 5-yr						
ATT	0.988***	0.185*	0.131**	0.758**	-0.569	0.851***
	(0.219)	(0.101)	(0.065)	(0.363)	(0.815)	(0.059)
p	<0.001	0.067	0.045	0.037	0.485	<0.001
untreated	33408	32077	27695	33408	32083	27701
treated (on)	192	186	167	192	186	167
N	33600	32263	27862	33600	32269	27868

Notes: Standards error are in parentheses – standard errors of PSM-estimated ATT are bootstrapped; * significant at 10%, ** significant at 5%, *** significant at 1%

Next, we examine possible heterogeneity in the effects of these arts infrastructure projects. This allows us to test the hypotheses related to differential treatment effects for different schools or in different regional contexts. Table 4 illustrates the estimated ATT treatment effects when we examine only the high-cost projects (top panel) or only the low-cost projects (second panel). High-cost projects are those that exceed $10 million and account for slightly more than one quarter of the projects. Low-cost projects consist of those costing less than $5 million. The bottom half of Table 4 compares the ATT effects for only those investments in college towns (third panel) with effects only for treatments in large urban centers (bottom panel). To define these "downtown" investments, we take our panel of schools in the 21 largest US cities (New York City through Boston) and identify the 75th percentile of their zip-code population densities. We limit "downtown" treatments to any school in our panel with a zip-code population density exceeding that threshold in order to capture high-density, large urban center treatments to contrast with college-town treatments. We additionally restrict these downtown treatments to be within 10 kilometers of the city center. Comparing between the downtown and college-town panels in Table 4 allows us to test the hypothesis that small-market investments will have bigger effects than those in major urban centers (hypothesis 3). Keep in mind that the downtown (college town) effects are estimated using nearest-neighbor matches to

those downtown (college town) observations, so comparing between panels in Table 4 is akin to comparing the difference in outcomes among downtown observations to the difference in outcomes among college-town observations (i.e., it is not comparing outcomes in treated downtown observations directly to treated college-town observations.) In all cases, Table 4 shows estimates for one-year growth rates.

In the upper half of Table 4, we examine heterogeneous treatment effects in relation to the observed impact for hypothesis 1 and 2. We find that high-cost projects appear to drive growth in the arts industry, while low-cost projects appear to drive broader impacts. In the high-cost sample, we see that the growth rate for arts firms in the *wide* definition increases by 5.1 percentage points, while the growth rate for jobs in the *narrow* arts category increases by 52 percentage points in zip codes with HEI investments in arts infrastructure. The coefficients on the *all* firms and jobs measures are positive for this subsample, but they are insignificant. For low-cost projects, the estimated effect sizes for the *all* jobs and firms categories are smaller in magnitude, but they are both significant. Interestingly, the coefficients on the *wide* definition of arts jobs and firms are positive and significant, showing a 30 percentage point and a 14 percentage point increase in the growth rate for each measure, respectively. However, the growth for the *narrow* category of jobs is insignificant in this subsample.

In the results for the partitioned sample, we see that the support for hypothesis one is driven largely by lower-cost projects, rather than higher-cost projects. However, arts jobs or firms experience enhanced growth regardless of the size of the investment, in the *narrow* category representing direct producers and distributors of the arts, and benefit most from high-cost investments.

The bottom half of Table 4 enables us to examine hypothesis 3 that arts infrastructure investments will be more impactful for college towns where the HEI often has a dominant influence. To understand the impact of the investment for college towns, we compare our findings to a similarly sized sample of investments from densely populated downtown areas. The results show some support for this hypothesis. In downtown areas, we see no evidence in increasing business activity in any of our measures for HEI investments. A negative effect on arts firm growth can be seen. In college towns, however, the investments tend to result in significantly higher growth rates, 30.1 percentage points, for these (*wide*) arts firms. Interestingly, *all* jobs and firms growth rates are unaffected in both college-town and downtown groups.

Table 4. Treatment effect estimates for subsets of arts-infrastructure projects

	All Firms	Wide Firms	Narrow Firms	All Jobs	Wide Jobs	Narrow Jobs
High cost						
ATT	1.636	0.051***	0.094	2.498	-0.487	0.520***
	(1.165)	(0.011)	(0.062)	(1.756)	(0.429)	(0.188)
p	0.160	<0.001	0.131	0.155	0.255	0.006
untreated	41893	38959	34342	41865	38926	34342
treated (on)	75	71	66	75	71	66
N	41968	39030	34408	41940	38997	34408
Low cost						
ATT	0.853**	0.300**	-0.030	0.799*	0.140*	0.246
	(0.432)	(0.142)	(0.052)	(0.412)	(0.076)	(0.293)
p	0.048	0.035	0.564	0.052	0.067	0.401
untreated	43109	41481	35688	43102	41480	35724
treated (on)	152	143	130	152	143	130
N	43261	41624	35818	43254	41623	35854
Downtown						
ATT	2.002	-0.075***	-0.164	0.591	-0.058	0.027
	(2.007)	(0.028)	(0.106)	(0.396)	(0.189)	(0.139)
p	0.319	0.007	0.123	0.136	0.759	0.845
untreated	17660	14595	13458	16851	14587	13384
treated (on)	33	30	29	33	30	29
N	17693	14625	13487	16884	14617	13413
College town						
ATT	0.067	0.301*	0.180	-0.024	0.382	0.430
	(0.082)	(0.155)	(0.113)	(0.060)	(0.386)	(0.329)
p	0.415	0.052	0.112	0.692	0.321	0.191
untreated	6602	6179	5213	6518	6157	5195
treated (on)	36	36	29	36	36	29
N	6638	6215	5242	6554	6193	5224

Notes: Standards error are in parentheses – standard errors of PSM-estimated ATT are bootstrapped; Significance: * significant at 10%, ** significant at 5%, *** significant at 1%

Our results indicate that HEI investments in arts infrastructure have a significant positive impact on the growth of jobs and firms in the regions of investing HEIs. These positive impacts extend jobs and firms in arts industries and to college towns. As a first step, our PSM model removes the bias resulting from the inclusion of low-propensity cases by finding comparable matches to the units receiving treatment. The quality of the results depends upon the extent to which the probit models in the first step adequately identify matches and achieve a balanced sample.

In Table 5, we present the results of our covariate balancing. In the columns reporting the standardized difference, we can see that mean differences between the treated and untreated groups shrink to negligible amounts in the propensity-score matched sample as compared to the raw sample. The variance ratios also indicate good matches, hovering around 1 for most variables, though rising above 2 for a few variables. Given the severe imbalance at the start of the PSM and the sheer number of variables used for matching, the covariate balancing results

indicate a strong, well-balanced matched sample that controls adequately for variables influencing selection into treatment.

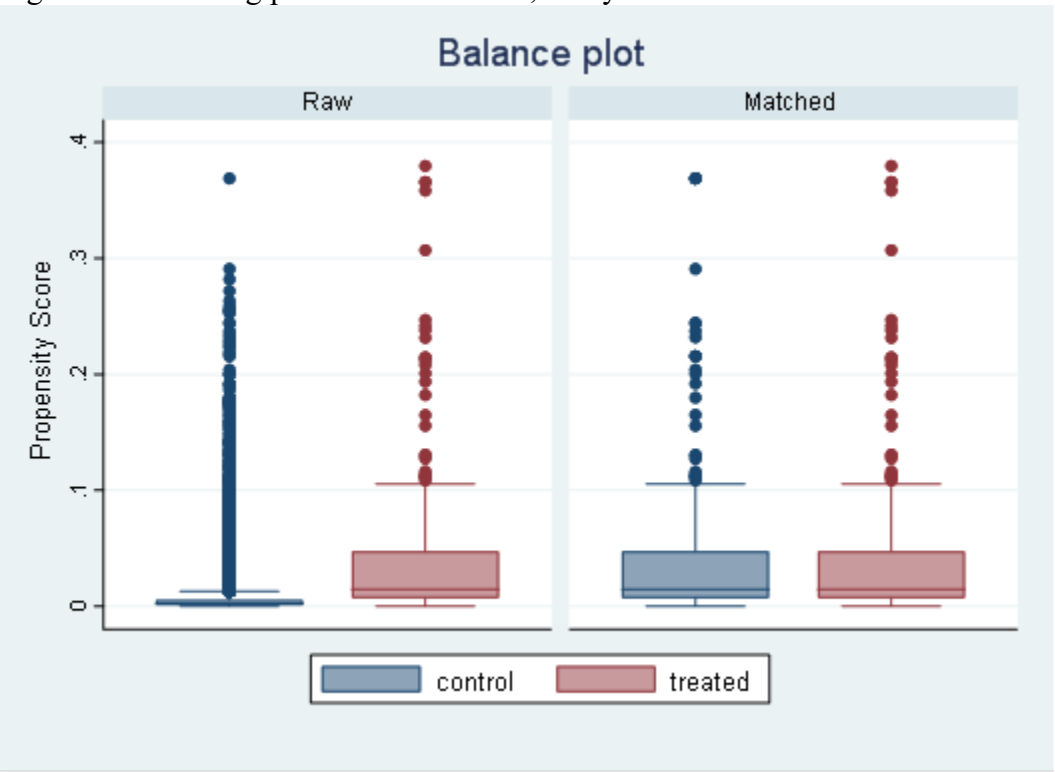
Table 5. Covariate balancing results

	Standardized Difference		Variance Ratio	
Variable	**Raw**	**Matched**	**Raw**	**Matched**
4-year	0.498	0.027	0.619	0.957
doctoral	0.776	0.030	4.531	1.022
public	0.355	-0.015	0.941	1.008
HBCU	-0.029	0	0.847	1
postsecondary	0.357	0.045	0.372	0.843
metro	0.516	0.044	0.960	0.976
occupational	-0.269	0.030	0.901	1.022
continuing	0.411	-0.008	1.757	0.994
recreational-avocational	0.059	0	1.056	1
remedial	-0.103	0	0.914	1
secondary	-0.041	-0.020	0.817	0.903
1-yr certificate	-0.114	0.015	0.941	1.011
1-2-yr certificate	-0.339	0	0.878	1
assoc	-0.438	0.064	1.193	1.007
2-4-yr certificate	-0.100	-0.044	0.800	0.900
postbac	0.617	0.007	1.852	1.002
masters	0.766	-0.024	0.833	1.027
other degree	0.103	0	4.468	1
phd	0.756	-0.014	1.834	1.000
abroad	0.860	-0.068	0.791	1.092
student services	-0.198	-0.039	1.272	1.040
career	0.418	-0.060	0.163	1.655
dorms	0.607	-0.046	0.617	1.081
placement	0.282	-0.057	0.501	1.217
daycare	0.517	0.035	1.197	0.995
library	0.146	0.038	0.283	0.669
no-credit	-0.274	-0.065	0.399	0.761
arts degrees	0.667	0.064	3.023	0.948
degrees	0.904	0.044	6.495	0.977
enrollment	0.931	0.038	3.676	0.814
tuition total	0.708	0.019	1.695	1.053
downtown dist	-0.134	0.050	1.218	1.208
college town	0.397	-0.051	4.499	0.899
pop density$_C$	-0.039	0.069	0.879	2.055
population$_C$	-0.062	0.135	0.700	1.708
unemployment$_C$	0.192	-0.040	1.311	1.214
firms, all$_{Zt-1}$	-0.160	0.002	0.918	1.074
State-level controls	Yes			
Zip-code-level controls	Yes			

We summarize the power of the covariate balancing in our empirical setting with the graph in Figure 2. Without the matching exercise, the propensity score of the full (raw) sample is very much skewed to virtually nil propensity to receive treatment. The treated observations, while

still unlikely to receive treatment overall, exhibited much greater propensity to receive a new infrastructure project. Once matched via the PSM technique, however, the propensities to receive treatment are distributed very similarly for the treatment and control samples.

Figure 2: Balancing plot for the *all* firms, one-year model



Conclusion

This research contributed to the literature on HEI spillover effects using construction starts (i.e., building projects) data coupled with data on HEIs and economic activity of regions. Specifically, we examined the effects of physical arts infrastructure investments at HEIs on a regional jobs and firms. Our contribution was two-fold. First, we identified that non-STEM fields, here the arts, can contribute to a region's economic activity in the form of more jobs and firms overall. These effects are more pronounced for lower-cost building projects, rather than higher-cost projects. Prior to this study, the literature on HEI spillovers has concentrated on STEM fields primarily. Second, we have provided evidence that arts physical infrastructure investments at HEIs also positively affect regional jobs and firms in the arts. These effects are demonstrated regardless the size of the investment, but are more pronounced for higher-cost projects. Moreover, we find that regional spillovers from HEI physical arts infrastructure investment are more pronounced in college towns, as compared to densely populated downtown areas, especially for firms and jobs in the arts.

In terms of our first contribution, we find that physical arts infrastructure investments at HEIs can influence greater economic activity in the region through more jobs and firms overall. Interestingly, these effects are greatest when HEIs makes relatively low-cost investments in the arts. Without knowing more about the specific details of HEI arts infrastructure projects, it is difficult to know the potential mechanism for spillovers to the overall sector. It may be that

through fostering the arts on campus, HEIs encourage creative thinking skills among students who eventually go on to work in firms in the region, or that students with creative thinking skills are more likely to attend HEIs that put emphasis on the arts. There is evidence that suggests transference of creative skillsets between arts and non-arts work (e.g., Hale and Woronkowicz 2020).

As for our second contribution, we find evidence that in particular high-cost physical arts infrastructure investments on campus translate into more jobs and firms in a region, specifically in the arts. The effect of these investments on campus seems to grow stronger over time. These results suggest that HEIs can help seed a regional arts infrastructure by providing workers in the arts, and stimulating the creation of arts firms. Students in the arts might work in regional firms, and workers in the arts might lend expertise to arts activity on campus. There is a natural blending of infrastructure that takes place between both campuses and their regions in the arts industry. Here we believe that the extent to which this seeding effect, or blending, can occur largely depends on the relative size of the region compared to its campus population (i.e., college towns). For many smaller regions with HEIs, the arts infrastructure on campus is not exclusively reserved for campus populations. In other words, many smaller regions with HEIs depend on their campuses to provide access to amenities to community populations, and vice versa. Thus, there may be an amenities effect of high-cost physical arts infrastructure at HEIs in smaller regions where community members choose to live, and work, in areas where the campus provides options to improve overall quality of life. This is an area ripe for research that we hope future studies will build on.

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Appendix

Table A1 –North American Industry Classification System (NAICS), Standard Industrial Classification (SIC) Codes Included in Wide, Narrow Arts Definitions

"Narrow" Definition			
NAICS	**NAICS Industry**	**Related SIC**	**Related SIC Industry**
453920	Art dealers	8412	Museums and art galleries
611610	Fine arts schools	n/a	n/a
711110	Theater companies and dinner theaters	7922	Theatrical producers (except motion picture) and miscellaneous theater services
711120	Dance companies	7911	Dance studios, schools, and halls
711130	Musical groups and artists	7929	Bands, orchestras, actors, and other entertainers and entertainment groups
711190	Other performing arts companies	7929	Bands, orchestras, actors, and other entertainers and entertainment groups
711310	Promoters of performing arts, sports and similar events with facilities	n/a	n/a
711320	Promoters of performing arts, sports and similar events without facilities	n/a	n/a
711510	Independent artists, writers, and performers	7929	Bands, orchestras, actors, and other entertainers and entertainment groups
712110	Museums	8412	Museums and art galleries
"Wide" Definition			
NAICS	**NAICS Industry**	**Related SIC**	**Related SIC Industry**
443142	Electronics Stores	5731	Radio, Television, and Electronic Stores
451140	Musical Instrument and Supplies Stores	5736	Musical Instrument Stores
451211	Book Stores	5942	Book Stores
451212	News Dealers & Newsstands	5994	News Dealers and Newsstands
512110	Motion picture and video production	7812	Motion picture and video tape production
512131	Motion picture theaters (except drive-ins)	7832	Motion picture theaters (except drive-ins)
512191	Teleproduction and other postproduction services	7819	Services allied to motion picture production
512199	Other motion picture and video industries	7829	Motion picture distribution services
512210	Record production	5735	Record and prerecorded tape stores
512220	Integrated record production/distribution	5735	Record and prerecorded tape stores
512230	Music publishers	n/a	n/a
512240	Sound recording studios	n/a	n/a
512290	Other sound recording industries	n/a	n/a

515111	Radio networks	4832	Radio Broadcasting Stations
515112	Radio stations	4832	Radio Broadcasting Stations
515120	Television broadcasting	4833	Television Broadcasting Stations
515210	Cable & other subscription programming	4841	Cable and Other Pay Television Services
532230	Video tape and disc rental	7841	Video Tape Rental
541310	Architectural services	8712	Architectural services
541320	Landscape architectural services	8712	Architectural services
541410	Interior design services	n/a	n/a
541420	Industrial design services	n/a	n/a
541430	Graphic design services	7336	Commercial art & graphic design
541490	Other specialized design services	n/a	n/a
541830	Media buying agencies	n/a	n/a
541840	Media representatives	7313	Radio, Television, Publisher Representatives
541921	Photography studios, portrait	7221	Photographic studios, portrait
541922	Commercial photography	7335	Commercial photography
712120	Historical sites	n/a	n/a
712130	Zoos and botanical gardens	8422	Botanical and Zoological Gardens
712190	Nature parks and other similar institutions	8422	Botanical and Zoological Gardens
713110	Amusement and theme parks	7996	Amusement Parks
713120	Amusement arcades	7993	Coin-operated Amusement Devices

Table A2 – Variable Definitions

Variable name	Description	Source
investdum	Invested in cultural infrastructure; dummy variable	A
project value	Value of HEI cultural infrastructure investments (in $1000s)	A
4-year	Four-year institution; dummy variable	B
research	Doctoral or research HEI in 1994-2018 Carnegie Classifications; dummy variable	B
public	Institution controlled by public officials; dummy variable	B
HBCU	Historically black college or university (1992 values applied to prior years); dummy variable	B
postsecondary	An active, open-to-the-public institution with a primary mission is to provide postsecondary education (available from 2000); dummy variable	B
metro	Located in in a CBSA that contains at least one urban area with a population of 50,000 or more (2007 values applied to prior years); dummy variable	B
occupational	Offers programs that provide training for a specific occupation; dummy variable	B
continuing	Offers programs that provide additional training to those who have already earned a professional degree; dummy variable	B
recreational-avocational	Offers programs for personal interest that do not accrue credits for a formal award; dummy variable	B
remedial	Offers adult basic or remedial instruction or H.S. equivalency; dummy	B

	variable	
secondary	Offers secondary high school programs; dummy variable	B
1-yr certificate	Offers a postsecondary award, certificate or diploma of less-than-1-year ; dummy variable	B
1-2-yr certificate	Offers a postsecondary award, certificate or diploma of at least one but less than two years; dummy variable	B
assoc	Offers Associate's degree; dummy variable	B
2-4-yr certificate	Offers a postsecondary award, certificate or diploma of at least two but less than four years; dummy variable	B
bachelor	Offers Bachelor's degree; dummy variable	B
postbac	Offers postbaccalaureate certificate; dummy variable	B
masters	Offers Master's degree; dummy variable	B
other degree	Offers other degree; dummy variable	B
doctoral	Offers doctoral degree (includes all first-professional degrees prior to 2008); dummy variable	B
abroad	Offers study-abroad programs (only available from 2001); dummy variable	B
student services	Offers remedial services for students; dummy variable	B
career	Offers employment services for students; dummy variable	B
dorms	Institution provides on-campus housing; dummy variable	B
placement	Offers placement services for completers; dummy variable	B
daycare	Offers on-campus day care for students' children; dummy variable	B
library	Institution has its own library facilities; dummy variable	B
no-credit	Noncredit courses offered on-campus (only available from 1999); dummy variable	B
arts degrees	Number of visual and performing arts awards/degrees conferred (in hundreds)	B
degrees	Number of awards/degrees conferred (in thousands)	B
enrollment	Total students, fall enrollment (in thousands)	B
tuition total	Average out-of-state tuition and fees for undergraduate students	B
downtown dist	Natural log of distance in meters from school to population center of nearest CBSA (center of population data from the 2010 census)	B, C
$income_S$	Natural log of median household income in the state	D
$enrollment_S$	Natural log of fall enrollment in degree-granting institutions in the state	E
public $enrollment_S$	Natural log of full-time equivalent enrollment in public institutions in the state	F
edu $spend_S$	Natural log of education appropriations for public higher education	F
avg $tuition_S$	Natural log of net tuition revenue at state institutions	F
school $spend_S$	State spending on elementary and secondary education per capita (in $100s)	G
HigherEd $spend_S$	State spending on higher education per capita (in $100s)	G
TANF $spend_S$	State spending on TANF per capita (in $10s)	G
capital $spend_S$	State capital spending per capita (in $100s)	G
$revenue_S$	State general fund revenue per capita (in $1,000s)	G
$unemployment_S$	State unemployment rate	H
college town	Located in a college town; dummy variable	I
pop $density_C$	County population density (in thousandths of people per square mile; imputed)	J
$population_C$	County population (in 1,000,000s, imputed) (only available before 2015, imputed thereafter)	K

$unemployment_C$	County unemployment rate	L
$population_Z$	ZIP code population (in 10,000s, imputed)	M
Age $18\text{-}24_Z$	College-age share of ZIP code population (imputed)	M
Age $25+_Z$	Adult population share of ZIP code population (imputed)	M
no-HS $18\text{-}24_Z$	Share ZIP code college-age population without high school diploma (imputed)	M
no-HS $25+_Z$	Share ZIP code adult population without high school diploma (imputed)	M
college $18\text{-}24_Z$	Share ZIP code college-age population with at least a bachelor's degree (imputed)	M
college $25+_Z$	Share ZIP code adult population with at least a bachelor's degree (imputed)	M
$income_Z$	Natural log of median earnings in ZIP code (imputed)	M
$unemployment_Z$	ZIP code unemployment rate (imputed)	M
year	Year	
estab., all_{it}	Count of all establishments in *i* in year *t*	N
estab., $wide_{it}$	Count of wide-definition arts establishments in *i* in year *t*	N, O
estab., $narrow_{it}$	Count of narrow-definition arts establishments in *i* in year *t*	N, O
jobs, all_{it}	Estimate of all jobs in *i* in year *t*	N
jobs, $wide_{it}$	Estimate of wide-definition arts jobs in *i* in year *t*	N, O
jobs, $narrow_{it}$	Estimate of narrow-definition arts jobs in *i* in year *t*	N, O

Notes: all variables measured at the school-year level (except for *college town* and *downtown dist.*, which are time invariant). Variable subscripts indicate the geography that contains the school or, in the case of school-years with projects (i.e., *investdum*=1), the geography that contains the project: *i=Z* for zip; *i=C* for county.

Source Notes:

A – McGraw-Hill Construction, Inc., Dodge Data and Analytics. (2017). Population data [Data file]. Available from https://www.construction.com

B – National Center for Education Statistics (NCES). (2018). Integrated Postsecondary Education Data System [Data set]. Retrieved from https://nces.ed.gov/ipeds/datacenter/DataFiles.aspx?goToReportId=7.

C – U.S. Census Bureau. (2010). Centers of Population [Data set]. Retrieved from https://www.census.gov/geographies/reference-files/time-series/geo/centers-population.html

D – U.S. Census Bureau. (2018). Median Household Income by State [Data set]. Retrieved from https://www2.census.gov/programs-surveys/cps/tables/time-series/historical-income-households/h08.xls

E – National Center for Education Statistics (NCES). (2017). Digest of education statistics [Data tables]. Retrieved from https://nces.ed.gov/programs/digest/

F – State Higher Education Executive Officers Association (SHEEO). (2018). State higher education finance: FY 2018 [Data file]. Retrieved from https://sheeo.org/project/state-higher-education-finance/

G – National Association of State Budget Officers (NASBO). (2019). State expenditure report data [Data file]. Retrieved from https://www.nasbo.org/reports-data/state-expenditure-report

H – Iowa Community Indicators Program, Iowa State University. (2018). Annual unemployment rates by state" [Data file]. Retrieved from https://www.icip.iastate.edu/tables/employment/unemployment-states

I – Gumprecht, B. (2003). The American college town. *Geographical Review 93*(1), 51-80.

J – Schroeder, J.P. (2016). Historical population estimates [Data file]. Retrieved from https://conservancy.umn.edu/handle/11299/181605

K – National Bureau of Economic Research (NBER). (2016). Census U.S. intercensal county population data [Data set]. Retrieved from https://data.nber.org/data/census-intercensal-county-population.html

L – U.S. Bureau of Labor Statistics. (2020). Local area unemployment statistics [Data set]. Retrieved from https://www.bls.gov/lau/

M – U.S. Census Bureau. (2020). American Community Survey educational attainment and school enrollment [Data set]. Retrieved from https://data.census.gov/cedsci/

N – U.S. Census Bureau. (2016). County and ZIP code business patterns [Data set]. Retrieved from https://www.census.gov/programs-surveys/cbp.html

O – Grodach, C., Currid-Halkett, E., Foster, N., & Murdoch, J. (2014). The location patterns of artistic cultures: A metro- and neighborhood-level analysis. *Urban Studies 51*(13), 2822-2843. https://doi.org/10.1177%2F0042098013516523

Table A3 – Descriptive Statistics

	N_A	N_B	$Mean_A$	$Mean_B$	$S.D._A$	$S.D._B$
investdum	4489 1	278	0.006	1	0.078	0
project value	278	278	9881.806	9881.806	15772.130	15772.130
%Δfirms., all_{Zt}	4489 1	278	0.032	1.156	1.433	8.497
%Δfirms., $wide_{Zt}$	4323 0	264	0.036	0.210	0.434	1.551
%Δfirms., $narrow_{Zt}$	3749 9	236	0.045	0.058	0.505	0.591
%Δjobs, all_{Zt}	4489 1	278	0.056	1.158	2.897	9.368
%Δjobs, $wide_{Zt}$	4323 0	264	0.132	0.228	1.565	1.388
%Δjobs, $narrow_{Zt}$	3749 9	236	0.230	0.622	3.001	4.503
firms, all_{Zt-1}	4489 1	278	806.028	701.586	692.622	664.543
firms, $wide_{Zt-1}$	4489 1	278	23.223	21.288	46.473	45.362
firms, $narrow_{Zt-1}$	4489 1	278	7.576	7.241	21.044	18.025
jobs, all_{Zt-1}	4489 1	278	15495.980	13456.340	15309.670	13270.870
jobs, $wide_{Zt-1}$	4489 1	278	309.478	307.032	781.308	688.160
jobs, $narrow_{Zt-1}$	4489 1	278	114.819	112.980	405.935	313.404
4-year	4489 1	278	0.603	0.817	0.489	0.388
research	4489 1	278	0.055	0.331	0.227	0.471
public	4489 1	278	0.457	0.629	0.498	0.484
HBCU	4489 1	278	0.030	0.025	0.169	0.157
postsecondary	4489 1	278	0.872	0.960	0.334	0.195
metro	4489 1	278	0.413	0.655	0.492	0.476
occupational	4489 1	278	0.466	0.338	0.499	0.474
continuing	4489 1	278	0.144	0.309	0.351	0.463
recreational-avocational	4489 1	278	0.289	0.317	0.453	0.466
remedial	4489 1	278	0.316	0.270	0.465	0.445
secondary	4489 1	278	0.040	0.032	0.195	0.177

1-yr certificate	4489					
	1	278	0.394	0.338	0.489	0.474
1-2-yr certificate	4489					
	1	278	0.486	0.324	0.500	0.469
assoc	4489					
	1	278	0.699	0.486	0.459	0.501
2-4-yr certificate	4489					
	1	278	0.142	0.108	0.349	0.311
bachelor	4489					
	1	278	0.603	0.817	0.489	0.388
postbac	4489					
	1	278	0.160	0.421	0.367	0.495
masters	4489					
	1	278	0.382	0.730	0.486	0.445
other degree	4489					
	1	278	0.003	0.011	0.050	0.104
doctoral	4489					
	1	278	0.167	0.489	0.373	0.501
abroad	4489					
	1	278	0.384	0.770	0.486	0.422
student services	4489					
	1	278	0.795	0.709	0.403	0.455
career	4489					
	1	278	0.878	0.982	0.327	0.133
dorms	4489					
	1	278	0.541	0.809	0.498	0.394
placement	4489					
	1	278	0.833	0.924	0.373	0.265
daycare	4489					
	1	278	0.295	0.540	0.456	0.499
library	4489					
	1	278	0.975	0.993	0.156	0.085
no-credit	4489					
	1	278	0.091	0.029	0.288	0.167
arts degrees	4489					
	1	278	30.863	114.327	93.109	158.255
degrees	4489					
	1	278	844.251	3081.086	1352.205	3340.374
enrollment	4489					
	1	278	4553.984	13686.960	6688.414	12578.220
tuition total	4489					
	1	278	12997.080	20011.300	8821.529	11388.390
downtown dist	4489					
	1	278	8.805	8.688	0.869	0.957
$income_S$	4489					
	1	278	10.755	10.786	0.196	0.176
$enrollment_S$	4489					
	1	278	12.913	13.127	1.094	0.991
public $enrollment_S$	4489					
	1	278	12.487	12.581	0.954	0.965
edu $spend_S$	4489	278	9.001	8.960	0.256	0.282

avg tuition$_S$	1 4489					
school spend$_S$	1 4489	278	8.443	8.564	0.503	0.536
HigherEd spend$_S$	1 4489	278	0.0002	0.0001	0.001	0.0005
TANF spend$_S$	1 4489	278	0.0001	0.0001	0.0002	0.0002
capital spend$_S$	1 4489	278	0.00001	0.00001	0.00004	0.00004
revenue$_S$	1 4489	278	0.00005	0.0001	0.0002	0.0002
unemployment$_S$	1 4489	278	0.0003	0.0004	0.001	0.001
college town	1 4489	278	6.113	6.857	2.079	2.251
pop density$_C$	1 4489	278	0.027	0.129	0.161	0.336
population$_C$	1 4489	278	2584.265	2253.069	8603.856	8088.252
unemployment$_C$	1 4489	278	933900.10 0	833823.50 0	1754820.00 0	1470518.000
population$_Z$	1 4489	278	0.062	0.067	0.025	0.029
age 18-24$_Z$	1 4489	278	26527.760	24265.950	17236.370	17090.440
age 25+$_Z$	1 4489	278	0.167	0.318	4.754	0.601
no-HS 18-24$_Z$	1 4489	278	0.628	0.514	4.170	0.249
no-HS 25+$_Z$	1 4489	278	0.162	0.094	0.247	0.139
college 18-24$_Z$	1 4489	278	0.152	0.116	0.148	0.111
college 25+$_Z$	1 4489	278	0.097	0.102	0.212	0.165
income$_Z$	1 4489	278	0.313	0.403	0.309	0.415
unemployment$_Z$	1 4489	278	10.351	10.262	0.541	0.664
year	1 4489	278	0.072	0.096	0.125	0.099
	1	278	2006.696	2009.227	5.505	4.209

Notes: Subscript A refers to the untreated HEI-years in the sample and subscript B refers to the treated HEI-years in the sample. See Table A2 for variable definitions and data sources for these variables and others used in the analysis.