CATERINA ADELAIDE MAURI

RADIO KILLED THE DANCEHALL STAR

Abstract. This paper examines how the introduction of radio broadcasting in the 1920s affected the geographic distribution of musicians in the United States. Using full-count US census data from 1920 and 1930, I analyze county-level changes in the share of musicians following the adoption of the radio. To address endogeneity concerns, I construct an instrumental variable based on natural features affecting AM radio signal propagation. The results reveal a heterogeneous impact: Radio reduced the share of musicians in highly urbanized areas but had positive effects in moderately urban and rural counties. This pattern suggests that radio functioned as a substitute for live music in cities where musical entertainment was already abundant, while serving as a complement in areas with previously limited access to professional musicians. These findings provide insights into how information-based technological innovations may differentially impact creative labour markets across varying geographic contexts, with implications for understanding modern digital disruptions.

Keywords. Radio, musicians, labor market, technological change, geographic distribution

1. INTRODUCTION

How does the labour market for creatives respond to technological innovations that expand their potential audiences? The radio revolution of the 1920s provides a compelling case study. Radio dramatically expanded access to entertainment and news, making knowledge exchange considerably cheaper and profoundly transforming markets for live and recorded music. Once consumers purchased a radio set, listening to music was free – creating fears that musicians would be displaced by the new technology. Simultaneously, radio broadcasting created a new national market for music that made some musicians wealthy (Taylor 2002) and brought music to places that had previously experienced little of it.

Unlike many other technological revolutions, such as mass production or advances in transportation, radio primarily involved what we would now term information, making it particularly relevant for understanding modern digital disruptions. This paper investigates the effects of this new medium on the geography of the labour market for musicians in the United States.

I employ US census data from 1920 and 1930, which provides unusually detailed information both on radio ownership (as respondents in 1930 were asked whether they owned a radio) and on occupations, allowing for analysis of the musician population at the county level across the entire country. To address endogeneity concerns relating to

unobserved covariates potentially linked to radio adoption, I construct instrumental variables based entirely on natural features affecting the reach of AM radio signals. These instruments affect the geographical spread of the radio during the period of the radio revolution and are plausibly exogenous.
The results of this paper indicate that radio reduced the share of musicians in highly urbanized areas but had moderately positive effects in rural areas. This pattern likely reflects differences in how radio substituted for or complemented live music. While urban musicians were partially replaced by radio broadcasts, the same technology stimulated demand in rural areas, which had previously seen little demand for professional musical entertainment.

This research contributes to three main areas of scholarship: The clustering of creative workers, technological shocks and their effects on disrupted markets, and the impact of the radio on various political and societal outcomes. The findings have implications for understanding how digital technologies might differentially affect creative labour markets across geographic and economic contexts.

1.1 The radio revolution

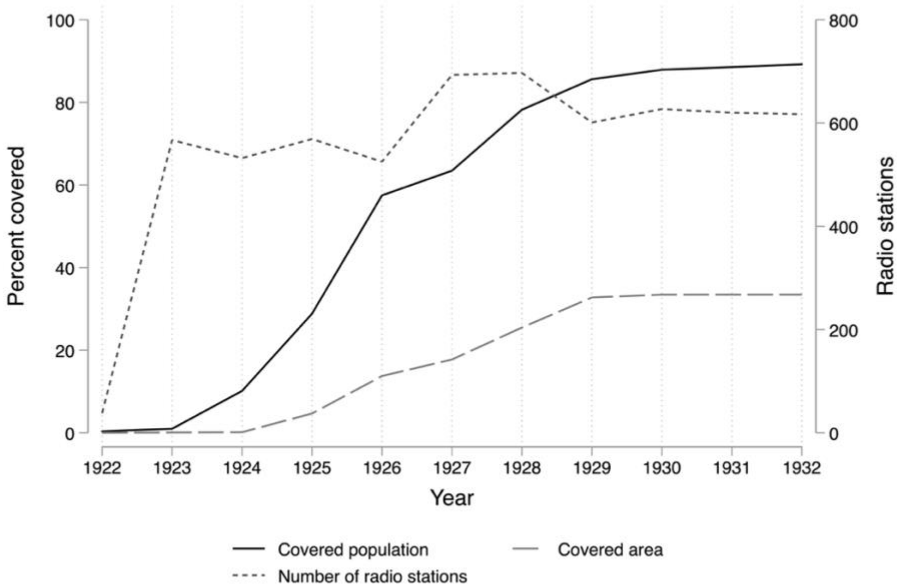
At the beginning of the 1920s, radio technology was expensive and primarily used for military and maritime communication. Civilian broadcasting had been banned during World War I, and experimental stations like 2XG in New York City were pioneers in the field. Early development was dominated by the Marconi Company, General Electric (which formed the Radio Corporation of America), and Westinghouse Electric Corporation.
The first licensed commercial broadcasting station began operations in November 1920 in Pittsburgh, operated by Westinghouse to stimulate demand for radio sets. Starting from the early 1920s, the technology spread rapidly. By 1927, there were more than 700 licensed radio stations, leading Congress to pass the Radio Act to regulate the rapidly growing industry.

Figure 1 illustrates this expansion using data from FCC Bulletins. The number of radio stations rose quickly from 1921 to 1932, reaching over 500 stations across the continental United States. While the number of stations stabilized afterward, their reach continued to expand as stations became more powerful and opened in previously uncovered areas. By 1930, radio signals covered 33% of the US land area containing 88% of the population, compared to just 0.1% of the land area (containing 1% of population) in 1923.

By the end of the decade, radio sets were widespread, though adoption rates varied considerably by region. The 1930 census data shows that in some areas, as much as half the population had access to a radio receiver in their household. Radio penetration was notably lower in the South compared to the North and West, and generally higher in urban than rural areas (with exceptions in parts of the Midwest) (Figure 2).

As the first real-time mass medium, radio had a remarkable impact on American society (Russo 2020), politics (Wang 2021) and the music business. It reconfigured notions of public and private life, helped usher in a new form of consumer economy, and played a large role in creating the star system in the entertainment industry. The technology came to cities first, where purchasing power was greatest and a large number of listeners could be reached cheaply.
However, its impact was especially significant in rural America, where it greatly reduced isolation and provided economic benefits, such as access to weather forecasts and agricultural market reports from the US Department of Agriculture (Craig 2001).

FIGURE 1 • NUMBER AND REACH OF LICENSED RADIO STATIONS 1923-1930



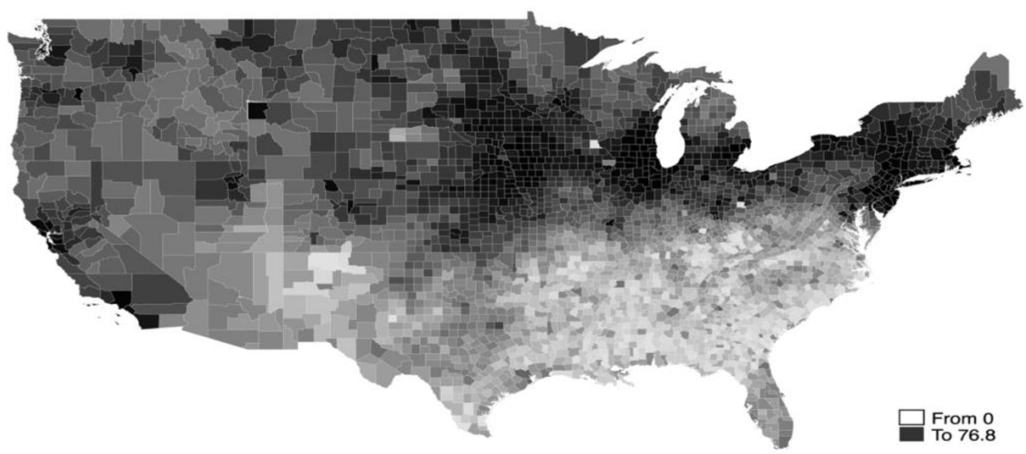
Notes: Covered area and covered population are based on author's own calculations as described in Section 2.

1.2 Effects of the radio on musicians

The radio was not the first technology to provide an alternative to live music. Recorded music had been available since the 1880s and steadily improved in quality. However, record players remained expensive and not ubiquitous in the 1920s. Radio distinguished itself by being considerably cheaper for home use and offering greater variety without requiring an extensive record collection. Even after the radio revolution, the vast majority of musicians earned their living from live performances, with very few recording music or performing for radio or motion pictures. A key question is whether radio served as a substitute for or complement to live music. While no empirical evidence existed on this question at the time, Nielsen (2013) suggests it was likely a complement, as dance halls and similar establishments boomed during the 1920s. Complementarities have also been found between more recent technologies, such as music video streaming and record purchases in the early 2010s (Kretschmer and Peukert 2014).

As a first approximation, radio can be viewed as a labour-saving innovation in music provision. It required fewer musician-hours per person-hour of music listening compared to live performances, thus enhancing production efficiency. However, consumers were not indifferent between forms of music consumption.
Radio could be enjoyed at home, while live music typically required travel to a venue but offered social experiences and amenities unavailable to radio listeners. Both substitution and complementary effects likely occurred simultaneously. Substitution happened when consumers chose radio over live music, while complementary effects occurred when radio exposure induced new demand for live performances. In areas where prior exposure to professional music was low – primarily rural regions – the complementary effect may have been stronger.

FIGURE 2 • SHARE OF POPULATION BY COUNTY WITH A RADIO SET IN THEIR HOUSEHOLD IN 19



Notes: Author's own calculations based on IPUMS data Ruggles *et al.* (2020).

2. Empirical strategy

2.1 Data sources

The primary data source is the US census, specifically the Integrated Public Use Microdata Series (IPUMS) (Ruggles *et al.* 2020). I use full-count census data for 1880, 1900, 1910, 1920, 1930, and 1940, though the analysis focuses primarily on 1920 and 1930.
The 1930 census uniquely asked respondents if they had a radio set at home, providing a detailed picture of radio penetration across the country. From the census data, I can identify musicians working as "Musicians and music teachers" while excluding those in educational services based on industry information.
To construct the geographical suitability instrument and compute population densities, I use geographical data from the National Historical Geographic Information System (Manson *et al.* 2018), a ground conductivity map from the Federal Communications Commission, a map of bodies of water from the North American Atlas (Natural Resources Canada 2010), and a map of landform classes from the U.S. Geological Survey (Hammond 1964).
For the analysis of radio station coverage, I digitized historical data from US Department of Commerce publications titled "Commercial and Government Radio Stations of the United States" (1923-1930), the "Radio Service Bulletin," and Federal Radio Commission Annual Reports (1931-1932).

2.2 Geographical suitability instrument

To address endogeneity concerns, I construct an instrument based only on natural environmental features that influence radio reception. This "geographical suitability" instrument exploits the fact that AM radio transmission, unlike FM broadcasting (which was only authorised in 1941), was significantly affected by ground conductivity and terrain characteristics.
The instrument represents the land area around a point from which a standardized transmitter could broadcast a receivable signal to that point. To construct this reverse coverage area I proceed as follows.

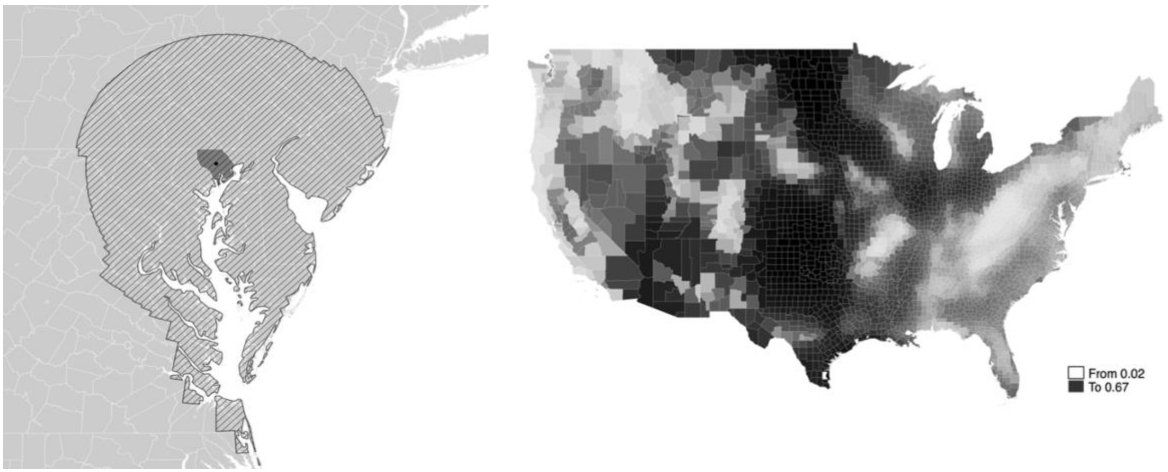
First, I obtain a ground conductivity map of the continental US and parts of Canada and Mexico adjacent to the border based on soil conditions assembled by the Federal

Communications Commission.[1] This information is supplemented with a map of bodies of fresh water and oceans from the North American Atlas (Natural Resources Canada 2010) as well as a map of land form classes by the U.S. Geological Survey (Hammond 1964). Conductivity levels for fresh water and ocean water are obtained from ITU (2014) and I set low conductivity levels for hilly and mountainous terrain. This effort results in a map of the continental US and a buffer region around it, where each point is assigned a conductivity level.

Second, for the centroid of each county that was part of the continental United States in 1930,[2] I construct 100 straight paths originating at the centroid and obtain the conductivity profile for each path. Each conductivity path is then used to compute how far the signal of a standard transmitter would have carried from the centroid, the *signal reach*.[3] The algorithm used to do this is symmetric, such that this is equal to the distance at which such a standard transmitter could at most be located along the path, so as to be receivable at the county centroid.

FIGURE 2 • ESTIMATED REVERSE COVERAGE AREAS

(a) Harford, MD **(b)** Resulting terrain suitability instrument



Notes: The county level terrain suitability measure is based on the author's own calculations following the methodology described in Section 2.

---

[1] The ground conductivity measure relies on information from a 1954 map by the Federal Communications Commission (FCC) reporting estimated effective ground conductivity in millimhos per meter for the contiguous continental United States. The map is freely accessible on the FCC website. The map was originally included in the Federal Communications Commission Report as an amendment to the Standards of Good Engineering Practice Concerning Standard Broadcast Stations.

[2] Data source for all counties shapefiles: Steven Manson, Jonathan Schroeder, David Van Riper, Tracy Kugler, and Steven Ruggles. IPUMS National Historical Geographic Information System: Version 15.0 [dataset]. Minneapolis, MN: IPUMS. 2020. http://doi.org/10.18128/D050.V15.0.

[3] This standard transmitter is defined to operate at a frequency of 1 MHz, at a power of 10 kW and with an antenna height of 30m; The corresponding receiver is assumed to be at a height of 3m above ground; A signal is considered receivable if it has a strength of at least 74 dBu (based on Trainotti 1990).

In order to compute each distance, I employ the program GRWAVE (ITU 2018). To make the method workable for paths consisting of segments of different conductivity levels, I employ an iterative algorithm based on the procedure developed by Millington (Millington 1949).

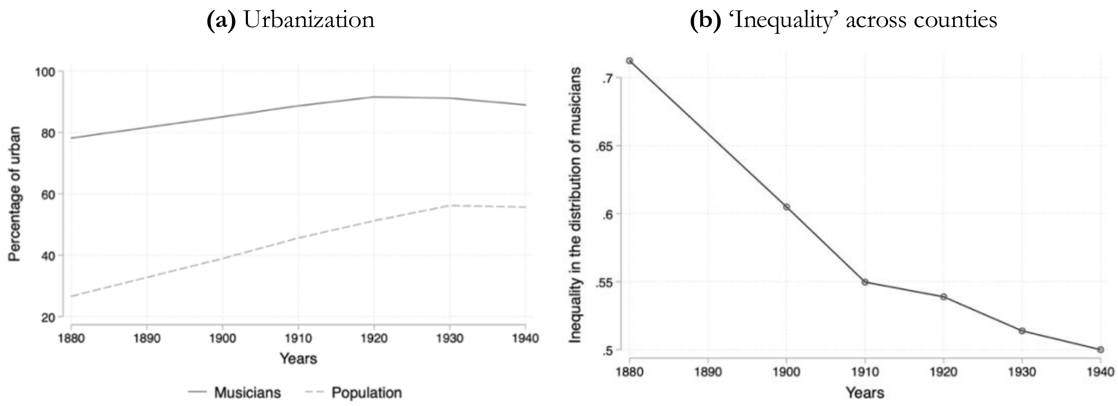
Third, the reverse coverage area is obtained by capping each path at its signal reach and then constructing an area for each one by rotating it around the centroid by 1% of a full rotation. Each such area has the shape of a very thin slice of pizza. These slices are then combined into one coverage area and only the part of the combined area that is land is retained. Figure 3a shows the resulting reverse coverage area for the centroid of Harford county in Maryland.

Finally, I compute the sizes of these reverse coverage areas for each county that was part of the continental United States in 1930. The resulting terrain suitability instrument is shown in Figure 3b. This instrument is highly predictive of radio adoption rates while being plausibly exogenous to factors influencing musician employment, as it depends solely on natural geographical features.

2.3 The geography of musicians

Musicians were considerably more urbanized than the general population throughout the sample period from 1880 to 1940. The distribution of musicians per capita in 1930 showed significant spatial inequality across the United States, with consistently higher concentrations in large cities and northern states compared to the South.
Over time, however, the urbanization gap between musicians and the general population narrowed (Figure 4a). In 1880, 78% of musicians lived in urban areas compared to 27% of the overall population. Both rates grew in subsequent decades, with musicians' urban share reaching 89% by 1930 while the general population's urban share rose to 56%. This convergence suggests that access to professional live music became more widespread during this period.
To further investigate this pattern, I calculated Gini coefficients for the distribution of musicians across counties (Figure 4b). The Gini coefficient for counties decreased steadily from 1880 to 1940, confirming that musicians became more evenly distributed across counties over time.

FIGURE 4 • URBANISATION AND INEQUALITY OF DISTRIBUTION OF MUSICIANS ACROSS COUNTIES



Notes: Panel (a) shows the percentage of urban musicians and the percentage of urban population over time. Panel (b) show the Gini coefficients of the distribution of musicians over time among counties. Results are based on the author's own calculations.

2.4 The impact of radio on musicians

To examine how the introduction of radio affected musician shares at the county level, I regress the percentage of musicians in each county's population in 1930 (musicians per 100 people) on the share of the population with home radio access. Overall, the share of musicians increased from 0.94% in 1920 to 1.1% in 1930, though there was substantial heterogeneity across counties.
All specifications include a set of demographic and economic factors as well as the 1920 musician percentage as controls. The inclusion of the latter is meant to absorb unobserved but constant determinants of the dependent variable. All regressions include regional fixed effects and are weighted by county population to account for the fact that information from larger counties represents averages over a larger number of individuals.

As Table 1 shows, OLS results show a significant negative association between radio ownership and musician share. However, when using the terrain suitability instrument in two-stage least squares (2SLS) regressions, this overall effect disappears with the radio coefficient becoming positive but insignificant. This suggests that the OLS effect may have had a downward bias, for instance because inhabitants of counties that experienced reductions in the share of musicians for unrelated reasons reacted by becoming early adopters of the radio.
An interaction between the radio share and urbanization levels is not significant in Column (3) of Table 1, but this may be misleading if the interaction is not linear. To account for this, and to test whether the effect does depend on the urbanisation share as hypothesised

in Section 1, I estimate a more flexible model in which the radio share is interacted with a spline basis for the urban share (see Table 3 in the Appendix).

The estimated marginal effects at different urbanization levels, shown in Figure 5, reveal that the relationship is indeed non-linear. In rural counties, radio either had no significant effect or a slightly positive effect on musician shares. In counties with moderate urbanization (30-40%), the effect was positive and significant. However, in highly urbanized counties (>80%), radio had a strong negative effect on the share of musicians.

TABLE 1 • EFFECT OF THE SHARE OF INDIVIDUALS WITH A RADIO AT HOME ON THE SHARE OF MUSICIANS IN 1930

	Dependent variable: Percentage of musicians					
	(1) OLS		**(2) 2SLS (A)**		**(3) 2SLS (B)**	
Musicians 1920	0.7953***	(0.0169)	0.8285***	(0.0214)	0.8289***	(0.0241)
Radio share	-0.0226***	(0.0047)	0.0341	(0.0222)	0.0336	(0.0220)
Radio share × Urban share					0.0019	(0.0459)
Urban share	0.0008	(0.0029)	-0.0041	(0.0035)	-0.0049	(0.0190)
Pop. density	0.0055***	(0.0004)	0.0045***	(0.0005)	0.0045***	(0.0012)
Unemployed share	-0.0258*	(0.0143)	0.0294	(0.0256)	0.0300	(0.0318)
Self employed share	0.0172***	(0.0054)	0.0318***	(0.0079)	0.0316***	(0.0087)
Regional FE	yes		yes		yes	
Anderson underid chi2			146.00		52.43	
Cragg-Donald F			152.51		26.52	
Anderson-Rubin F			2.45		1.32	
N	3063		3063		3063	
R-Squared	0.82		0.82		0.82	

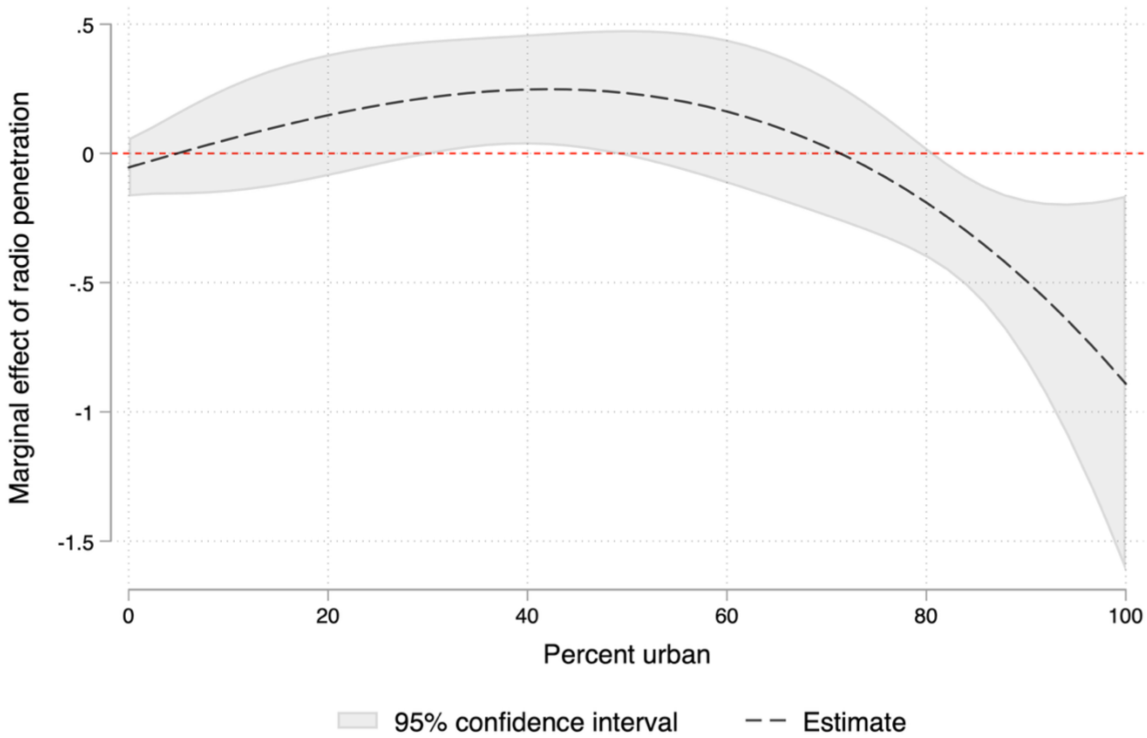
Standard errors in parentheses
* p<.1, ** p<.05, *** p<.01

Notes: Regressions are at county level and weighted by population. The dependent variable is the number of musicians per 100 people in 1930, while the variable of interest is the share of individuals with a radio at home. Controls include: Share of literate, seniors and black, share of the population that speaks English and those whose state of birth differs from the current state of residence. Moreover I include a state level control: Average income. First stage results in Table 2.

The estimated effect sizes are large, but plausible. For counties with a 50% urban share, the estimated effect size shown in Figure 5 is around .25. Since the musician share is measured as a percentage, this translates to an increase of 0.0025 percentage points in the share of musicians for increase in the radio share of one percentage point. For counties with a 90% urban share, the estimated effect is a decrease of 0.005 percentage points in the musician share for each increase of one percentage point in the radio share.

These results are consistent with the hypothesis that radio served as a substitute for live music in urban areas, where live music was already abundant, but complemented it in rural areas where professional music had previously been scarce. The complementary effect was strongest in moderately urban counties, perhaps because they combined sufficient population density to support musician employment with relatively low pre-radio exposure to professional music.

FIGURE 5 • MARGINAL EFFECT OF THE RADIO PENETRATION BY LEVELS OF URBANIZATION



Notes: The graph shows the estimated marginal effect of the percentage of individuals owning a radio at home on the percentage of musicians in each county by the level of county urbanization. Urbanization is measured as the percentage of individuals in a county living in urban areas. Results are based on the results shown in Table 3.

3. Conclusion

This paper investigates the effects of the radio revolution on the labour market for musicians in the United States during the 1920s. Radio technology was rapidly adopted by the population and could both complement and substitute for live music while employing relatively few musicians directly.

The results indicate that complementarities between radio and live music outweighed displacement effects in relatively rural places, but musicians were substituted by radio in highly urban areas. This pattern is consistent with a process whereby radio brought a taste for professional music to rural places that had previously experienced little of it, while acting mainly as a cheaper substitute in cities where access to live music was already ubiquitous.

This pattern of unequal impact across geographic and economic contexts parallels more recent experiences with digital information technologies. The findings suggest that when new media technologies expand the reach of creative content, we should expect heterogeneous effects based on pre-existing access to such content, with potential substitution in already-served markets and complementary effects in previously underserved areas.

While this analysis focuses on employment numbers rather than earnings, it hints at the possibility that radio contributed to wage inequality among musicians, particularly in urban areas where many musicians may have been displaced while others gained access to national audiences through broadcasting. This dimension of technological impact warrants further investigation in both historical and contemporary contexts.

References

Craig, S. (2001), *The Farmer's Friend: Radio Comes to Rural America, 1920-1927*, «Journal of Radio Studies», 8, 2: 330-346

Hammond, E. (1964), *Classes of Land-surface Form in the United States*, Data retrieved from U.S. Geological Survey

Hirsch, M. (2017), *Python for ITU P.368: Ground-Wave Propagation Curves For Frequencies Between 10 kHz and 30 MHz*

ITU (2014), *Handbook on Ground Wave Propagation - International Telecommunication Union. Radiocommunication Bureau.*

– (2018), *Ground-Wave Propagation (GRWAVE). Version 9.2. - International Telecommunication Union*

Kretschmer, T., Peukert, C. (2014), *Video Killed The Radio Star? Online Music Videos and Digital Music Sales*, CEP Discussion Papers 1265

Manson, S., Schroeder, J., Van Riper, D., Ruggles, S. (2018), IPUMS *National Historical Geographic Information System: Version 13.0 [Database]*, Minneapolis, University of Minnesota

Millington, G. (1949), *Ground-Wave Propagation Over an Inhomogeneous Smooth Earth*, Proceedings of the IEE-Part III: Radio and Communication Engineering, 96, 39: 53-64

Natural Resources Canada (2010), *North American Atlas – Hydrography*, Data retrieved from U.S. Geological Survey

Nielsen, E. (2013), *The Impact of the Digital Age on Professional Musicians*

Ruggles, S., Flood, S., Goeken, R., Grover, J., Meyer, E., Pacas, J., Sobek, M. (2020), *IPUMS USA: Version 10.0 [dataset]*, Minneapolis

Russo, G. (2020), *Mass Media and Cultural Homogenization: Broadcasting the American Dream on the Radio*, unpublished manuscript

Taylor, T.D. (2002), *Music and the Rise of Radio in 1920s America: Technological Imperialism, Socialization, and the Transformation of Intimacy*, «Historical Journal of Film, Radio and Television», 22, 4: 425-443

Trainotti, V. (1990), *Simplified Calculation of Coverage Area for MF AM Broadcast Stations*, «IEEE Antennas and Propagation Magazine», 32, 3: 41-44

Wang, T. (2021), *Media, pulpit, and populist persuasion: Evidence from Father Coughlin*, «American Economic Review», 111, 9: 3064-3092

APPENDIX

A. Additional Tables

This section contains additional tables such as full first stage regression results for table in the main text and a preliminary analysis looking at the long term effect of the radio on the share of musicians in 1940. Table 2 reports first stage results for the regression reported in Table 1, Columns (2) and (3).

TABLE 2 • EFFECT OF THE SHARE OF INDIVIDUALS WITH A RADIO AT HOME ON THE SHARE OF MUSICIANS IN 1930 - FIRST STAGE

	Share of individuals with a radio at home					
	(1) 2SLS (A)		**(2) 2SLS (B)**		**(3) 2SLS (B)**	
Suitability	0.0315***	(0.0025)	0.0414***	(0.0036)	-0.0053*	(0.0031)
Suitability × Urban share			-0.0236***	(0.0062)	0.0327***	(0.0053)
Urban share	0.0513***	(0.0110)	-0.0064	(0.0188)	0.4879***	(0.0158)
Regional FE						
N	3063		3063		3063	

Standard errors in parentheses
* $p < .1$,** $p < .05$,*** $p < .01$

Notes: The table reports first stage estimates for the regressions in Table 1, Columns (2) and (3). The dependent variable is the share of radios in the county. See Section 2 for details on data sources.

Table 3 reports the spline regression and the relative first stage regressions. The marginal effects estimated are plotted in Figure 5.

TABLE 3 • EFFECT OF THE SHARE OF INDIVIDUALS WITH A RADIO AT HOME ON THE SHARE OF MUSICIANS IN 1930 - SPLINE REGRESSION

	Dependent variable: Percentage of musicians				
	(1) 2SLS	**(2) First stage**	**(3) First stage**	**(4) First stage**	**(5) First stage**
Musicians 1920	0.5305***	-0.0200***	-0.2052***	-0.3364***	-0.0619***
	(0.1166)	(0.0074)	(0.0331)	(0.0350)	(0.0068)
Radio share × B-spline 1	-1.3557				
	(3.6657)				
Radio share × B-spline 2	0.0311				
	(1.3463)				
Radio share × B-spline 3	0.9053				
	(1.6370)				
Radio share × B-spline 4	-9.0006				
	(7.1610)				
Pop. density	0.0041**	0.0001	0.0100***	0.0124***	0.0010***
	(0.0019)	(0.0002)	(0.0010)	(0.0011)	(0.0002)
Unemployed share	-0.1122*	-0.0362***	-0.3853***	-0.4544***	-0.0549***
	(0.0636)	(0.0060)	(0.0267)	(0.0283)	(0.0055)
Self-employed share	0.0909***	-0.0421***	-0.2281***	-0.0706***	0.0061**
	(0.0291)	(0.0027)	(0.0120)	(0.0127)	(0.0025)
B-spline 1	-6.6208	0.6055***	1.5159***	-1.6963***	-1.0890***
	(5.2530)	(0.0746)	(0.3319)	(0.3508)	(0.0680)
B-spline 2	-5.4368*	0.1297***	0.9728***	-1.2121***	-0.8030***
	(3.1026)	(0.0339)	(0.1507)	(0.1593)	(0.0309)
B-spline 3	-6.6013	0.1613***	0.9189***	-1.1820***	-0.9596***
	(4.4450)	(0.0540)	(0.2402)	(0.2539)	(0.0492)
B-spline 4	0.0000	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)	(.)

	Dependent variable: Percentage of musicians				
	(1) 2SLS	**(2) First stage**	**(3) First stage**	**(4) First stage**	**(5) First stage**
Suitability × B-spline 1		0.1437***	0.2852***	-0.4117***	-0.0721***
		(0.0142)	(0.0634)	(0.0670)	(0.0130)
Suitability × B-spline 2		-0.0264***	-0.0226	0.1416***	0.0222***
		(0.0043)	(0.0193)	(0.0204)	(0.0040)
Suitability × B-spline 3		0.0245***	0.0308	-0.1317***	-0.0228***
		(0.0045)	(0.0202)	(0.0213)	(0.0041)
Suitability × B-spline 4		-0.0933***	-0.0346	0.6274***	0.1037***
		(0.0174)	(0.0775)	(0.0819)	(0.0159)
N	3063	3063	3063	3063	3063

Standard errors in parentheses
$* \ p < .1, ** \ p < .05, *** \ p < .01$

Notes: The table reports results from a spline regression where the dependent variable is the number of musicians per 100 people in 1930 and the radio share is interacted with cubic splines for the urbanization rate. See Section 2 for details on data sources.