Technical Change and Superstar Effects: Evidence from the Rollout of Television

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Paper Overview

- The Rosen (1981) framework argues that (scale-related) technical change can amplify inequality at the top of the wage distribution and generate extremely well-paid superstars $\rightarrow$ but little causal evidence
- This paper will:
  - present a closed-economy superstar model
  - leverage a natural experiment to develop an empirical test of the superstar model.
- Empirical Setting: The entertainment industry and the early rollout of TV across the nation.

Theoretical Model: Superstar Effects and SRTC

- Setup: Workers (actors) with heterogeneous talents (t) and firms (theaters) of varying size (s). Production function is such that t and s are complements ($\frac{\partial Y}{\partial s \partial t} > 0$)
- Distributional assumption: t and s are Pareto distributed with shape parameters α and β, respectively.
- Each theater hires only one actor and generates revenue $Y(s,t) = \pi(st)^{1/\phi}$, where:
  - π is the output price.
  - ϕ is the degree of returns to scale in production. High ϕ implies more diminishing returns to scale.
  - The results will hold for broader functional form assumptions
- The equilibrium is characterized by the incentive compatibility condition, the participation condition, the assignment function of workers to firms, and market clearing.

Theoretical Model: Superstar Effects and SRTC

- Complementarity assumption ($\frac{\partial Y}{\partial s \partial t} > 0$) $\rightarrow$ better actors have a comparative advantage in bigger theaters $\rightarrow$ 1-1 Positive assortative matching equilibrium
- The share of workers with income above ω, denoted by p_ω, can be derived as:

$$\ln(p_\omega) = \gamma_0 - \gamma_1^\omega \phi$$

where $\gamma_0 = \frac{\phi}{\alpha+\beta} \ln(\frac{\beta\pi}{\alpha+\beta})$ and $\gamma_1^\omega = \frac{\ln(\omega)}{\alpha+\beta}$

- Consider a scale-related technical change (SRTC) that expands production scalability by decreasing ϕ. Both terms of the above equation are affected by ϕ:
  - The first term affects all workers equally and captures the general change in marginal cost and marginal revenues.
  - The second term captures the gains, which are unequally distributed: γ_1^ω is larger for ω $\rightarrow$ SRTC generates larger gains at the top of the distribution.

Derivation of Key Equation

- From incentive compatibility (IC) constraints:

$$Y(s_i, t) - w(t) \geq Y(s_i, t') - w(t') \; \forall \; t' \rightarrow \frac{\partial w}{\partial t} = \frac{\partial Y(S_i, t)}{\partial t}$$

- Using the functional form assumptions and PAM 1-1 sorting, we can rewrite (where $\xi = \frac{\phi}{\alpha+\beta}$):

$$\frac{\partial w}{\partial t} = \frac{\pi}{\phi} s^{1/\phi} t^{1/\phi - 1} = \frac{\pi}{\phi} t^{1/\xi - 1}$$

- Integrating and normalizing $w(\underline{t}) = 0$ give:

$$w(t) = \int_{\underline{t}}^{t} \frac{\partial w}{\partial t} = \frac{\phi\beta}{\alpha+\beta} t^{-1/(\beta\xi)} = \frac{\phi\beta}{\alpha+\beta} [p_w]^{-1/\xi}$$

taking logs, evaluating w at ω and re-arranging yields the equation $\ln(p_\omega) = \gamma_0 - \gamma_1^\omega \phi$

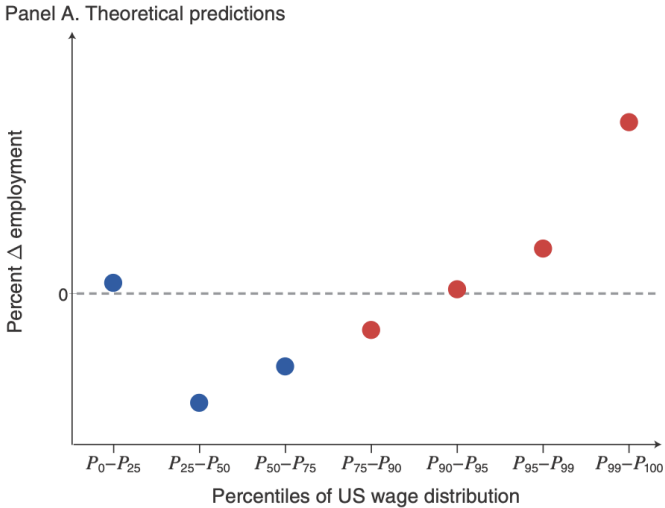
Theoretical Model: Superstar Effects and SRTC

PROPOSITION 1: In the superstar economy, SRTC leads to:

1. Top wage growth: for sufficiently high income k, SRTC increases the share of workers above this extreme income level: $\Delta \ln(p_\omega)|_{\omega > k} > 0$
2. Fractal inequality: the effect of SRTC on the share of workers with income greater than ω (p_ω) is larger at higher income levels: $\Delta \ln(p_\omega) > \ln(p_{\omega'})$ if $\omega > \omega'$
3. Adverse effects for lesser talents: employment at midpay levels declined
4. Employment loss: for a given outside option w^{res} and corresponding participation threshold $\bar{p}$, SRTC increases the participation threshold $\bar{p}$: $\partial \bar{p} / \partial \phi < 0$

Theoretical Model: Superstar Effects and SRTC

Theoretical predictions derived by differentiating equation above and parameterizing the result for a stylized shock that changes the scale parameter by a factor of 1.3



Model Discussion

- Canonical skill-based technical change models features only 2 skill groups $\rightarrow$ produce little top-income dispersion.
- To replicate fractal inequality, would need to introduce more groups of workers (taking the number of groups to infinity) that are imperfect substitutes $\rightarrow$ unattractive option since it introduces infinitely many parameters.
- Task-specific technical change models face similar limitations: wage dispersion arises across skill groups only. Can generate a task model that is isomorphic to a superstar model by letting the number of tasks and skill groups $\rightarrow \infty$.
- The task model studies the impact of factor augmenting shocks. To produce fractal inequality with such shocks, have to assume that the technological shock is fractal itself (technology boosts productivity most for the highest-productivity workers.)

Empirical Test of Superstar Effects

- Television is a canonical case of SRTC, sharply expanding audience reach for entertainers $\rightarrow$ exploit the rollout process:
  - Technological and regulatory constraints largely confined pioneering TV stations to film live and locally to the broadcast antenna.
  - A second source of variation is an unplanned interruption of the rollout in 1948 $\rightarrow$ can use the stations whose license was on hold for placebo checks.
  - Also observe the decline of local TV filming in a subsequent period (bc of the videotape) $\rightarrow$ use this period to test whether local stations stop generating local superstars
- Descriptive evidence:
  - Between 1940 and 1970, the entertainer wage distribution became more right skewed and midpaid positions were reduced.
  - Employment growth among entertainers lagged behind the rest of the leisure industry

Descriptive Evidence

Entertainers include: actors, athletes, dancers, musicians, and entertainers not elsewhere classified

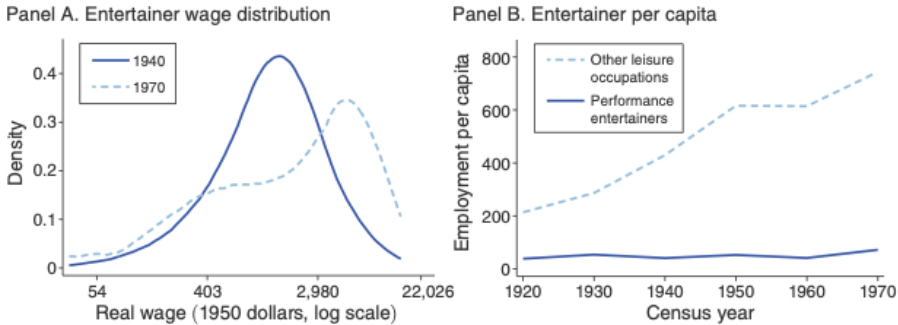


FIGURE 2. CHANGE IN ENTERTAINMENT 1940–1970

Empirical Strategy

- Data on local entertainers: the US decennial population census 1940-1980.
- Data on television exposure: hand-collected data on the location of television stations.
- The full sample includes 722 local labor markets (CZs), five occupation groups, and four census years
- The DID estimation equation is

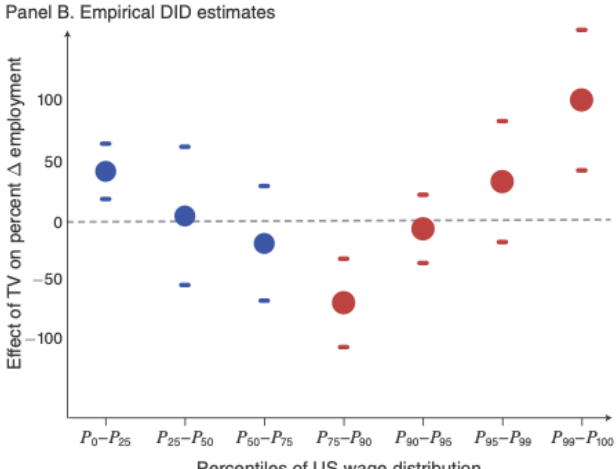
$$Y_{mot} = \alpha_m + \delta_{ot} + \gamma X_{mt} + \beta_t TV_{mt} + \epsilon_{mot}$$

- β_t captures the effect of local television stations, and this effect is allowed to change with the invention of the videotape in 1956.

Empirical Results

Outcome variable: the share of entertainers that reach income level ω in each local labor market (p_ω)

Measurement issue: the denominator of p_ω is affected by SRTC as well $\rightarrow$ Solution: fix a baseline employment level



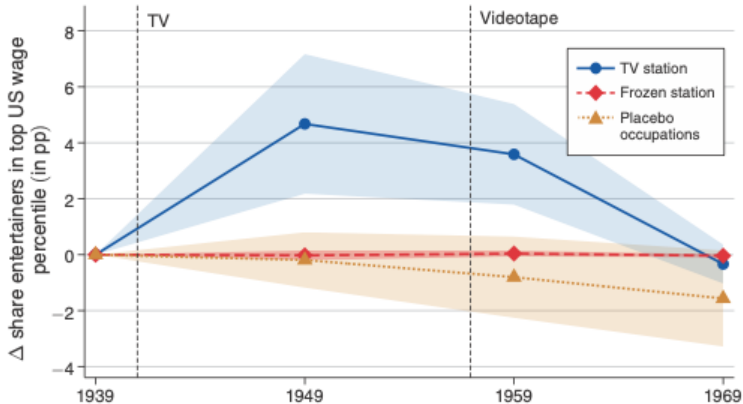
Empirical Results

Outcome variable: Log wage at the 99th percentile

	(1)	(2)	(3)
	Ln(99^{th} Percentile of Entertainer Wages)		
	Panel A: No Imputation		
Local TV stations	0.182	0.189	0.147
	(0.078)	(0.079)	(0.118)
	Panel B: Fixed Multiple Imputation		
Local TV stations	0.213	0.218	0.171
	(0.085)	(0.087)	(0.125)
	Panel C: Pareto Imputation		
Local TV stations	0.283	0.277	0.237
	(0.095)	(0.089)	(0.132)

Robustness

Placebo occupations: main high-paying occupations (medics, engineers, managers, and service professionals)



Employment effects

	ln(*Employment in Entertainment*)			
	(1)	(2)	(3)	(4)
Panel A. Sample 1940–1970				
TV signal$_t$	−0.128	−0.114	−0.139	
	(0.061)	(0.061)	(0.062)	
Panel B. Placebo sample 1940–1970				
Placebo TV signal$_t$	0.053	0.044	0.053	
	(0.083)	(0.083)	(0.084)	
Panel C. Sample 1930–1970				
TV signal$_{t+1}$				0.039
				(0.033)
TV signal$_t$	−0.133	−0.127	−0.133	−0.123
	(0.059)	(0.059)	(0.061)	(0.060)

Monopsony effects

- In many modern contexts SRTC may be associated with rising monopsony power, since a small number of technology companies control access to such technologies.
- To investigate this, distinguish between places with a single monopsony TV station and places with multiple stations.
- Markets with a single TV station see almost no top income growth, while in markets with competing TV stations top incomes increase sharply.
  $\rightarrow$ The growing market scale only translates into rising top pay if employers are competing for talent.

Monopsony effects

	(1)	(2)	(3)
	Entertainer among Top 1% of US Earners		
Local TV station (dummy)	5.90	0.75	-0.55
	(3.06)	(1.91)	(0.32)
Multiple local TV stations (dummy)		9.07	10.37
		(4.99)	(4.70)
Blocked competitor (dummy)			1.43
			(2.10)

Alternative Channels

- Migration of entertainers? The census asks individuals if they migrated recently $\rightarrow$ use this information to test for entertainer migration responses and find very small effects.

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- Commuting across local labor market boundaries? Excluding areas that are adjacent to television launch locations from the analysis shows very similar effects
- Television changed the type of talent required of entertainers?
  - Historic description of television recruiting at the time suggests that the types of talent remained the same.
  - Digitize "who is who" lists of 1950 TV stars and merge individuals in these lists to their 1940 census records to build a small panel $\rightarrow$ Analyze changes in earning ranks of TV stars $\rightarrow$ TV did not generate major leapfrogging.

Conclusion

- This paper provides the first direct test of the Rosen superstar, using a simple natural experiment, and finds clear evidence that scale-related technological change can generate superstar effects.
- The launch of a TV station increased audiences of star entertainers and created high-paid superstar entertainers.
- Interesting avenue for future research: explore which other sectors meet the conditions for superstar effects and to quantify how the magnitude of these effects vary across different sectors of the economy.