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Music in the air: estimating the social return to cultural amenities

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Abstract If being around smart people makes us smarter and more productive, what can regions do to attract smart people? This paper considers endogenous cultural amenities as a location factor for high-skilled workers. To overcome selection in the provision of cultural amenities, we exploit variation in contemporaneous cultural amenities that is explained by the path-dependence of historical agglomerations of the cultural activities. To assess spillovers from high-skilled

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workers attracted by cultural amenities, we use a 1% sample drawn from the population of all West German workers under social security during the period 1975–2010. This panel of individual observations allows us to compare wages of similar individuals who work in locations with different levels of high-skilled workers who are attracted by cultural amenities. To account for non-random selection of workers among cities, we use individual-location fixed effects. Our results show that cultural amenities are an important factor in the location decision of high-skilled workers. The positive effect of the local share of high-skilled workers on unskilled, skilled and high-skilled wages indicates strong and productive spillovers.

Keywords High-skilled workers · Location factor · Productive spillovers · Cultural amenities

JEL Classification R23 · J30 · I26 · H41

1 Introduction

It is well accepted that being around smart people makes us smarter and more innovative (cf. Lucas 1988). By clustering geographically, innovators can foster each other's creative spirit, learn from each other and become overall more productive.¹ This implies that once a city attracts some innovative workers and companies, its economy may change in ways that make it even more attractive to other innovators. This multiplier effect is one explanation for self-enforcing agglomeration economies. From a policy perspective, there are two approaches to attract innovative workers that may jump start self-enforcing agglomeration economies. *Demand-side approaches* aim at attracting firms by direct or indirect subsidies with the hope that workers will follow (“people follow jobs”). *Supply-side approaches* pursue the reverse direction and focus on attracting workers with consumption amenities that contribute to the city's quality of life, with the hope that firms will follow (“jobs follow people”). While there is an increasing literature on place-based policies for firms, we know comparatively little about place-based policies for workers.² However, Moretti (2012) expresses doubts about the effectiveness of supply-side policies and references the example of Berlin, a city that managed to become the world's coolest city with only one problem: there are not enough jobs.

This paper analyses how differences in the local supply of cultural amenities affect the share of high-skilled workers who generate productive spillovers that benefit other individuals in the same local labor market. We use a 36-year panel of individual wage data from the German social insurance records. The data allow us to distinguish low, medium- and high-skilled workers who are nested in 325 West German districts (NUTS-3 regions) and we exploit the panel structure of our data to

¹ For a recent summary of this extensive literature, see Carlino and Kerr (2014).

² See Neumark and Simpson (2014) for an extensive overview of place-based policies.

absorb individual characteristics as potential drivers of non-random selection of workers among locations (Combes et al. 2008; Glaeser and Mare 2001).

The main challenge relates to a chicken-and-egg problem: Does the existence of amenities attract high-skilled workers or does the supply of cultural amenities follow high-skilled workers, spurred by their willingness and ability to pay for such amenities (Diamond 2016; Shapiro 2006). To solve this endogeneity, we draw on a quasi-natural experiment in German history to explain the emergence of historical agglomerations of cultural activities which remained highly persistent until today. This path-dependence leaves us with a historically determined shifter of the regional share of high-skilled workers who value the cultural scene.

Our results suggest that high-skilled workers are attracted by cultural amenities and all skill groups in a location benefit from the agglomeration of high-skilled workers. In our preferred specification, a 1% point increase in the share of high-skilled workers causes low-skilled workers' wages to increase by 1.4%; skilled workers' wages increase by 1.6%; and high-skilled workers enjoy 1.1% higher wages. This finding is in line with survey evidence for Germany. The McKinsey survey *Perspektive Deutschland* finds that high-skilled movers name "cultural offerings and an interesting cultural scene" among the top five reasons (out of 15 possible reasons) for their location choice (cf. Buettner and Janeba 2016).

Our paper contributes to a stream of literature in public economics discussing whether cultural amenities like theaters or opera houses should be considered public goods that are financed by tax-payers' money. One of the first and most prominent arguments in support of the public aspect of cultural goods is developed in Baumol and Bowen (1966), who assign an existence value to cultural amenities that even matters to those individuals who never intend to actually use the amenity (see also Throsby 1994). They argue that cultural amenities benefit the community as a whole, justifying thus the provision of public money. Our results provide empirical evidence for this argument. Our findings further connect to an established literature on the effects of amenities and quality of life on the spatial distribution of economic activities starting with Rosen (1979) and Roback (1982). Kahn and Walsh (2015) provide a comprehensive overview of this literature. Finally, our analysis relates to a strand of literature that examines spillovers from high-skilled workers (cf. Moretti 2004, Glaeser and Mare 2001).

In the following, Sect. 2 will provide a more detailed discussion of the historic argument underlying our instrument. Section 3 lays out the empirical strategy, and Sect. 4 introduces our data. We present our results in Sect. 5 and discuss their robustness in Sect. 5. Finally, Sect. 6 concludes with policy implications and an outlook to future research.

2 Historical agglomerations of the cultural activities in Germany

The Peace of Westphalia ended the 30 years' War in the Holy Roman Empire of the German Nation in 1648. Part of the treaty was a concept of coexisting sovereign states. As a result, we observe a heavily fragmented political landscape with numerous kingdoms, princedoms and dukedoms that continued to exist until the

German Empire was established in the second half of the nineteenth century. During this period, many of the local rulers competed for prestige and aimed at imitating the French court. As a result, they spent enormous amounts of money to make their local courts glamorous. With musical performances becoming more and more popular at many local courts in fragmented Germany, competition for composers of music started increasing and made the region an attractive place for musicians (Elias 1993). The increased demand for musicians and musical innovations is reflected in a large number of famous composers of the baroque era who came from politically fragmented areas in Germany or equally fragmented areas in Italy (Scherer 2001; Vaubel 2005).³

An opera performance at court was a particularly glamorous and prestigious spectacle that was supposed to demonstrate the glory and the power of the ruler. Such performances were single events that normally took place in the court's premises with admission restricted to the members of the court and some invited nobles (Raynor 1972).⁴ Since they have in no way been part of everyday life they cannot be considered as early cultural concentrations that could predict today's distribution of cultural amenities. In some places, however, the rulers' enthusiasm for operas became so strong that they constructed a special opera house. This was a significant commitment to the musical arts, involving the permanent maintenance of an orchestra and singers, stage designers, costume designers, and so forth. With a dedicated opera house, performances were no longer single events for a restricted audience but became regular and much more frequent—one could rent a seat for the season—and they were opened to the general public spreading this type of artistic culture among the population. Only a part of the people involved in opera performances—often singers and musicians—had a contract for a longer period of time that was not always well paid. Many contributions were made on a freelance basis often as a supplement to one's regular occupation (e.g., architects as stage designers).⁵ Many of the professional artists, particularly those who worked more or less on a freelance basis, developed all kinds of cultural activities in order to earn additional income to support their living. In this way, singers and musicians often spread their abilities as music teachers. As a result, the presence of a stand-alone opera house in the baroque era marked the nucleus of a wide range of cultural activities in the respective location.

These findings suggest that the initial stimulus for building opera houses in the baroque period resulted from the cultural competition between kings, dukes, and princes at a time when strategic marriages and war alliances instead of economic factors determined regional prosperity. Of course, one could argue that the funds needed to build a prestigious opera house did not just magically appear but must have been, at least to some degree, based in the region's economic status. However, as discussed by Duchhardt (2007) and Vierhaus (1984), the theory that you can only

³ Among these composers were Johann Sebastian Bach, Georg Friedrich Handel, Georg Philipp Telemann, Joseph Haydn, Christoph Willibald Gluck, Ludwig van Beethoven, Wolfgang Amadeus Mozart, and Antonio Vivaldi.

⁴ Helm (1960) gives a detailed description of such events at the courts of Frederik the Great in Berlin and Potsdam.

⁵ Generally, the members of the choir were amateurs coming from all kinds of professions.

spend what you have was not a popular one among the absolutistic rulers of this era. Indeed, it was not uncommon for rulers to incur huge debts and engage in deficit spending in their quest for grandeur. Furthermore, it was general practice to sell subjects as mercenaries to foreign sovereigns in order to improve public finances (Loewenstein 2001).

Figure 1 maps the locations of the 29 stand-alone opera houses in Germany built before 1800 (cf. Falck et al. 2011). Interestingly, all of these opera houses still operate today, some of those were destroyed by fires or during war times having been rebuilt afterward. The map clearly shows that the baroque opera houses were not located solely in today's big cities such as Berlin, Munich, or Hamburg, but also in several smaller towns such as Bautzen, Neustrelitz, Weimar, Passau, or Stralsund. Many of these smaller courts were petty principedoms that could hardly afford expensive opera performances but nevertheless committed themselves to this type of artistic culture.⁶ These cases clearly demonstrate that setting up an opera house at that time was rather independent of economic wealth. Instead, it was driven by baroque ruler's idiosyncratic preferences.

Under the assumption of agglomeration economies in the production of cultural goods, we would expect historical agglomerations of cultural activities to be highly path-dependent. In support of this assumption, Table 1, Panel A, shows a simple comparison of cultural activities in locations with a baroque opera house and locations with an opera house that was built after the baroque era. Overall, we observe 92 opera houses today in Germany, 29 of which can be traced back to the baroque era (cf. Zöchling 1983). To measure cultural activities, we exploit detailed information from social insurance records and a special social insurance for freelance artists (cf. Haak 2005), and calculate the number of artists per 1000 inhabitants on the German district level as an average over the years 2002–2007. Together, these two data sources allow us to draw a comprehensive picture of locations' cultural amenities today, which, among other things, led us to observe significantly higher shares of artists in baroque opera house locations. Interestingly, these differences are not restricted to those types of artists that are typically employed in opera houses, such as singers and musicians. They include a wide range of artists and thus truly support our argument that baroque opera houses initiated a diverse cultural scene that is still present today. Further support for our argument is provided in the last row of Table 1, where we exploit information from the 1907 census (Statistik des Deutschen Reichs 1909a, b). Here, we find information on the number of workers engaged in creative businesses. Using these data, we compare the employment share of artists in 1907 across the same two types of locations. Again, we find a significantly higher share of artists in baroque opera house locations, thus underlining the time persistence of these early cultural concentrations.

We finally compare public expenditure for different categories between baroque opera house locations and other opera house locations. If our argument was true, we

⁶ Fischer-Dieskau (2006) gives a lively and detailed description of the development of opera performances around 1800 in the city of Weimar. At that time, Weimar was the small capital of the rather poor and petty dukedom of Saxe-Weimar that, however, became one of the leading centers for arts in nineteenth century Germany.



Fig. 1 Locations of baroque opera houses in Germany. *Notes:* The map shows the 29 baroque opera house locations in Germany

should indeed see differences between public expenditure for culture but not for other categories. Table 1, Panel B, shows public expenditure in 2004 for the categories “Theater, Concerts and Cultivation of Music,” “Sports Facilities,

Table 1 Comparison between baroque opera house locations and other opera house location

	Baroque opera house location	Other opera house location	Difference (1)–(2) [<i>p</i> value]
Panel A: Artists per 1000 inhabitants 2002–2007 or 1907			
Freelance artists, writing	2.639 (0.481)	1.660 (0.226)	0.979 [0.019]
Freelance artists, acting	1.181 (0.178)	0.748 (0.088)	0.433 [0.008]
Freelance artists, music	2.802 (0.288)	1.826 (0.165)	0.976 [0.001]
Freelance artists, graphic arts	3.846 (0.484)	2.457 (0.275)	1.389 [0.005]
Freelance artists, all	10.468 (1.334)	6.691 (0.699)	3.777 [0.004]
Employed artists subject to social insurance	6.697 (0.586)	5.074 (0.438)	1.623 [0.018]
Artists in 1907	2.389 (0.561)	1.573 (0.253)	0.816 [0.065]
Panel B: Public spending in Euro per inhabitant, 2004			
Theater, concerts and cultivation of music	100.19 (12.05)	69.47 (6.50)	30.72 [0.008]
Sports facilities, swimming pools, and other recreational facilities	46.12 (3.57)	48.48 (2.97)	– 2.36 [0.681]
Popular education	19.47 (2.50)	21.04 (1.55)	– 1.57 [0.708]
Number of observations	29	63	–

The table shows means and standard errors for different measures of local artists per 1000 inhabitants (Panel A) and public spending in Euro on amenities (Panel B) in 29 baroque opera house locations (column 1) and 63 locations where the opera house was built after the baroque era (column 2). Column 3 shows the difference (diff) between column 1 and column 2 along with the *p* value of H_0 : diff < 0. The share of artists in 1907 is measured per 1000 workers

Swimming Pools, and other Recreational Facilities,” and “Popular Education.”⁷ In line with our expectations, we see a significant difference for the category “Theater, Concerts, and Cultivation of Music,” but not for the other categories.

3 Empirical strategy

Our empirical strategy is based on a simple theoretical framework outlined in Moretti (2004). The spatial equilibrium approach considers two representative locations, *A* and *B*, and two types of workers, low-skilled and high-skilled. If

⁷ The underlying data were supplied by the statistical offices of the German states. They are part of a report on the 2004 municipal budgets.

location A increases its spending on cultural amenities and thus becomes more attractive for high-skilled workers, the relative share of high-skilled workers increases in location A. Standard demand and supply considerations suggest that an increasing supply of high-skilled workers has a negative effect on high-skilled workers' wages, while unskilled workers' wages increase if we assume complementarity between high- and low-skilled workers. If we additionally allow for productive spillovers from high-skilled workers, we still expect a strictly positive effect on low-skilled workers' wages. For high-skilled workers, the direction of the effect depends on the strength of the spillover; if spillovers overcompensate the negative supply effect, we would observe a wage increase, otherwise a decrease. In equilibrium, workers are indifferent between location A and B, since higher rents in the relatively more attractive location A will equalize *real wages*. The higher real wage earned in location B thus acts as compensating differential for the lower level of amenities. Any observed differences in *nominal wages* point to productivity advantages that firms must obtain to offset paying higher wages. Without productivity gains, producers of tradable goods would relocate to locations with lower wages. This condition holds as long as every location hosts some firms producing traded goods and as long as workers are free to move between tradable and non-tradable sectors (Moretti 2012).

Since we are interested in productive spillovers from high-skilled workers that value cultural amenities, we have to look at nominal wage differences across locations with different shares of high-skilled workers. Specifically, in our empirical model, we extend the specification in Moretti (2004) and estimate individual wage regressions for *three* skill levels (high, medium, low). For a given skill group the wage regression is of the form:

$$\ln(w_{ilt}) = \beta_1 hs_{lt} + X'_{it}\beta_{2s} + X'_{it}\beta_3 + \alpha_{li} + \alpha_t + \varepsilon_{ilt} \quad (1)$$

where $\ln(w_{ilt})$ is the natural logarithm of the nominal wage of individual i with a given skill level working in location l at time t . The coefficient of interest is β_1 , the effect of the share of high-skilled workers (hs_{lt}) on the skill group's wages. X_{it} is a vector of time-variant individual controls including nationality (since workers may become German over time), experience, experience², industry or occupation controls, and interactions between experience/experience² and gender/nationality as suggested in Beaudry et al. (2012). X_{lt} are time-variant location characteristics that may be correlated with hs_{lt} and the dependent variable. Specifically, we include log population to account for general agglomeration effects and the labor force participation rate as proxy for changes in labor demand. α_{li} is a set of individual-location fixed effects, which implies that identification of the coefficient of interest does not come from movers but from stayers who experience different shares of high-skilled workers over time. Finally, α_t is a set of year dummies for 1975–2010 which capture such factors as wage increases compensating for inflation. ε_{ilt} is an error term clustered on the individual-location level.

To focus on the effect of high-skilled workers who are attracted by cultural amenities, we introduce a first-stage relationship that links the location's share of high-skilled workers to the exogenous spatial distribution of baroque opera houses.

Strictly speaking, this is a reduced form of two stages: The first stage relates today’s local cultural amenities to the exogenous emergence of a baroque opera house in the past; the second stage relates access to today’s cultural amenities to the local share of high-skilled workers.

In this reduced form specification, we cannot rule out that high-skilled workers are attracted by the *built heritage* (Backman and Nilsson 2016) of a baroque opera house (and the historic city center) and not the historical agglomeration of cultural activities that is present at baroque opera locations. However, the descriptive statistics in Table 1 show that baroque opera house locations are home to a rich cultural scene today *and* the same is true for 1907. We cautiously interpret this persistence as evidence in support of our argument that baroque opera houses stimulated the agglomeration of cultural activities. In unreported robustness tests (for details, we refer to Falck et al. 2015a), we further show that conditioning our regressions on the existence of monasteries—one specific type of built heritage—does not change our results. In summary, this makes us confident that the effect of baroque opera houses on high-skilled workers mainly works through the agglomeration of cultural activities today.

Since the effect of cultural amenities like an opera house is not restricted to a location itself but may also benefit surrounding locations, we use the minimum distance from each location l to the closest baroque opera house as instrument. The underlying logic is that being closer to a baroque opera house location means better access to cultural amenities, which is particular attractive for high-skilled workers. In the robustness test in Sect. 6, we will also present an alternative specification where we only consider a dummy variable that indicates baroque opera house locations. Our first-stage regression of the share of high-skilled workers on the minimum distance to the next baroque opera house location takes for a given skill group the following form:

$$hs_{it} = \sum_{l=2}^{36} \delta_1 \mu_l \text{dist}_l + X'_{ilt} \delta_2 + X'_{it} \delta_3 + \mu_{il} + \mu_t + \omega_{ilt} \tag{2}$$

Here, hs_{it} represents the share of high-skilled workers in a first-stage regression for individuals i of the given skill group at location l and at time t . The coefficients of interest are $\delta_1 \mu_t$, which give us the time-variant effect of distance to the closest baroque opera house (dist_l) over the period 1976–2010.⁸ 1975 is the base category. We estimate time-variant effects $\delta_{1s} \mu_t$ for two reasons: First, cultural amenities as one contribution to a district’s quality of life might have gained increasing importance over our 36-year observation period (Rappaport 2009). Second, the existence of a baroque opera house might have kick-started a cumulative process of attracting high-skilled workers, that is, high-skilled workers were initially attracted by the closeness to a baroque opera house; further high-skilled workers followed expecting higher wages due to human capital spillovers. Note that these spillovers are not necessarily limited to the opera house location, but may also come from

⁸ In unreported specifications, we replace distance with a baroque opera house dummy (see Falck et al. 2015b). We find qualitatively similar results.

high-skilled workers in surrounding locations that are also close to a baroque opera house. The main effect of distance is captured in the location-individual fixed effects. The remaining control variables are the same as the ones employed in Eq. (1).

Our instrumental variable strategy thus identifies the effect of changes in the local share of high-skilled workers on *non-mobile workers* at the same location. Changes in the share of high-skilled workers come from *mobile* high-skilled workers who are either directly attracted by the proximity to cultural amenities or indirectly by other culturally disposed mobile high-skilled workers.

The key requirement on our instrument is that it affects individual wages only through the assumed channel as location factor for high-skilled worker but not through any direct channel. As discussed in Sect. 2, we argue that baroque rulers' decision to build an opera house was purely idiosyncratic and not determined by any regional location factors that may affect funding. The competing argument would be that only rich rulers could afford to build an opera house and the same factors that contributed to the rulers' wealth in the past may still determine regional prosperity today. To the extent that these location factors are completely time-invariant, our fixed effects will absorb them. However, one remaining concern can be that past location factors may affect future outcomes by causing a movement from one equilibrium state to another. This transition would create path dependencies that are not captured by fixed effects (Nunn 2009). In the robustness checks, we will explore the assumed randomness of the baroque opera house locations in more detail, by checking whether observable historic location factors can explain the existence of a baroque opera house.

4 Wage data 1975–2010

Our data stem from the Historic Employment and Establishment Statistics (HES) database (cf. Bender et al. 2000, for a detailed description). The administrative origin of HES implies that the data are restricted to information relevant for social insurance purposes. This includes information on daily wages, a range of socio-demographic variables (such as educational attainment, gender, and age) and the industry, occupation, and place of work for all German workers subject to social insurance. To be represented in the HES, individuals must be subject to Germany's social security system. As a result, civil servants and self-employed individuals are not included in our database. We further choose to exclude workers younger than 18 or older than 65. Finally, we exclude all individuals in training and in part-time jobs since there is no information on hours worked in the HES.

There is no information for East Germany prior to 1990. After 1990, East Germany is a special case, since qualifications from the former GDR were sometimes formally no longer valid or knowledge and experience diminished in value (cf. Fuchs-Schündeln and Izem 2012; Burda and Hunt 2001). Consequently, we are not sure what types of spillovers to expect from high-skilled workers and thus focus in our main specifications on West Germany excluding Berlin, since we cannot distinguish between East and West Berlin in our data. In doing so, we can

Table 2 Descriptive statistics

	Period 1975–1991	Period 1992–1999	Period 2000–2010
Variables on the individual level			
Log wage high-skilled workers	4.136 (0.403)	4.588 (0.394)	4.748 (0.448)
Log wage skilled workers	3.753 (0.460)	4.190 (0.459)	4.340 (0.496)
Log wage unskilled workers	3.422 (0.565)	3.817 (0.586)	3.984 (0.583)
Experience (years)	19.57 (12.23)	20.29 (11.52)	22.85 (11.07)
Female (%)	36.95	40.00	42.68
Foreign (%)	9.11	9.17	7.73
Manufacturing (%)	42.09	35.99	30.38
Variables on the district level			
Population (in TSD)	378.06 (368.11)	381.09 (363.45)	387.86 (373.86)
Labor force participation rate (%) (workers/population)	31.00 (11.17)	29.90 (10.45)	27.60 (10.00)
Share high-skilled workers (%)	4.61 (2.70)	7.17 (3.83)	9.89 (5.06)
Avg. distance to the next baroque opera house (km) (distance measured from the district centroid)		51.31 (33.84)	
Avg. distance to the next baroque opera house (km) (distance measured from the district's population center)		50.77 (35.14)	
Number of districts	325	325	325

The table shows the mean of all variables. Individual-level variables refer to all full-time employed West German workers in the age group from 18 to 65. District-level variables refer to the 325 West German districts in their 2009 boundaries. Standard deviations of continuous variables are in parenthesis

also exploit our exceptionally long-time series from 1975 to 2010. Workers in West Germany are nested in 325 West German districts (NUTS-3 regions)—our spatial level of analysis.

The wage information is very reliable, since it is used to determine social insurance contributions, but wages are censored due to the limit for compulsory social insurance payments. To deal with this, we use Gartner's (2005) procedure to impute the truncated distribution. The educational attainment of workers is differentiated into three categories: low-skilled (workers without vocational training), medium-skilled (with vocational training), and high-skilled (workers with a degree from a university or a university of applied sciences).

In the period from 1975 to 2010, we can follow more than 53 million West German full-time employed workers in the age group between 18 and 65 throughout their working lives. However, to reduce the computational burden, we restrict our

analysis to a 1% random sample. Our random sample thus consists of 530,624 workers who spent their working lives in West Germany and who were at least once recorded as full-time workers during this 36-year period. Descriptive statistics for our West German random sample are provided in Table 2.

We complement the individual worker information with district-level information on the share of high-skilled workers, our treatment variable, on population size in order to account for time-variant general agglomeration effects, and on the labor force participation rate calculated as the share of workers in the overall population as a control for cyclical changes in the local labor market that may simultaneously affect the share of high-skilled workers and wages.

Finally, we use information on 19 stand-alone baroque opera houses in West Germany (excluding Berlin). We geocode the address of each of these opera houses and use this information to calculate the distance to all 325 West German districts, using both the district's centroid and today's population center as reference point.⁹ Centroid and the population center are both located within the district-polygons and they are correlated by 0.965. The average distance of all West German districts to the closest baroque opera house across all West Germany is 53.5 km (based on the district's centroid), meaning that cultural amenities at the baroque opera house location tend to be within a reasonable travel distance. Figure 2 shows kernel density estimates for distance to the centroid or population center. Small differences between the two measures may occur if redrawing districts' boundaries has induced an uneven population distribution across space or generated irregular shapes. We will use distance to the centroid in our baseline specifications and show alternative specifications using distance to the population center in our robustness checks.

5 Results

This section discusses our baseline results, looks at effect heterogeneity, and finally contests the validity of our instrumental variable. For additional robustness tests that contest the validity of our approach, we refer the interested reader to Falck et al. (2015b), Sect. 6.

5.1 Baseline

Figure 3a illustrates the first-stage relationship for the specification with high-skilled workers as a dependent variable in the second stage. As we can see, distance to the next baroque opera house has the expected sign in all years—the share of high-skilled workers increases as distance to the next baroque opera house decreases—and the 95% confidence interval around the point estimates shows that the relationship is persistently different from zero in all years after 1982. *F*-tests of the joint significance of the instruments formally support the visual impression that we are dealing with strong instruments. The absolute rise of the distance coefficient

⁹ We used Google Earth and the Corine Land Cover database to determine each district's population center.

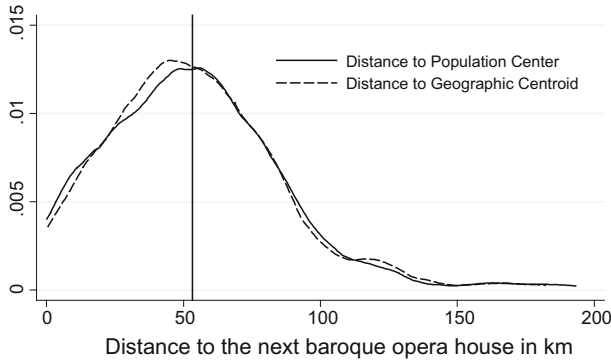


Fig. 2 Kernel density of distance to the next opera house in West Germany. *Notes:* The figures show kernel density plots of the all distances between (1) districts’ population center (solid line) and (2) countries’ centroids (dashed line) to the closes West German baroque opera house. Excluding West Berlin, we observe 19 baroque opera houses across West Germany. The vertical line represents both the mean minimum distance to the population center of 53.3 km as well as to the centroid of 53.5 km. The two are not distinguishable from each other in the figure

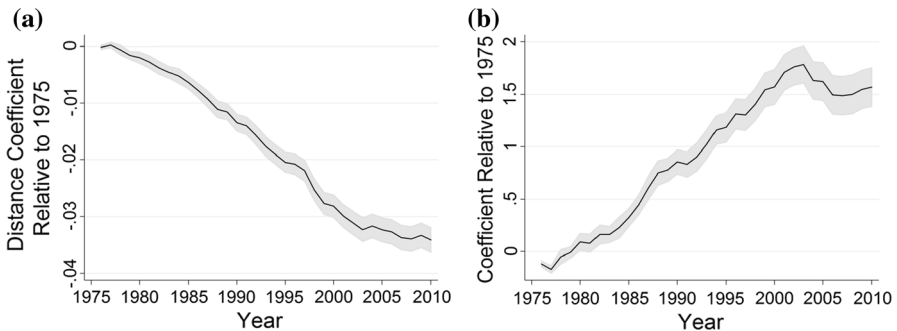


Fig. 3 First-stage relationship. **a** Distance to the closest opera house, **b** opera house dummy. *Notes:* The figure is a graphic representation of the time-variant coefficients from the first-stage regression in Eq. (2) with 1975 as base year. Panel **a** shows coefficients on the interactions between the minimum distance to the next opera house and year dummies and panel **b** shows coefficients of interactions between opera house dummies and year dummies. Each coefficient shows the expected relative percentage point increase in the share of high-skilled workers when moving 1 km closer to a baroque opera house location. This specification considers the subset of high-skilled workers. Coefficients are enclosed by 95% confidence band. Standard errors are corrected for individual-district clustering

clearly corroborates our arguments of an increasing importance of cultural amenities as one determinant of quality of life of high-skilled workers and of the cumulative process of attracting high-skilled workers initiated by the closeness to a baroque opera house.

Tables 3, 4, and 5 present the results of our wage estimations for high-skilled (Table 3), medium-skilled (Table 4), and low-skilled (Table 5) workers. In column I, we present a specification without instrumenting the share of high-skilled workers. This corresponds to Eq. (1). In columns II–VI, we instrument the share of

Table 3 Second-stage results for West Germany—high-skilled workers

Dependent variable: log wage	I FE	II IV-FE	III IV-FE	IV IV-FE	V IV-FE	VI IV-FE
Share high-skilled workers	0.567*** (0.100)	0.958*** (0.371)	1.160*** (0.332)	1.161*** (0.331)	1.053*** (0.360)	1.043*** (0.359)
Individual controls						
Foreign	0.022 (0.021)	–	0.026 (0.021)	0.024 (0.021)	0.025 (0.021)	0.024 (0.021)
Experience	0.057*** (0.013)	–	0.059*** (0.013)	0.058*** (0.013)	0.058*** (0.013)	0.058*** (0.013)
Experience ²	– 0.001*** (0.000)	–	– 0.001*** (0.000)	– 0.001*** (0.000)	– 0.001*** (0.000)	– 0.001*** (0.000)
District controls						
Log population	0.011 (0.030)	–	–	–	0.035 (0.034)	0.040 (0.034)
Labor force participation	0.088* (0.049)	–	–	–	0.105** (0.050)	0.105** (0.050)
Industry dummies (10 categories)	Y	N	N	Y	Y	Y
Anderson–Rubin <i>F</i> test	–	0.0197	0.0045	0.0041	0.0628	0.0802
Kleibergen–Paap Wald rk <i>F</i> statistic	–	49.90	50.10	49.80	43.69	43.689
Individual × location FEs	73,898	54,827	54,827	54,827	54,827	54,820

Table 3 continued

Dependent variable: log wage	I FE	II IV-FE	III IV-FE	IV IV-FE	V IV-FE	VI IV-FE
Number of observations	375,861	356,790	356,790	356,790	356,790	356,725

The table reports regressions of log average daily wages of high-skilled workers on the share of high-skilled workers conditional on time-variant individual controls (interactions between foreign/female and experience/experience² as well as the censoring dummy and its interactions with all control variables are not displayed in the table) and district controls. Column 1 presents the results of an uninstrumented specification with individual-location fixed effects. In columns 2–6, the share of high-skilled workers is instrumented with proximity to the next baroque opera house. Column 2 only includes an imputation control and a control for full-time employment. Column 3 includes a full set of individual controls, interactions between the individual controls and the censoring dummy, and year dummies. In column 4, we additionally consider 10 industry dummies controlling for one-digit industries and again, we interact these controls with the censoring dummy. In column 5 we add country level controls and in column 6, we use one-digit occupation controls instead of one-digit industry controls. Across all specifications, standard errors are corrected for individual-district clustering

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Table 4 Second-stage results for West Germany—medium-skilled workers

	I	II	III	IV	V	VI
	FE	IV-FE	IV-FE	IV-FE	IV-FE	IV-FE
Share high-skilled workers	1.040*** (0.037)	0.959*** (0.154)	1.523*** (0.135)	1.567*** (0.135)	1.563*** (0.142)	1.566*** (0.143)
Individual controls						
Foreign	0.039*** (0.007)		0.042*** (0.007)	0.043*** (0.007)	0.043*** (0.007)	0.043*** (0.007)
Experience	0.018*** (0.006)		0.018*** (0.006)	0.018*** (0.006)	0.018*** (0.006)	0.018*** (0.006)
Experience ²	- 0.001*** (0.000)		- 0.001*** (0.000)	- 0.001*** (0.000)	- 0.001*** (0.000)	- 0.001*** (0.000)
District controls						
Log population	- 0.061*** (0.010)				- 0.032*** (0.012)	- 0.032*** (0.012)
Labor force participation	- 0.052*** (0.017)				- 0.029 (0.018)	- 0.029 (0.018)
Industry dummies (10 categories)	Y	N	N	Y	Y	Y
Anderson-Rubin <i>F</i> test	-	0.000	0.000	0.000	0.000	0.000
Kleibergen-Paap Wald rk <i>F</i> statistic	-	366.2	367.1	366.9	357.4	356.9
Individual × location FEs	542,631	542,631	421,492	421,492	421,492	421,379

Table 4 continued

	I FE	II IV-FE	III IV-FE	IV IV-FE	V IV-FE	VI IV-FE
Number of observations	4,269,770	4,269,770	4,148,631	4,148,631	4,148,631	4,147,129

The table reports regressions of log average daily wages of medium-skilled workers on the share of high-skilled workers conditional on time-variant individual controls (interactions between foreign/female and experience/experience² as well as the censoring dummy and its interactions with all control variables are not displayed in the table) and district controls. Column 1 presents the results of an uninstrumented specification with individual-location fixed effects. In columns 2–6, the share of high-skilled workers is instrumented with proximity to the next baroque opera house. Column 2 only includes an imputation control and a control for full-time employment. Column 3 includes a full set of individual controls, interactions between the individual controls and the censoring dummy, and year dummies. In column 4, we additionally consider 10 industry dummies controlling for one-digit industries and again, we interact these controls with the censoring dummy. In column 5 we add country level controls and in column 6, we use one-digit occupation controls instead of one-digit industry controls. Across all specifications, standard errors are corrected for individual-district clustering

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Table 5 Second-stage results for West Germany—low-skilled workers

	I FE	II IV-FE	III IV-FE	IV IV-FE	V IV-FE	VI IV-FE
Share high-skilled workers	0.978*** (0.071)	- 0.041 (0.326)	1.159*** (0.287)	1.276*** (0.281)	1.364*** (0.301)	1.368*** (0.301)
Individual controls						
Foreign	0.180*** (0.008)		0.178*** (0.008)	0.183*** (0.008)	0.183*** (0.008)	0.183*** (0.008)
Experience	- 0.057 (0.047)		- 0.057 (0.047)	- 0.057 (0.047)	- 0.056 (0.047)	- 0.056 (0.047)
Experience ²	- 0.001*** (0.000)		- 0.001*** (0.000)	- 0.001*** (0.000)	- 0.001*** (0.000)	- 0.001*** (0.000)
District controls						
Log population	0.043** (0.017)				0.066*** (0.024)	0.066*** (0.024)
Labor force participation	0.117*** (0.028)				0.126*** (0.029)	0.127*** (0.029)
Industry dummies (10 categories)	Y	N	N	Y	Y	Y
Anderson-Rubin <i>F</i> test		0.0383	0.00163	0.0004	0.0004	0.0004
Kleibergen-Paap Wald rk <i>F</i> statistic		92.39	93.79	93.64	94.34	94.19
Individual × location FEs	291,952	200,416	200,416	200,416	200,416	200,327

Table 5 continued

	I FE	II IV-FE	III IV-FE	IV IV-FE	V IV-FE	VI IV-FE
Number of observations	1,421,857	1,421,857	1,330,321	1,330,321	1,330,321	1,329,729

The table reports regressions of log average daily wages of low-skilled workers on the share of high-skilled workers conditional on time-variant individual controls (interactions between foreign/female and experience/experience² as well as the censoring dummy and its interactions with all control variables are not displayed in the table) and district controls. Column 1 presents the results of an uninstrumented specification with individual-location fixed effects. In columns 2–6, the share of high-skilled workers is instrumented with proximity to the next baroque opera house. Column 2 only includes an imputation control and a control for full-time employment. Column 3 includes a full set of individual controls, interactions between the individual controls and the censoring dummy, and year dummies. In column 4, we additionally consider 10 industry dummies controlling for one-digit industries and again, we interact these controls with the censoring dummy. In column 5 we add country level controls and in column 6, we use one-digit occupation controls instead of 1-digit industry controls. Across all specifications, standard errors are corrected for individual-district clustering

*** Significant at the 1% level
 ** Significant at the 5% level
 * Significant at the 10% level

high-skilled workers with the distance to the next baroque opera house as specified in Eq. (2). The results of the first-stage regression are omitted from the tables, but Fig. 1 illustrates the size and significance of the first-stage relationship throughout the specifications. The Anderson Rubin F statistics and the Kleibergen Paap F statistic both suggest that weak instruments are not a major concern in our estimations. In column II, we present the instrumental variable regression without individual controls, district-level controls, or year dummies. We only condition on individual-location fixed effects, a dummy variable indicating whether we imputed the wage or not and whether the individual is working full time in this year or not. In column III, we add time dummies and individual time-variant controls including interactions between gender/nationality and experience to allow for differential effects for females or foreigners. We also include interactions between the individual controls and the censoring dummy. In column IV, we include ten one-digit industry controls and again interact them with the censoring dummy, and in column V we include district-level controls. Finally, column VI presents a specification where we replace the industry controls with one-digit occupation controls.

Our preferred specification is in column V, where we consider the full set of individual and district controls and one-digit industry controls. Our results suggest that a 1% point increase in the share of high-skilled workers increases high-skilled workers' wages by 1.1%, medium-skilled workers' wages by 1.6%, and low-skilled workers' wages by 1.4%. As predicted by the theory underlying our estimations, the effect is positive for the two less-educated groups, which indeed should experience a strictly positive effect. Since we also observe a positive effect on high-skilled workers' wages, we conclude that spillovers from high-skilled workers exceed the negative supply effect. Since recent literature has shown that spillovers are highly localized (Ahlfeldt et al. 2015) we interpret these findings as combined effect of localized spillovers on the district level.

The estimated coefficients are qualitatively comparable to the effects reported by Moretti (2004) for the USA. He finds that a 1% point increase in the share of college graduates raises high school dropouts' wages by 1.9%, high school graduates' wages by 1.6%, and college graduates' wages by 0.4%. However, our effect on the low-skilled workers is somewhat lower than Moretti's effect for the high school dropouts. The reason for this might be that our group of low-skilled workers primarily consists of workers without a basic degree from secondary school while Moretti looks at workers who have at least attended high school for some time. Furthermore, we find a stronger effect for high-skilled workers than Moretti does for college graduates. The reason for this might be that we observe a particularly interesting group of high-skilled workers—those who value cultural amenities and who are willing to move to be close to them. These workers might generate especially productive spillovers for other high-skilled workers. By contrast, Moretti looks at college graduates in general or college graduates who are immobile (in the land grant college specification) since they also work at the college location. To further quantify the wage effects, we relate our estimates to the 2005 average wages of the three skill groups. We find that the average high-skilled worker, who earns €39,457 per year, would earn an extra €434.03 if the share of high-skilled workers in

the local labor market increases by 1% point. The average medium-skilled worker, who earns €30,295, would earn an extra €484.72, and the average low-skilled worker, with an income of €21,189, would earn an additional €296.65.

5.2 Effect heterogeneity

We will now explore the effect heterogeneity and show that our results are robust to a number of sample splits. The results of all exercises are summarized in Table 6. The three different columns represent estimation results for high-skilled (column 1), medium-skilled (column 2), and low-skilled (column 3) workers. Each line includes the result from a different model and each cell stands for a separate regression.

We start with subsample estimations for female and male workers, as well as manufacturing workers. In these estimations, we look at different subsamples of recipients of the spillovers, while the source of spillovers, high-skilled workers, remains unchanged. While the overall results do not change qualitatively, one interesting finding is that spillovers on females are in general stronger than on males. Looking at manufacturing versus non-manufacturing industries, we find even stronger effects for our three skill groups. This is important because manufacturing industries are typically producers of tradable goods which would relocate to locations with lower wages if higher nominal wages did not imply productivity advantages. Finally, we split the sample into below/above mean distance to the closest baroque opera house. The idea behind this sample split is that we should see effects for districts located close enough to a cultural center so that one can, e.g., attend an evening performance. The mean distance to the closest baroque opera is 53.5 km. Thus, districts with a below mean distance to the closest baroque opera house are in travel distance. Reassuringly, we find that our effects especially come from the short-distance sample.

5.3 Instrument validity

To explore the randomness of the baroque opera house locations,¹⁰ we try to identify historic twin locations of the baroque opera house locations. Twin locations did not receive a baroque opera house, but had the same initial probability of having one given a large set of observable historic location factors. The idea to identify twin locations reflects our assumption that having a baroque opera house is the result of a baroque ruler's idiosyncratic preferences. To exploit our search for twins, or counterfactual baroque opera house locations, we calculate the distance to the closest counterfactual baroque opera house location and check whether closeness to a counterfactual baroque opera house location can predict the share of high-skilled workers in a district. If this was the case, one may argue that factors other than the existence of a baroque opera house drive our results.

We consider a large number of *historic* district characteristics to determine historical twins of the opera house locations. Differences in rulers' wealth are the most obvious reason why some regions got an opera house while others did not.

¹⁰ For a critical discussion of the instrument validity, see also Bauer et al. (2015) and Falck et al. (2015a).

Table 6 Effect heterogeneity

	I High-skilled workers Baseline: 1.053***	II Skilled workers Baseline: 1.563***	III Unskilled workers Baseline: 1.364***
Female	1.706* (0.976)	1.863*** (0.266)	1.417*** (0.495)
Male	0.824** (0.354)	1.337*** (0.152)	1.307*** (0.355)
Manufacturing	1.629*** (0.55)	1.732*** (0.249)	1.221*** (0.459)
Non-manufacturing	0.989** (0.436)	1.434*** (0.175)	0.799** (0.404)
Above mean distance	– 0.002 (1.045)	1.194*** (0.382)	– 0.369 (0.743)
Below mean distance	0.874*** (0.285)	1.939*** (0.113)	2.166*** (0.230)

Each cell presents the result from a separate regression. The independent variable is the share of high-skilled workers and the dependent variable is the log of the daily wage of high-skilled workers (column 1), skilled workers (column 2), and low-skilled workers (column 3). We instrument the share of high-skilled workers in a region with the minimum distance to the next baroque opera house interacted with year dummies. Individual controls include foreign, experience, experience², censored wage dummy, time dummy, interactions of experience with female and foreign, and interactions of the censoring dummy with individual controls. Industry controls are dummies for ten one-digit industries. District-level controls include log population and the labor force participation rate. If not otherwise stated standard errors are corrected for individual-location clustering

*** Significant at the 1% level

** Significant at the 5% level

* Significant at the 10% level

Factors that may have contributed to a places' wealth were the availability of mineral deposits, agricultural productivity, the size of the state, degree of urbanization, access to the coast or large rivers, existence of a historic university, and free, Hanseatic or imperial city status. Beyond that, we may think that the rulers' religious determination may have influenced the decision to build an opera house, with religion affecting educational attainment and subsequent economic development (Becker and Woessmann 2009).

To proxy for these location factors, we use a combination of current and historic information. Specifically, we account for the percentage of land that is located on coal, ore, quartzite, or slate deposits as proxy for mineral deposits. To proxy agricultural productivity, we rely on the Food and Agricultural Organization's (FAO) Global Agro-Ecological Zones (GAEZ) 2002 dataset and choose the suitability for cereal (rain-fed at moderate input) or pasture as in Nunn and Qian (2011); the size of the principality (out of 99) and the log of its population in 1700 according to Bairoch et al. (1988); the cumulative population in all 'Bairoch' cities within today's district borders in 1700 and the population growth between 1700 and 1800, access to the coast and cumulative kilometers of large rivers within today's district boundaries; the

existence of a historic university (Eulenburg 1904); free, Hanseatic or imperial city status; the principalities' religious determination (Shepherd 1923).

Using these location factors, we perform a propensity score matching and determine the nearest neighbor of each actual opera house location. To determine the propensity score, we estimate a probit model of having a baroque opera house using historic location factors plus the district size today (in km²) and an indicator for city district as explanatory variables. Based on the predicted probabilities, we determine a counterfactual opera house location with the closest predicted probability to receive an opera house. This is the nearest neighbor of each actual opera house location predicted on the base of the observable historic location factors discussed above.

Table 7 shows the pairs of actual and counterfactual opera house locations along with the predicted probabilities (columns 2 and 4) and the difference in the predicted probabilities (column 5). As we can see, we find relatively close twins for all actual baroque opera house locations. However, for seven actual baroque opera house locations, we find the city district of Mainz to be the best twin.¹¹

We now calculate the minimum distance of all districts to these counterfactual baroque opera house locations and use this distance to instrument the share of high-skilled workers in the wage regressions. Figure 4 shows the first-stage relationship over time between distance to closest counterfactual baroque opera house and the share of high-skilled workers as compared to the relationship between distance to closest actual baroque opera house and the share of high-skilled workers. The figure reveals that distance to the closest counterfactual opera house location has hardly any predictive power. This finding supports the validity of our instruments.

6 Conclusions

Our results suggest that “music in the air” does indeed pay off for a location. We exploit comprehensive individual-level panel data over a long period of 36 years and find that high-skilled workers who are attracted to locations with a rich and diverse cultural scene generate productive knowledge spillovers. Importantly, these knowledge spillovers do not just benefit other high-skilled workers but also lower-skilled workers. Our paper thus highlights an important channel through which the overall minor direct contribution of a cultural scene to the local economy is leveraged: a rich cultural scene attracts high-skilled workers; the agglomeration of high-skilled workers generates productive knowledge spillovers that in turn benefit all workers in a region.

From our first-stage regressions, we further see that proximity to cultural amenities—here measured as distance to the next baroque opera house—becomes increasingly important during the observation period of 36 years. This finding provides an interesting perspective on regional location factors. In the past, physical capital and infrastructure were probably the best predictors for a location's economic success. With the shift from manufacturing goods to the more knowledge-

¹¹ We show in Falck et al. (2015b) that omitting those seven locations does not affect our results.

Table 7 Predicted probabilities using historic location factors

Opera house location	Predicted probability (1)	Counterfactual location	Predicted probability (3)	Difference (1)–(3)
Munich	0.7894	Mainz	0.8425	– 0.0531
Coburg	0.2841	Memmingen	0.3120	– 0.0279
Luebeck	0.4762	Emden	0.5017	– 0.0255
Muenster	0.5379	Stuttgart	0.5447	– 0.0068
Mannheim	0.3234	Bielefeld	0.3300	– 0.0066
Trier	0.4466	Nuremberg	0.4490	– 0.0024
Aachen	0.0110	Herford	0.0125	– 0.0015
Passau	0.2129	Straubing	0.2139	– 0.0010
Brunswick	0.2547	Duesseldorf	0.2540	0.0007
Augsburg	0.0762	Krefeld	0.0751	0.0011
Wuerzburg	0.3363	Bielefeld	0.3300	0.0063
Darmstadt	0.4557	Nuremberg	0.4490	0.0066
Frankfurt	0.8497	Mainz	0.8425	0.0072
Bayreuth	0.2731	Duesseldorf	0.2540	0.0191
Ulm	0.8954	Mainz	0.8425	0.0528
Regensburg	0.9209	Mainz	0.8425	0.0784
Koblenz	0.9719	Mainz	0.8425	0.1293
Bremen	0.9760	Mainz	0.8425	0.1334
Hamburg	0.9800	Mainz	0.8425	0.1375

The table shows pairs of 19 actual and counterfactual opera house locations in West Germany. Counterfactual opera house locations result from a Mahalanobis matching on the predicted probabilities from probit estimations of the baroque opera house dummy on the area of today's district; an independent city status dummy; log of slope measured as difference between the highest and lowest elevation; the log of the area of the historic principality that covers the most of today's district; the log of the historic population in 1700 and the population growth between 1700 and 1800 in all Bairoch cities within the district today; the log of river-km in the district; a coast dummy; a dummy if the location was home to a university before 1800; Hanseatic city status dummy; free city status dummy; percent of the area that contains coal, ore, quartzite, and/or slate; soil's suitability for cereal and pasture at medium input; and an indicator for the dominant religion. Column (5) shows the difference between the predicted probability for the actual and counterfactual opera house

intensive production of innovation, factors that increase a location's quality of live and help attract innovative people have gained increasing importance. In this paper, we cannot separate this increasing amenity effect from a cumulative effect where innovative workers who value a location's quality of live attract more innovative workers. However, in both cases, variation in the share of high-skilled workers across locations (initially) comes from cultural amenities. We can thus isolate the effect of culture on the agglomeration of high-skilled workers and their productive spillovers.

From a policy perspective, our findings clearly raise the question whether investing in cultural amenities is a promising place-based policy. The answer is twofold. On the one hand, our results suggest that economic activities can benefit from the presence of consumption amenities, in our case a proxy for the existence of

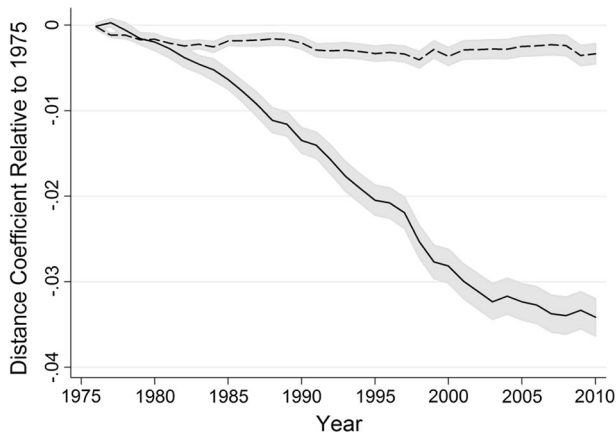


Fig. 4 First-stage relationship for distance to the actual and counterfactual opera house locations, 1976–2010. *Notes:* The figure is a graphic representation of the time-variant distance coefficients from the first-stage regression in Eq. (2) with 1975 as base year. The solid line represents distance coefficients for the actual distance to the closest baroque opera house (cf. Fig. 3a), and the dashed line represents the first stage using the counterfactual distances. The coefficients are enclosed by 95% confidence band. Standard errors are corrected for individual-location clustering. Each coefficient shows the expected relative percentage point increase in the share of high-skilled workers when moving 1 km closer to a baroque opera house location. This specification is for the case of high-skilled workers

cultural amenities. This may explain why local spending on culture is hotly debated among local policymakers. For “cool” places like Berlin, this further suggests that there is hope that jobs will follow people.

On the other hand, we advise caution, since our analysis focuses on regions that benefit from an increasing share of high-skilled labor. If the overall supply of high-skilled workers is constant, this would imply a beggar-thy-neighbor policy: one region’s gain in high-skilled employment means a loss to another region. To end up with an overall positive welfare effect, the positive effect of the knowledge spillovers must therefore be larger in the gaining regions than the diseconomies in the losing regions. Evaluating the overall welfare impact is beyond the scope of this paper and we thus refer it to future research.

The relevance of our distance instrument further suggests that locations can benefit from cultural amenities in neighboring locations. Instead of investing in own cultural amenities, local policymakers might thus choose to free-ride. Since we do not explicitly look at the financing side of cultural amenities, we cannot contribute to answering the question of how one could solve this coordination problem. Instead, we again refer this to further research.

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