Arts Districts, Universities, and the Rise of Digital Media

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Abstract

In the last decade, arts and culture have been placed at the center of attention when discussing economic growth. In particular, studies on the "creative class" have been using arts and culture as an important factor impacting local economies. In addition, studies on local economic development have frequently viewed universities as a major factor in economic growth. In the middle of this discussion is new economic growth via creativity, via new recipes and new combinations of local capital, and via innovation centers. Combining these disparate literatures brings to center stage both clusters of arts and culture and concentrations of research and human capital development. Hence, the focus of this paper is to analyze the dual impacts of universities and arts districts on innovation and economic growth through employment in digital media. The results indicate that cultural districts have a consistently positive effect on local digital media economic activity – employment and innovation. The same cannot be said for research universities.

Introduction

According to the new economic growth theory, people and ideas create technological change, which results in economic growth. In his work, Romer refers to the use of existing resources in a different way as a new recipe for growth. Attention has been placed on the ability of arts and culture to make an economic impact. In particular, studies on the "creative class" have been using arts and culture as an important factor impacting local economies. In addition, studies on local economic development have frequently viewed universities as a major factor in economic growth. In the middle of this discussion is new economic growth via creativity, via new recipes and new combinations of local capital, and via innovation centers. Combining these disparate literatures brings to center stage both clusters of arts and culture and concentrations of research and human capital development. Hence, the focus of this paper is to analyze the dual impacts of universities and arts districts on innovation and economic growth through employment in digital media.

There are several ways to identify clusters of arts and culture in an economy. The approach taken here opts for officially designated *arts districts* as a formally recognized cluster that generally manifests as part of some targeting public investment. For simplicity only, throughout we refer to cultural districts and arts districts synonymously. Frost-Kumpf (1998) lists over 90 US cities with cultural districts, which gives us an excellent measure of arts districts observed roughly in the middle of the available timespan of data. When coupled with the long-standing existence of research intensive (i.e., R1) universities, these two major investments (universities, arts districts) are seen as "treatments" that are hypothesized to affect long-term development of arts-related activities. Simple statistical inferences in this

context, especially for arts districts, will be limited by obvious endogeneity concerns. We address these preliminarily by employing a difference-in-difference estimator to see how trends in employment (and innovation in) in digital media differ in cities with arts districts (or universities) and those without. By measuring arts-related employment and innovation as shares of overall employment and innovation, our approach resembles a sort of triple-difference estimator to identify how digital media employment (and innovation) differs from overall employment (innovation) in the city, and how trends in that difference differ by treatment.

The results indicate that cultural districts have a consistently positive effect on local digital media economic activity – employment and innovation. The same cannot be said for research universities. The results show that on average R1 universities positively impact digital media employment levels and trends. In particular, cities with more than 6 R1 universities in the same city can expect a positive impact on arts and digital media employment and patenting. These results actually imply that the impact of universities is a general impact on not necessarily related directly to arts or digital media. Cultural districts appear to foster arts and digital media related employment between 1998 and 2006. Moreover, the size of the arts district is positively correlated with employments and patenting.

Culture, Universities, and Economic Development: What do we know?

Economic development studies view industrial clusters, universities, and culture as important. Each of these factors is significant but requires additional factors in the form of

human capital, knowledge, and absorptive capacity to make local economic contribution. In particular, studies show that the strength of universities in economic impact is not limited to technology commercialization. Other activities in the form of policy, real estate, and neighborhood revitalization have shown as much vitality although less quantifiably. Similarly, culture in general and art in particular have been increasingly viewed as economic-growth generating tools through the creation of cultural districts and institutions as well as a tool for economic development through the attraction of high quality labor and large corporations (Rushton, 2013) The following section examines each of these factors in more detail.

The role of the university in economic development

Starting in the 19th century, universities increasingly have become important factors for local economic growth. Moreover, in the late 1980s and early 1990s,with the development of the knowledge economy, where knowledge is a product, led to an increased reliance on universities' contribution to financial economic development by way of focusing on outcomes of academic research (Etzkowitz and Leydesdorff, 1997, Goddarrd and Chatterton, 1999). As a result, universities have played a central role in contributing to regional and national economies.

Universities are an important source of new knowledge and technology, with the potential to be commercialized (Scott, 1977). The pressure on modern universities to pay back to the community has created what is known as the "third role" of universities, by which many universities are now obliged to make a contribution to society through research and

development (R&D), collaborations, and technology transfer with industry (Minshall et al., 2004).

Universities use a variety of mechanisms to transfer technology to industry. Technology commercialization is the common way by which universities' economic development is evaluated (Etzkowitz and Leydesdorff, 1997, Feldman and Breznitz, 2009, Lawton Smith, 2000, Lerner, 2004, Markman et al., 2005, Nelsen, 2003, Rahm et al., 2000, Siegel et al., 2004). Formal mechanisms include patents, licenses, and spinout firms (Di Gregorio and Shane, 2003, Link and Siegel, 2005, Mowery et al., 1999, Owen-Smith and Powell, 2001, Sampat, 2006, Siegel et al., 2003, Thursby et al., 2001). Though not the only economic contribution universities make, patents, licenses and spinout firms are easy to quantify and use to measure university productivity.

In addition, studies have found a direct link between the distance of firms and universities as a proof for the knowledge spillover generated by university research (Feldman, 1994, Jaffe et al., 1993). This points to a geographic cost to the transmission of knowledge and creativity out of university centers, and it raises interesting questions about the mechanisms behind the spatial clustering of this knowledge and creativity (e.g., geographic sorting by innovators, transportation costs related to communication costs, the role of in-person experiences in creating or consuming the knowledge). In the center of many successful technological regions we find an innovative university with a research focus on the same technology. The mere existence of a university in a region, however, is not a guarantee for economic success. While considerable research effort has gone into understanding the role of universities in

generating innovations, transferring technologies and new ideas, and stimulating (local) economic development, nearly all of that work has focused on various technologies with scientific emphases or with commercial and industrial applications. Universities' roles in spawning innovations and economic impacts in arts-related fields have not received much attention to this point. While this oversight may be for several fairly obvious reasons, we argue that arts-related impacts of universities are particularly interesting not just to the arts sector but also as a way of understanding broader university knowledge spillovers in areas not typically the focus of "tech transfer" or local economic stimulus.

When we examine the overlapping relationships between culture and universities we find that universities are found in most highly ranked cities in the "creative class index" (Florida, 2002). Universities are an important part of local economic growth. Florida (2002) claims that the main contribution of universities is in the 3Ts: creating and dispensing technology, talent, and tolerance. Hence, the impact of university R&D is important, but its main effects might arise through a different role: its ability to draw talented students and faculty and grow a talented work pool, as well as its education program and diversity that creates an environment of tolerance, to which, according to Florida, many firms are drawn.

Strengthening Florida's notion as to the extended role of universities in economic development, studies find that there are many services and activities provided by universities, such as community and volunteer work that cannot easily be quantified and is not recognized by the public service provided by universities (Breznitz and Feldman, 2012a, Forrant et al., 2001, Maurrasse, 2001). In particular, Breznitz and Feldman have identified two additional

roles for universities: policy advice and research as well as becoming an active player in local economic initiatives. This includes efforts like workforce development, partnership development, community development, real estate development (Breznitz and Feldman, 2012a).

Culture and art in economic development

The importance of culture as a factor in economic development is not new. Starting in the 1960s this argument was a contributing factor to the creation of many culture and culture-related institutions such as the National Endowment for the Arts is the US (Rosenberg, 2001). The role of culture and art in local economies can be divided to two parts: generating direct income from local institutions and artists, and as a powerful tool for drawing large corporations and highly skilled labor to a region.

Artists as an industry sector on their own have been shown to make a direct contribution via exporting goods and services. Though many artists do not sell their products in the local economy they contribute to the exporting base of their region (Breznitz and Feldman, 2012b, Breznitz and Feldman, 2012a). Moreover, the existence of art and cultural institutions such as museums and theaters draws outside funding and visitors to a region. Though, some studies claim that the cost-benefit analysis is very difficult to measure and to compare with places that have not fared so well due to cultural investments (Rosenberg, 2001).

The rise of the new digital media sector, defined in more detail below, in recent years in some regions has demonstrated several important properties that we investigate further here.

First, the emergence of the digital media sector shows how the venerable arts industry sector can have a large, disruptive, and exciting impact on economies. The rapid growth and sheer size of the video game industry, for instance, reflects both a potential and a reality for arts-related innovation to occupy a substantial role in an economy. Second, the (spatial) clustering of Digital Media production is commonly observed at least anecdotally. The serious efforts from states and localities to attract more of that business to their region point to digital media as an avenue (viable or not) for local economic development. Third, how new digital media combines truly artistic and creative content with emergent and novel technologies – the staple of most innovation studies – offers a fascinating intersection between arts and technology and an area with seemingly greater potential for economic impact and innovation for universities.

Importantly, the indirect contribution of culture and art can be measured through its impact on other firms and industries (Breznitz and Feldman, 2012b, Breznitz and Feldman, 2012a). In particular, arts and artists attract firms and high level human capital to a region contributing to the productivity of other industries (Florida, 2002). Similarly to universities, culture and art are contributing factors to the environment in which firms and individuals choose to live and work (Eaton and Bailyn, 1999).Studies claim that some cities or regions have added jobs more rapidly over time as a result of cultural industries (Tomusk, 2011). These additional positions are attributed to large concentration of cultural industries, which have been viewed important to diverse economic base in highly specialize cities (Tomusk, 2011). However, studies find conflicting results regarding the possible causality between

cultural activity and the attraction of other firms and high income workers (Bramwell and Wolfe, 2008, Infoplease Atlas, 2000-2007).

In addition, physical investment in arts helps revitalize neighborhoods or districts (Ladry et al., 1996, Carnegie foundation for the advancement of teaching, 2012). As stated by Perryman: “Even in less obvious places the cultural industry plays a measurable economic role” (Kenney and Patton, 2009). Hence, culture can be used as an economic development tool. Its contribution, however, depends on a change in the political economy of cities and in the organization and mission of cultural institutes, which create close and mutual benefits between urban political, economic, and cultural entrepreneurs (Strom, 2002, Florida, 2002).

Though studies on culture view its impact positively they also caution us about overestimating its impact. “Conventional economic impact studies could be strengthen by stricter criteria for determining the extent to which a given arts or cultural investment induces external income, increased scrutiny with regards to the substitution effect, and attention to efficiency and equity concerns through cost-benefit analyses and participation studies” (Rosenberg, 2001).

Research Design and Method

To assess the importance of universities and arts districts as they are depicted in the economic development literature, this paper analyzes the impact of universities and arts districts on economic growth through employment and innovation in digital media. In particular, the paper focuses on three research questions:

- How do trends in employment and innovation in digital media differ in cities with arts districts and universities?
- How do digital media employment and innovation differ from overall employment and innovation in the city, and how do trends in that difference differ by treatment (i.e., whether the city has an arts district or university)?

We choose to focus on *digital media* as our industry of choice because of its strong relationships to both arts and university research. Moreover, digital media is a booming industry including but not exclusive to: video games, motion pictures, television, internet publishing, application development, and online entertainment (streaming content, music & video downloads, etc.). For the purpose of this paper, we define digital media as "An artistic and creative content in new (especially digital) formats and media, such as digital art, computerized animation, internet and interactive art."

The paper is based on a quantitative analysis of 100 cities, with measures of local arts districts, research universities, employment related to arts and digital media, and digital media-related patenting over the years. We define economic development mainly through two dependent variables: (1) employment in arts and digital media, and (2) innovation, measured by total patents and by the share of those patents related to digital media. Our independent variables are the local presence and size of cultural districts and the number of "research one" (R1) universities.

The preliminary research design starts with a sample of the 100 largest cities in the United States, ranging from New York, NY (population of 8.2 million in 2011) to Rochester, NY (population of 210,855). This list represent 41 cities with arts districts out of the Frost-Kumpf (1998)'s inventory of 89 cities with arts districts. We use the 100 largest cities for this study due to the strong connection between city size and arts related employment (Florida, 2002). Moreover, our analysis includes employment data from the Current Population Survey (CPS), which is only available at a sufficiently refined geographic scale for the largest metro areas. We also use patent data in our analysis and we expect that these cities have stronger representation of patenting activity, R&D and universities, and digital media-related activity.

Summary data sources

1. A list of cities with arts districts based on Frost-Kumpf (1998) -

The Frost-Kumpf inventory is used to indicate the presence of cultural districts in each municipality (Frost-Kumpf, 1998). Arts districts are represented in the paper by their size relative to the city that hosts them. Each district's boundaries are mapped using ArcGIS software and overlaid against Census map files to obtain population and area shares. The *population share* measure uses 2000 population from block groups (a Census unit smaller than tracts), with block groups contributing population to the district in proportion to its area contained in the district. We created a small/medium/large designation for the Frost-Kumpf list based on whether 0.1% of the city's area and 0.1% of the city's population are in the district. If an arts district contains over 0.1% of the city area *and* the city population, then the cultural district is defined as "large"; if either share exceeds 0.1%, then it is "medium"; and if neither, then it is "small". The median *population share* is less than 0.1% and the median

area share is 0.16%. Hence, most districts are "small" or "medium". In fact, for the 41 districts from Frost-Kumpf in the 100 largest cities, they are categorized as 11 small, 12 medium, and 18 large.[1]

The Frost-Kumpf cultural districts listed by size category are:

SMALL	LARGE
Louisville KY	Cleveland OH
Albuquerque NM	New Orleans LA
Columbus OH	Detroit MI
Houston TX	Sacramento CA
San Diego CA	Phoenix AZ
Scottsdale AZ	Tucson AZ
Charlotte NC	Baltimore MD
New York NY	Denver CO
Dallas TX	Fort Worth TX
San Jose CA	Saint Paul MN
Austin TX	Minneapolis MN
	Long Beach CA
	Raleigh NC
MEDIUM	Seattle WA
	Rochester NY
Birmingham AL	Oakland CA
Buffalo NY	Portland OR
Tampa FL	St. Louis MO
Pittsburgh PA	
Miami FL	
Newark NJ	
Milwaukee WI	
Philadelphia PA	
Washington DC	
San Francisco CA	
Boston MA	
Kansas City MO	

2. A list of the number of research extensive universities in each city – The R1

[1] In the analysis of the impact of art districts on patenting, the medium variable was split into two: medium cities where the arts district has a large share of the population but a small area (9 cities), and medium cities where the art district has a small population share but a large area (2 cities).

universities used in this study were matched to the list of top 100 largest cities in the United States. Using the Carnegie classification of universities, we created a list of the number of research extensive universities in each city. This definition is drawn using the Carnegie foundation Research I – Doctoral/Research Universities-Extensive definition (Markusen, 1996). Hence, these institutions are referred to in the paper as R1 universities. These institutions typically offer a wide range of baccalaureate programs, they are committed to graduate education through the doctorate, and are often the focus of studies of universities' economic impact and tech transfer. During the period studied, they awarded 50 or more doctoral degrees per year across at least 15 disciplines. This variable is also represented in the analysis in three levels: "few" R1 universities (one), "some" (two or three), and "many" (four or more).

3. A list of art-related degree programs - This list was compiled by examining each city in our list of 100 largest cities and conducting an online search for art and digital media related programs within local universities and art institutes.

4. Employment data from the Current Population Survey - These are matched using the metro area of the respondents. Employment data are drawn from four categories: Arts-related Industries, and Digital Media-related Industries, Arts-related Occupations, and Digital Media-related Occupations. When available in the CPS, for recent years, we count a respondent as employed in one of these categories if their primary or secondary job is coded as such. Since our list of arts districts reflects the establishment of cultural districts in or before 1998, we use 1998 CPS data as the starting point or baseline in this analysis. Our end year depends on data availability. The employment data from the CPS cover as recently as 2011. Employment data taken from the Current Population Survey (CPS) at various years

(always the month of May for any given year) are matched to the city based on the respondents' Metropolitan Statistical Area (MSA) for 1998 and earlier and based on the respondents' Core Based Statistical Area (CBSA) for 2006 and later. This difference is entirely the result of changes in the geography reported in the public-use CPS data files. As geographic areas, MSAs capture the bigger (50,000 people or more) urban areas. CBSAs are based around urban centers of at least 10,000 people and adjacent areas that are socioeconomically tied to the urban center by commuting. Thus, the CBSA captures micropolitan areas and is more inclusive than the match by MSAs. Restricting the sample to the 100 most populous cities renders this distinction of little consequence for matching purposes, but it does imply that city's labor market is defined somewhat differently between 1998 and 2011 here.[2]

5. Patents and media art patents are available from the NBER data base 1989 – 2006 - Patent data (at various points in time) are measured based on whether the patent assignee's address matches that city or not.[3] For patent data, the NBER files only reach 2006. http://www.uspto.gov/web/patents/classification/selectnumwithtitle.htm

Employment definitions

[2] Our unit of observation in this analysis is a "city," although this is somewhat imprecisely defined. As noted, some variables are available only at broader, metropolitan levels (and thus describe more than just within the city limits). This may weaken the observed relationships, but the interdependence of economic development within a metropolitan region suggests that activity in one city might well affect development in a neighboring city. Furthermore, as the definitional change is the same across all treatment groups, emphasizing the difference in trends limits its consequences for the analysis.

[3] For the cities in the sample, a dictionary of alternate and misspelled city names were used in the matching. Inaccuracies are common in the NBER patent database, and our approach to manually create city synonyms for our sample of cities addresses this. Cities like New York has 19 separate spellings (e.g., "N.Y.", "New York City", "New Yotk") while Milwaukee had 13 (e.g., "Mulwaukee" and "Milwaukie").

The broader field of "the arts" and newer fields like digital media do not map particularly well onto the industry and occupation categorizations used in the CPS. Further, classifications of employment responses changed in the CPS over the timespan of the data. For 1998, the analysis uses 11 categories for arts-related industries. It uses 11 categories for digital media-related industries, some of which overlap with arts industries. For 2011, the arts industry codes and digital media industry codes changed in the CPS. Similarly, for occupation codes, several categories were combined for arts occupations and for digital media occupations, some of which overlap, for earlier years of the CPS. Recent years required re-categorizations for arts occupation codes and for digital media occupation codes. See Appendix 1 for details of the coding categories. (The research design here, by measuring arts-related employment as a percent of total employment, should avoid most of the problems associated with the re-categorization, because the re-categorization affects all cities or observations equally and concurrently.)

Patent definitions

Like employment, the field of new digital media does not map well onto existing technology classifications. Digital media-related patents are classified here under digital media according to their description. See Appendix 1 for details on coding categories. When considering which patents relate to digital media, this paper used a wide and inclusive definition.[4]

[4] For patenting classifications, industry codes, and occupation codes, alternate (more restrictive and more expansive) coding was experimented with, and the results do not differ substantially.

Identification approach

The analysis here seeks to measure the impact of cultural districts and R1 universities – analogs to "treatment variables" in this context. We assess their impact on four separate measures for arts employment: two for arts (employment in an arts-related industry and employment in an arts-related occupation) and two for digital media (employment in a digital media-related industry and employment in a digital media-related occupation). Just one, the share of all patents related to digital media-arts, is used for patenting.

One problem with attributing differences in employment and patenting in "treated" cities to these clusters of investment (districts, universities) is that these differences may arise if there is some other force or factor that affects everything in the city, not just digital media employment or digital media innovation. Similarly, a problem arises if it is just a matter of scale, and cities of certain sizes tend to have more or less arts-related innovation or employment. To address this issue, the employment and patenting variables are measured as "shares of overall innovation" or "shares over total employment." In this way, we are interpreting our impacts of districts and universities as impacts on digital media *relative to the local economy as a whole*. This approach implicitly controls for factors like the Great Recession, for example, with are large external shocks that affect the entire local economy. Only if that shock affected digital media innovation or employment disproportionately and that shock was correlated with cities with districts or universities would the results be biased. Similarly, measuring everything in terms of "shares" or percentage of overall employment or patenting controls for scale effects (e.g., innovators disproportionately congregate in bigger cities) because everything is measured relative to non-arts related activity in that city.

Even that might not be enough. A second concern is that the share of arts or digital media activity (e.g., employment, patenting) is correlated with something else unobserved about the city that is also correlated with the location of arts districts or universities there. Not addressing this could bias the results. For instance, a city might have a long history of an active artist community, or it might have long had strong arts departments at local universities. In those cases, high levels of digital media employment or patenting might appear to be due to the presence of an arts district or university when, in fact, it is really due to the latent artistic strength of the town. To mitigate this problem, a first-differenced approach is also taken. Because our "treatment" variables are time-invariant – the presence of districts and universities is constant throughout time in our data – then as a practical matter we can only estimate the impact of districts and universities on the *trends* in employment and innovation. The trends analysis shows how having an arts district or R1 universities alters the trajectory of digital media-related employment and innovation. In a sense, this controls for any (time-invariant) latent, underlying differences across the cities that might affect the level of digital media employment or innovation. Instead, the trends models show how the impact of these local economic development engines has changed over time. If cities with cultural districts, for instance, have seen their digital media employment (as a share of total employment) rise faster than it has in cities lacking arts districts, this approach will identify that effect.

Impacts on digital media employment or patenting that also affect all other employment or patenting will not be detected here; it's only differential effects. And impacts on digital

media employment or patenting that might be due to some intrinsic characteristics of the cities with arts districts (or more universities) will not be detected in the trends analysis – only how the performance of those cities has changed differentially over time relative to cities without arts districts (or universities). Of course, problems remain if (a) there is some other force that happened to affect digital media-related employment or innovation more than other sectors *and* (b) that force's impact changed over time *and* (c) tended to affect cities with cultural districts (or more universities).

Descriptives

Table 1 depicts some descriptive statistics from our sample. While the arts and digital media appear to occupy small shares of overall employment and patenting in the sample, they are not so small as to be undetectable.

Arts and digital media employment by industry and occupation hold a small share of total employment. This is expected and part of a general trends in cities, especially in larger cities. Considering we are using the top 100 cities by population, this is not a surprise. These niches in the labor market range among cities from 0% to 5-7%. Since 1998, those niches have grown and shrunk considerably in those cities – with the standard deviations in trends in employment shares roughly equal to their 1998 means. Moreover, an interesting trend over time is the negative average growth in both the share of employment in arts and digital media industries from 1998 to 2011. When we look at digital media patents we see a small share with a positive average of four patents in 1998 and a growth in total patents of 3.2 from 1998-2006.

The arts districts are presented in the table by the variable "Frost", these are the original cultural district from Frost-Kumpf 1998. As presented in Table 1, there are 41 cultural districts in our sample of top 100 cities. The table presents the categories of cities by size: small, medium, and large and by the number of Research 1 universities. There is considerable variation in the combinations of R1 universities and arts district sizes across cities in the sample. This is evident in the cross-tabulation in Table 2. Another variable is the number of art-related educational programs from a university or and art institute within each city. This is an interesting variable that shows an average of eight programs per city with a maximum of 36 art-related programs. The *R1s* variable is also used as the number of Research 1 universities in the city.

Table 1: Descriptive Statistics

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
ArtsInd98	% employed in Arts industry in '98	97	0.018	0.010	0	0.051
ArtsOcc98	% employed in Arts occupation in '98	97	0.011	0.006	0	0.029
DMInd98	% employed in DM industry in '98	97	0.033	0.014	0	0.069
DMOcc98	% employed in DM occupation in '98	97	0.009	0.005	0	0.034
patpDM98	% of patents in DM in '98	98	0.015	0.021	0	0.105
patsDM98	# DM patents in '98	100	4.120	10.768	0	73
AInd9811	% employed in Arts industry in '11 - % in '98	95	-0.002	0.010	-0.040	0.025
AOcc9811	% employed in Arts occupation in '11 - % in '98	95	0.004	0.008	-0.021	0.033
DMInd9811	% employed in DM industry in '11 -	95	-0.010	0.011	-0.037	0.01

	% in '98					2
DMOcc9811	% employed in DM occupation in '11 - % in '98	95	0.012	0.010	-0.014	0.049
CrossOver9811	change in % employed in (DM occupations in Arts industry or Arts occupations in DM industry) from '98 to '11	95	0.002	0.004	-0.012	0.019
patpDM9806	% of patents in DM in '06 - % in '98	98	0.003	0.026	-0.089	0.077
patsDM9806	# of patents in DM in '06 - # in '98	100	3.190	17.040	-35	145
Frost	1 if city listed in Frost-Kumpf's catalog of cultural districts; 0 otherwise	100	0.410	0.494	0	1
areashare	area of arts district in city / area of city	94	0.002	0.004	0	0.020
popshare	population of arts districts / population of city[a]	94	0.001	0.002	0	0.013
small	1 if 0<areashare<0.001 and 0<popshare>0.001; 0 otherwise[b]	100	0.670	0.473	0	1
medium	1 if areashare>0.001 or popshare>0.001; 0 otherwise	100	0.120	0.327	0	1
large	1 if areashare>0.001 and popshare>0.001; 0 otherwise	100	0.210	0.409	0	1
R1s	Count of R1 univerisities	100	0.730	1.072	0	6
Few	1 if R1s=1; 0 otherwise	100	0.37	0.485	0	1
Some	1 if R1s=(Rushton, 2013); 0 otherwise	100	0.08	0.273	0	1
Many	1 if R1s≥4 ; 0 otherwise	100	0.04	0.197	0	1
schools	count of university arts degree programs in the city	100	8.170	6.409	0	36

[a] District population computed by summing populations from 2000 Census block-groups overlapping districts, weighted by the share of the block group's area contained in district.
[b] District maps for 6 of the Frost-Kumpf districts could not be located. They are coded as "small," as they appeared to minor to even warrant a detailed website as most districts have.
Note: "DM" represents "media arts-related" in this table.

Table 2: Cross-Tabs of "Treatment" Variables

	District Size				
R1 Size	**none**	**small**	**medium**	**large**	**Total**
none	40	3	3	5	51
Few	17	6	3	11	37
Some	1	1	4	2	8
Many	1	1	2	0	4
Total	59	11	12	18	100

Table 2 presents the count of cities in each of the district and R1 size combinations. Interestingly, there are no cities with large districts that also have many Research 1 universities. The majority of our observations, 40, have no cultural districts and no Research 1 universities. That said, the rest of the categories have some level of representation with many variations.

Research Findings

Employment

This section reviews the effect of arts districts and R1 universities on art and digital media employment. We start our analysis with the share of total employment for arts and digital media jobs, followed by the effects of R1 universities on arts and digital media employment. Overall, arts districts have some impact on art and digital media employment while research universities do not. The small values in tables 3 and 4 actually represent rather sizable impacts given the small baseline levels of these employment measures. Of course, some values are substantively small and represent statistically insignificant differences. But many of the small numbers represent substantive effects for this sector relative to the small size of its niche to start.

Table 3: Arts districts Impact on Employment

Districts	**No**	**Small**	**Medium**	**Large**	**Any**	
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**sig.**
ArtsInd98	0.018	0.018	0.016	0.020	0.018	
ArtsOcc98	0.010	0.010	0.013	0.013	0.011	
MAInd98	0.030	0.034	0.035	0.041	0.036	*
MAOcc98	0.009	0.009	0.012	0.012	0.010	
AInd9811	-0.003	-0.001	0.001	0.003	0.0002	
AOcc9811	0.004	0.004	0.001	0.004	0.003	
MInd9811	-0.010	-0.010	-0.008	-0.008	-0.009	
MOcc9811	0.011	0.014	0.014	0.015	0.014	*
CrossOver9811	0.002	0.003	0.003	0.003	0.003	

[a] *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 3 compares employment shares and trends in cities with arts districts by size including cities with no districts. The first four rows indicate the share of employment in arts and digital media industry and occupations in 1998. 1998 is considered the starting year ,because this is the year of the (Frost-Kumpf, 1998) district inventory. Hence, it is not surprising to see that the lack of an arts district or its size do not have a significant effect on employment. The difference can only be noticed in the largest districts on digital media industry. This result can reflect the nature of digital media industry and its rate of development. This is a fast growing industry, which is effected by resources in the form of research and talent. Hence, even though arts districts were just established, the larger ones have a larger effect on a fast developing industry.

Examining employment trends between 1998 and 2011, we find a small positive growth in arts industry jobs in cities with districts. The difference between having large arts districts and no arts districts in terms of arts industry employment growth is a difference between

growing to a 1.9% share and falling to a 1.5% share (from a baseline of 1.8%). Given the variation in employment trends, however, this difference is not statistically significant.[5] Interestingly, when we look at the digital media industry, we find a decline all over. However, in cities with districts the analysis shows a smaller decline, emphasizing the positive impact of arts districts. Cities' performance in creating more media arts-related employment improves with larger arts districts, such that the difference is even statistically significant ($p<0.08$) for digital media occupations. This is especially interesting in light of arts districts' lackluster performance with respect to arts-related industries and occupations.

Table 4: Research 1 Universities' Impact on Employment

R1s	No	Few	Some	Many	Any	
Variable	Mean	Mean	Mean	Mean	Mean	sig.[a]
ArtsInd98	0.018	0.019	0.018	0.016	0.019	
ArtsOcc98	0.011	0.010	0.010	0.016	0.011	
DMInd98	0.032	0.033	0.032	0.040	0.033	
DMOcc98	0.010	0.008	0.008	0.016	0.009	
AInd9811	-0.002	-0.001	-0.001	0.006	-0.001	
AOcc9811	0.004	0.004	0.004	0.004	0.004	
DMInd9811	-0.010	-0.010	-0.008	-0.009	-0.010	
DMOcc9811	0.013	0.012	0.011	0.011	0.011	
CrossOver9811	0.002	0.003	0.001	0.003	0.003	

[a] *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4 presents the share and trend of jobs in arts and digital media in cities with different number of Research 1 universities. The first four rows provide a snapshot of the patenting level and number in 1998. When we review the table we find no statistically significant differences in arts-related employment, regardless of whether the city has no, few, some, or many Research 1's. One possible exception can be seen in row *Aind9811* in Table 4. Many

[5] If the district size variable is treated as a continuous variable, ranging from 0 (no district) to 3 (large district), this variable is positively correlated with *AInd9811* with r=0.20 (and a p-value<0.06).

R1 universities in one city (more than three) contribute to an increase in arts-related employment. With only four such cities, however, the p-value for the t-test of different average trends between cities with many R1s and cities with no R1s is just under 0.2. Statistically significant relationships are elusive in Table 4. The seeming ineffectiveness of extensive research and research funding in one city can be accounted for in the "employment share" nature of the measurement. Concentrating considerable investments via R1s will have a multiplier effect on any employment, not just arts- and digital media-related employment (Stephan, 2012).

These results are not surprising as Research 1 universities do not focus specifically on arts or digital media. It does however raise a question regarding the employment impact of arts and digital media-related education. Interestingly, the correlation between the number of art schools and programs (*schools*) and growth in arts-industry employment (*AInd9811*) is positive (0.17) and significant at the 10% level. The correlation between arts schools and the "crossover" measure of arts- and digital-media job growth (*CrossOver9811*) is even stronger at 0.22 (p=0.35). Moreover, the number of art schools and Research 1 universities in the city have a strong correlation of 0.68 (p-value<0.00001). Thus, the presence and impact on art industry employment is connected to art education.

Innovation and Patents

This section analyzes the impact of R1 universities and arts districts on digital media patents. The analysis focuses on the impact of arts districts and universities on the ability of cities to patent digital media innovations by share and by total numbers.

As can be seen from Table 5 below, districts are associated with a faster growth in digital media-related patenting. This is all the more remarkable when we consider that these cities had similar starting points as non-district cities in terms of the share of patenting in digital media-related classes.

Table 5: The Impact of Arts Districts on Digital Media Innovations

Districts	**No**	**Small**	**Medium >% city area and <% pop**	**Medium <% city area and >% pop**	**Large**	**Any**	
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**sig.[a]**
patpDM98	0.012	0.017	0.023	0.264	0.012	0.018	
patsDM98	1.576	8.095	15.00	2.777	10.444	7.780	***
patpDM9806	-0.003	0.014	0.017	-0.009	0.021	0.010	**
patsDM9806	0.085	12.810	2.500	-0.444	4.889	7.659	**

[a] *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

When we examine the share of digital media patenting by the size of the arts district we find that in 1998 there was hardly a difference whether a city had an arts district or not. This is not surprising considering many arts districts were newly created in 1998. Table 5 also shows that major cities with arts districts patent more overall than other major cities, and that this implies a great number of digital media-related patents in a 1998. But, again, their share for digital media patenting in 1998 was no different among cities without or with arts districts. However, the impact of arts district can be seen in the astounding growth in the share of digital media patents from 1998 to 2006. Here we find that the difference between cities with arts districts and cities without arts districts is statistically significant. On average, cities

with arts districts had a strong, positive growth in digital media-related patenting rates, compared to a small and negative growth in non-district cities.

Moreover, when we examine the share of digital media patents of the total patents, we find that the share increases with larger districts as measured by their share of the total population of the city in the district.[6] Hence, the more people live in a designated arts district, the more the district has an impact on the rise of digital media-related innovation.

Table 6: The Impact of Research 1 Universities on Digital Media Innovations

Districts	**No**	**Few**	**Some**	**Many**	**Any**	
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**sig.[a]**
patpDM98	0.012	0.015	0.016	0.020	0.016	
patsDM98	1.320	4.000	4.250	12.300	5.192	**
patpDM9806	-0.001	0.004	0.004	0.007	0.004	
patsDM9806	-0.400	4.213	9.938	-2.800	4.507	

[a] *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

On average, the number of Research 1 universities in a city positively impacts digital media patenting. As with employment, however, the number of R1s in a city better explains greater innovation in general with no bias in favor of greater or increasing shares of patenting in digital media patent classes. While it appears that the share of patenting for digital media classes is growing faster in cities with more R1s than in cities lacking R1s, there are large variances around the means in each of these categories. This limits any strong conclusions about a positive impact of R1s on digital media innovation through patents. The science and technology literature provides a basic explanation to these results, i.e. there are only a few

[6] For this category, the *areashare* of the arts district does not make a difference.

universities which patent the majority of inventions (Geuna and Nesta, 2006, Jaffe and Lerner, 2004, Mowery and Sampat, 2001b). The means, thus, can appear skewed by a few influential R1s, but generalizing to all R1s or cities is not warranted. In addition, these results strengthen our argument that universities help with patenting in general rather than "playing favorites" for digital media.[7]

Discussion and Conclusions

Overall, in this simple model, arts districts have a stronger effect than Research 1 universities on art and digital media related employment and innovation in major US cities. R1 universities in the urban area have little effects on arts and digital media-related patenting and employment. If at all, the positive impact of R1 universities is only evident in arts industry employment growth and not in digital media. These results, together with correlations between art programs and Research 1 universities, raise the question whether this effect is the outcome of the city size and the general resources for education and research. Yet locally concentrated investment in the form of cultural districts does appear to have a modest effect on digital media-related employment growth. Specifically for employment, arts district have a positive effect on both arts and digital media employment. This suggests that a intensive effort might have a focused employment effect.

With respect to patenting, the story is clearer: arts districts promote more digital media patenting, whereas the number of R1 universities in the city positively impacts digital media patenting. For innovation through digital media-related patenting, the presence and size of

[7] Our data on art schools and programs in the city is available only in 2011. Since our patent data ends in 2006, we cannot review the impact of these programs on patenting and patenting trends.

arts districts in a city exhibited a strong positive association with trends in patenting intensity. The arts district impact is strong and statistically significant, while the impact of R1 universities seems to be more general.

Hence, arts districts present important resources for arts-related employment and innovation. Research universities continue to show a general support for local economies, but not specific to arts or digital media. These results strengthen studies regarding the role of culture and universities in economic growth. The Innovation growth in digital media with the growth in the percentage of the city population within the arts district indicates the importance of knowledge transfer. These results support economic geography and cluster studies relating to the importance for innovation in the proximity to knowledge source.

The employment trends observed here arise from the interplay of demand and supply forces in the labor market. At issue in this analysis, in a sense, is whether the equilibrium employment intensity in digital media-related jobs can be shifted through relatively greater localized investment in arts districts or research institutions. We might expect districts and universities to affect both labor demand and supply for arts- and digital media-related workers. Firms starting up in or relocating to these local "centers" will be expected to increase the demand for specialized labor. Moreover, universities increase the supply of labor with particular skillsets, and arts districts may do likewise through far less formalized learning processes. Outward shifts in both labor supply and demand predict an increase in

equilibrium employment level.[8] While theory suggests we observe this in cities with more investment centers like arts districts or universities, the more narrow focus of this investigation – impacts on arts- and digital media-related jobs – highlights the specialization aspect of these local economic development engines. However they promote local economic development, universities do not appear to differentially favor faster growth in digital media-related employment. Arts districts, on the other hand, may fare better at targeting their supply and demand shocks in this specialized "creative industry".

Arts districts' targeted impact on the market for innovations is even stronger than its impact on labor markets. Digital media innovation flourishes around arts districts, likely due to a combination of attracting a more creative talent pool and greater demands for innovative products to serve the district. Both the increased supply of innovators and the demand for innovation finds a common ground in digital media technologies as artists seek novel and commercializable production forms and digital media producers tap into artistic talent for content for their new technologies. Universities seem to foster innovation with no favoritism to digital media.

Previous studies in regional economics, economic geography, and technology transfer all discuss the impact of knowledge spillovers (Camagni, 1991, Feldman, 1994, Jaffe et al., 1993, Nelson, 1993, Nelson and Nelson, 2002). Particularly, studies on innovation view the importance of local actors, and especially the network of actors in creating a milieu of

[8] Of course, other effects might result, too. Universities might drive up wages or other input prices, possibly reducing labor demanded. Arts districts might do likewise, or they might specialize in art forms with little or no overlap with digital media technologies.

specialized knowledge. Hence, in this case the spillovers from the arts districts have a direct impact on innovation and specialization.

These results also conform to cultural studies literature and indicate that culture has a direct positive connection to economic development (Rushton, 2013). Hence, art and culture impacts economic growth both directly through employment and also indirectly through innovation.

Future Work

Future work should include several extensions of this preliminary investigation. First, richer measures of cultural clusters beyond the inventory of cultural districts should be explored. This includes controlling for the age, size, and nature of the cultural districts as well as using Strom's (2002) inventory of 71 major cultural facilities being built or renovated between 1985-2005. Better employment and patent data, covering more years and more refined spatial indicators, could help address some of the current limitations. A qualitative investigation of the top- and bottom-performing cities in terms of digital media employment and innovation would greatly enhance the exploration of the relationships between universities, cultural districts, and the arts and digital media sectors. This could be complemented with data allowing migratory flows to be tracked to assess how (or if) firms and workers are drawn to which sort of local cluster, and the extent to which these localized investments enhance or simply rearrange human capital.

References

BRAMWELL, A. & WOLFE, D. A. 2008. Universities and Regional Economic Development: The Entreprenurial University of Waterloo. *Research Policy,* 37**,** 1175-1187.

BREZNITZ, S. M. & FELDMAN, M. P. 2012a. The Engaged University. *The Journal of Technology Transfer,* 37**,** 139-157.

BREZNITZ, S. M. & FELDMAN, M. P. 2012b. The Larger Role of the University in Economic Development Introduction to the Special issue. *Journal of Technology Transfer,* 37**,** 135-138.

CAMAGNI, R. 1991. Local 'milieu' uncertainty and innovation networks: Towards a new dynamic theory of economic space. *In:* R. CAMAGNI (ed.) *Innovation Networks: Spatial Perspectives.* London: Belhaven.

CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING. 2012. *1994 Edition Data File* [Online]. Available: http://classifications.carnegiefoundation.org/resources/ 2012].

DI GREGORIO, D. & SHANE, S. 2003. Why do some universities generate more start-ups than others? *Research Policy,* 32**,** 209-227.

EATON, S. C. & BAILYN, L. 1999. Work and life strategies of professionals in biotechnology firms. *Annalas. American Academy of Political and Social Science,* 562:**,** 159-173.

ETZKOWITZ, H. & LEYDESDORFF, L. 1997. *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations,* London, UK, Pinter.

FELDMAN, M. P. 1994. *The Geography of innovation,* Kluwer Academic Publishers.

FELDMAN, M. P. & BREZNITZ, S. M. 2009. The American Experience in University Technology Transfer. *In:* MCKELVEY, M. & HOLMÉN, M. (eds.) *European Universities Learning to Compete: From Social Institutions to Knowledge Business.* Edward Elgar.

FLORIDA, R. 2002. *The Rise of the Creative Class,* New York, NY, Basic Books.

FORRANT, R., PYLE, J., LAZONICK, W. & LEVENSTEIN, C. (eds.) 2001. *Approaches to Sustainable Regional Development: The Public University in the Regional Economy*: University of Massachusetts.

FROST-KUMPF, H. A. 1998. Cultural Districts: The Arts As a Strategy for Revitalizing Our Cities. Washington DC: Americans for the Arts.

GEUNA, A. & NESTA, L. J. J. 2006. University patenting and its effects on academic research: the emerging European evidence. *Research Policy,* 35**,** 790-807.

GODDARRD, J. & CHATTERTON, P. 1999. Regional development agencies and the knowledge economy: Harnessing the potential of universities. *Environment and Planning C: Government and Policy,* 17:**,** 685-699.

INFOPLEASE ATLAS. 2000-2007. *Connecticut Maps and Online Resources*. Pearson Education, publishing as Infoplease.

JAFFE, A. B. & LERNER, J. 2004. *Innovation and its Discontents: How Our Broken Patent System is Endangering Innovation and Progress, and What To Do About It,* Princeton, New Jersey, Princeton University Press.

JAFFE, A. B., TRAJTENBERG, M. & HENDERSON, R. 1993. Geographic localization of knowledge spillovers as evidenced by patent citations. *The Quarterly Journal of Economics,* 108**,** 577-598.
KENNEY, M. & PATTON, D. 2009. Reconsidering the Bayh-Dole Act and the Current University Invention Ownership Model. *Research Policy,* 38**,** 1407-1422.
LADRY, C., BIANCHINI, F., EBERT, R., GNAD, F. & KUNZMAN, K. 1996. The Creative City in Britain and Germany.
LAWTON SMITH, H. 2000. *Technology Transfer and Industrial Change in Europe,* Macmillan
LERNER, J. 2004. The University and the Start-Up:Lessons from the Past Two Decades. *The Journal of Technology Transfer,* 30**,** 49-56.
LINK, A. & SIEGEL, D. 2005. Generating science-based growth: an econometric analysis of the impact of organizational incentives on university-industry technology transfer. *European Journal of Finance,* 11**,** 169-181.
MARKMAN, G. D., GIANIODIS, P. T., PHAN, P. H. & BALKIN, D. B. 2005. Innovation speed: Transferring university technology to market. *Research Policy,* 34**,** 1058-1075.
MARKUSEN, A. 1996. Sticky places in slippery space: A typology of industrial districts. *Economic Geography,* 72**,** 293-313.
MAURRASSE, D. J. 2001. *Beyond the campus : how colleges and universities form partnerships with their communities,* New York, Routledge.
MINSHALL, T., DRUILHE, C. & PROBERT, D. 2004. The evolution of "Third Mission" activities at the university of Cambridge: Balancing strategic and operational considerations. *12th High Tech Small Firms Conference.* University of Twente, The Netherlands: University of Twente.
MOWERY, D., ROSENBERG, R. R., SAMPAT, B. N. & ZIEDONIS, A. A. 1999. The Effects of the Bayh-Dole Act on U.S. University Research and Technology Transfer. *In:* BRANSCOMB, L. M., KODAMA, F. & FLORIDA, R. L. (eds.) *Industrializing knowledge : university-industry linkages in Japan and the United States*
Cambridge, Mass.: MIT Press.
MOWERY, D. C. & SAMPAT, B. N. 2001b. University patents and patent policy debates in the USA, 1925-1980. *Industrial & Corporate Change,* 10**,** 781-814.
NELSEN, L. 2003. The Role of University technology Transfer Operations in Assuring Access to Medicines and Vaccines in developing Countries. *Yale Journal of Health, policy, Law, and Ethics,* III**,** 301-308.
NELSON, R. R. 1993. *National Innovation Systems: A Comparative Analysis,* New York, Oxford University Press.
NELSON, R. R. & NELSON, K. 2002. Technology, institutions, and innovation systems. *Research Policy,* 31**,** 265-272.
OWEN-SMITH, J. & POWELL, W. 2001. To Patent or Not: Faculty Decisions and Institutional Success in Academic Patenting. *Journal of Technology Transfer* 26**,** 99-114.
RAHM, D., KIRKLAND, J. & BOZEMAN, B. 2000. *University-industry R & D Collaboration in the United States, the United Kingdom, and Japan,* Dordrecht, The Netherlands, Kluwer Academic Publishers.
ROSENBERG, D. 2001. *Cloning Silicon Valley: The next generation high-tech hotspots,* London, Financial Times/Prentice Hall.

RUSHTON, M. (ed.) 2013. *Creative Communities: Art Works in Economic Development,* Washington DC: Brookings Institution Press.
SAMPAT, B. N. 2006. Patenting and US academic research in the 20th century: The world before and after Bayh-Dole. *Research Policy,* 35**,** 772-789.
SCOTT, P. 1977. *What Future for Higher Education,* London, Fabian Tracts.
SIEGEL, D. S., WALDMAN, D. & LINK, A. 2003. Improving the effectiveness of commercial knowledge transfers from universities to firms. *Journal of High Technology Management Research,* 14**,** 111-133.
SIEGEL, D. S., WALDMAN, D. A., ATWATER, L. E. & LINK, A. N. 2004. Toward a model of the effective transfer of scientific knowledge from academicians to practitioners: qualitative evidence from the commercialization of university technologies. *Journal of Engineering and Technology Management,* 21**,** 115-142.
STEPHAN, P. 2012. *How Economic Shapes Science,* USA, Harvard University Press.
STROM, E. 2002. Convertin Pork into Porcelain: Cultural Institutions and Downtown Development. *Urban Affairs Review,* 38.
THURSBY, J. G., JENSEN, R. & THURSBY, M. C. 2001. Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities. *The Journal of Technology Transfer,* 26**,** 59-72.
TOMUSK, V. 2011. The Micropolitics of Knowledge in England and Europe. *In:* RHOTEN, D. & CALHOUN, C. (eds.) *Knowledge Matters: The Public Mission of the Research University.* New York: Columbia University Press.