An economic analysis of federally funded vocational education in the early 20th-century U.S.

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A shift in public conversation

History repeats itself

"Surely it is eminently in accord with the principles of our democratic life that we should furnish the highest average industrial training for ordinary skilled workmen. But it is a curious thing that in industrial training we have tended to devote our energies to producing high-grade men at the top rather than in the ranks."

- **President Theodore Roosevelt**
Letter to the National Society for the Promotion of Industrial Education (May 24, 1907)

This project

1. Has federal spending increased enrollment in vocational training historically?
   i. 1944: Servicemen's Readjustment Act (G.I. Bill)
   ii. 1917: Smith-Hughes Vocational Education Act

2. Among non-college bound students, did attending vocational school improve wages and reduce unemployment?

Why these questions matter:

- Implications for national education and labor policy
- Role of the public education system in matching labor supply + demand

Literature

G.I. Bill overview

An Act to provide Federal Government aid for the readjustment in civilian life of returning World War II veterans. […] This Act may be cited as the "Servicemen's Readjustment Act of 1944".

– June 22, 1944, Public Law 346

- Direct cash benefits to individual veterans
  - $500 for tuition/books + $50-$120 monthly stipend
  - Served between Sept. 1940 and July 1947; at least 90 days
  - Min. 1 year training/eduction → up to 4 years depending on service
- Similar Bill for Korean War (served 1950-1955)

G.I. Bill take up

Utilization of Veterans' Education Benefits

G.I. Bill	Number Eligible	Number of Veterans Enrolled				Program Cost (Billions of Dollars)
		College	Other Schools	On-the-Job Training	Farm Training	
World War II	15,440,000*	2,230,000	3,480,000	1,400,000	690,000	14.5
Korea	5,509,000	1,213,000	860,000	223,000	95,000	4.5
Vietnam	8,200,000	5,100,000	2,500,000	591,000	56,000	42

SOURCE.—U.S. Department of Veterans' Affairs (1999).
* Total veteran population.

Source: Bound & Turner (2002), Appendix B2

Empirical strategy #1

Vocational school completion

Approach - Bound and Turner (2002), Thomas (2017)

Idea: WWII military service → benefit eligibility → college education

$$Y_{ics} = \beta_0 + \beta_1 * WWII_{cs} + \beta_2 * Korea_{cs} + \beta_3 * State + \beta_3 * Trend + \beta_4 * Trend^2 + e_{ics}$$

Y_{ics}: College graduate; years of education → **This project: use vocational school completion**

$WWII_{cs}$: fraction served in WWII (birth cohort-state)

$Korea_{cs}$: fraction served in Korean War (birth cohort-state)

State: State of birth dummy

Trend: birth year – 1929 + birth quarter/4

Empirical strategy #2

Possible complication: G.I. Bill allows college, high school, or job training

Solution: multinomial logit model

- Compare relative odds of choosing vocational training over, e.g., GED
- Alternatives
  - No education
  - H.S. (or equivalent) but no vocational training
  - Vocational school
  - College

Public data sources

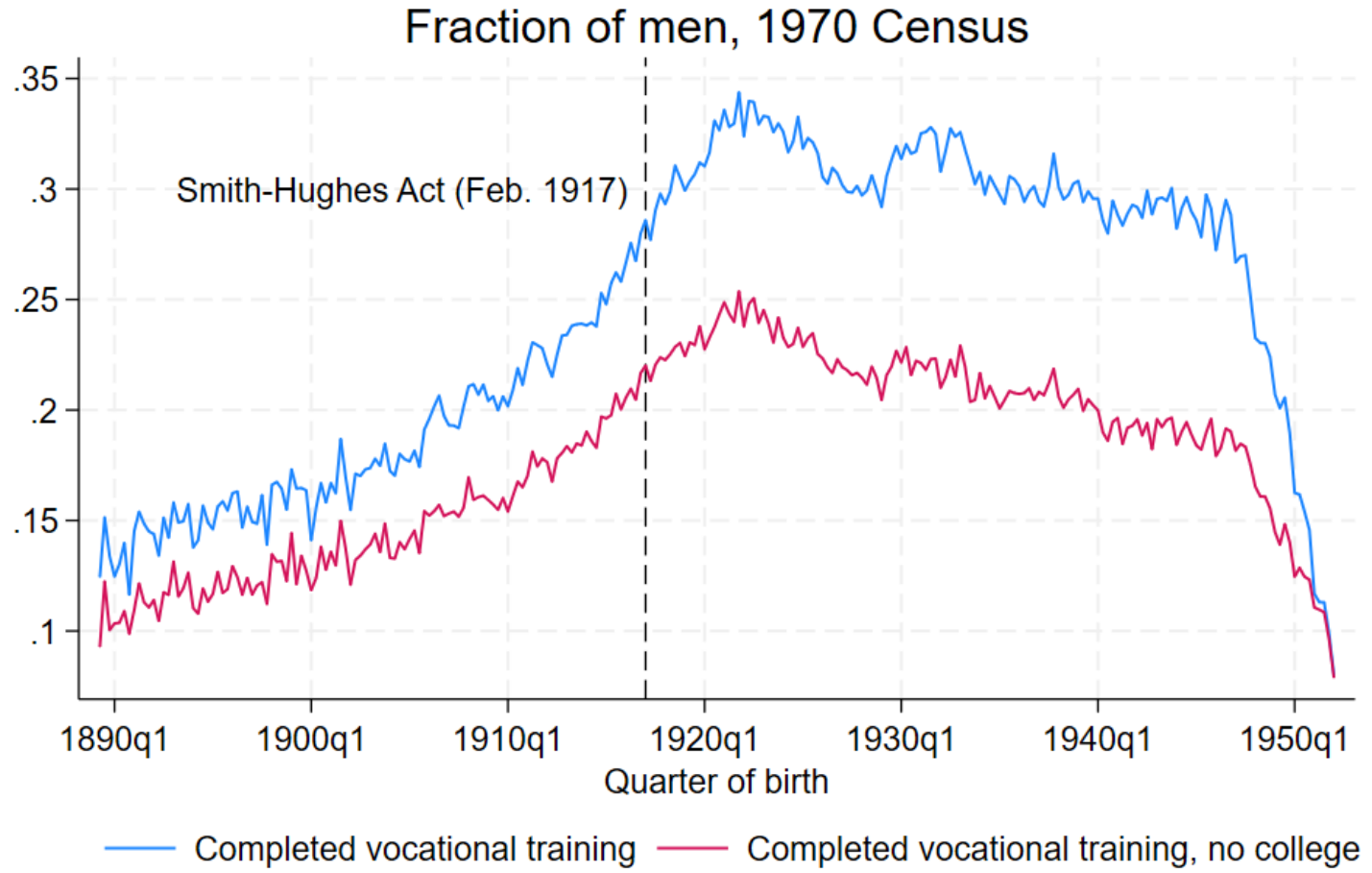
U.S. Census - 1970 1% samples (IPUMS)

Key variables:

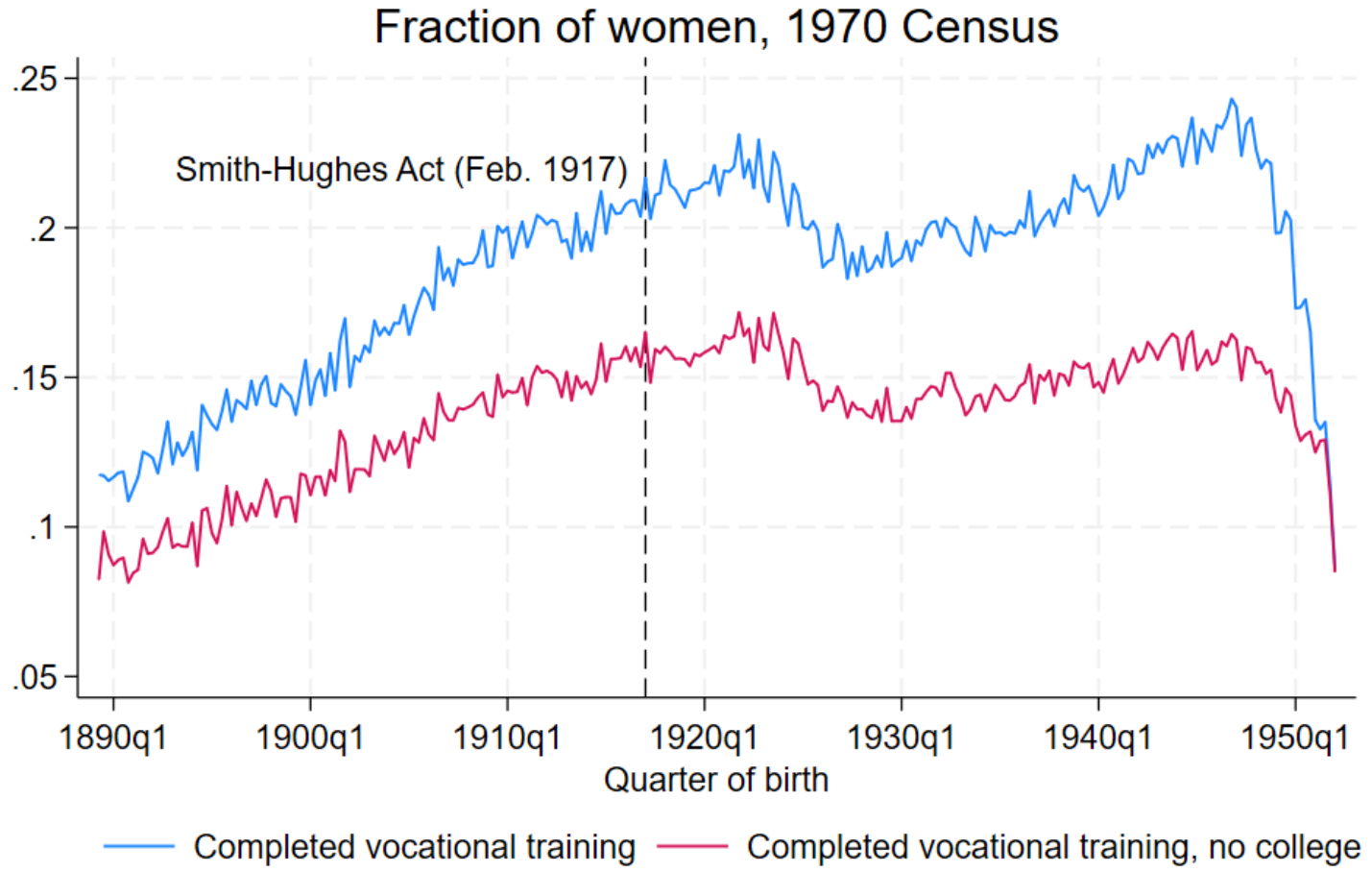
- Vocational training *(SCHLVOC)*
  - Ever completed a vocational training program + main field of training.
  - Special high school programs, apprenticeships, business, nursing, and trade schools, technical institutes, and armed forces schools

- Military service *(VETWWII, VETKOREA)*

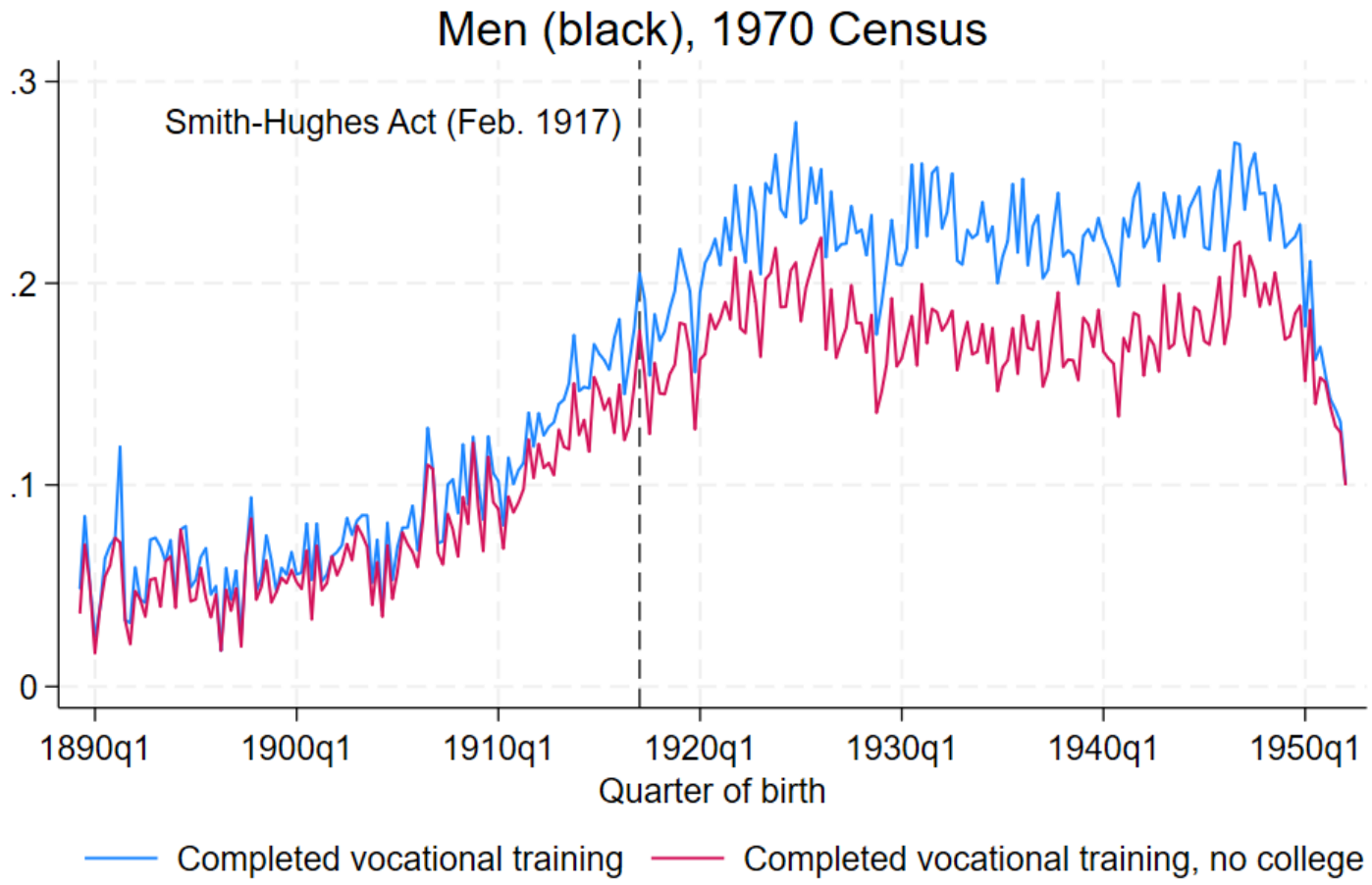
Vocational training by birth cohort



Vocational training by birth cohort



Vocational training by birth cohort



What kind of training?

Table 1: Type of vocational training - Men

	Vocational training %	Only voc. training %	White %	Black %
Business, office work	14.15	11.05	11.22	8.44
Nursing, health fields	2.47	1.53	1.44	3.00
Trades and crafts	55.40	64.14	64.41	60.17
Engineering, drafting, science technician	12.52	8.48	8.69	5.40
Agriculture, home economics	3.36	3.65	3.66	3.46
Other vocational field	5.67	4.79	4.71	5.93
Field not reported	6.42	6.35	5.87	13.59
N	298,429	212,595	199,367	13,228

Age 25-65, in labor force. 'Only' vocational training omits any college.

Women

What types of occupations?

Occupation (1950)	No vocational training	Business	Nurse	Trade	Engineer	Ag + Home Ec	Other	No report
Barbers, beauticians	16.08	1.46	0.66	77.52	0.24	0.14	2.3	1.61
Practical nurses	17.97	1.26	78.97	0.78	0.04	0.08	0.21	0.7
Nurses, professional	23.2	1.63	72.63	0.76	0.24	0.19	0.33	1.01
Office machine-mechanic	32.42	4.51	0.18	37.89	21.38	0.24	1.84	1.54
Technicians	32.59	2.56	0.78	28.44	31.46	0.36	2.38	1.44
Radio and television- repair	34.12	1.18	0.2	48.22	12.07	0.13	2.03	2.06
Airplane mechanics	36.4	1.16	0.27	54.14	4.14	0.59	1.8	1.51
Pattern and model makers	38.05	0.64	0	52.95	5.47	0.54	1.18	1.18
Electricians	38.27	0.98	0.15	54.8	3.02	0.42	0.89	1.46
Airplane pilots	39.07	1.05	0.28	40.9	4.71	0.98	9.7	3.3
Electrotypers and stereotypers	39.63	4.27	0	51.83	0	0	1.22	3.05
Tool makers, and die-makers	39.79	0.85	0.07	53.75	3.01	0.25	1.06	1.22
Funeral directors and embalmers	42.46	15.29	17.86	9.95	1.07	0.21	8.77	4.39

Did the GI Bill increase vocational training?

Table 3: Effect of WWII service on Vocational training (0/1)

	(1) Vocational training	(2) Only voc. training	(3) College	(4) H.S.
Fraction WWII	0.165***	0.0926***	0.0769*	0.0358
	(0.0279)	(0.0222)	(0.0293)	(0.0428)
Fraction Korea	0.206***	0.115***	0.0573	0.116*
	(0.0314)	(0.0264)	(0.0343)	(0.0442)
N	192,340	192,340	382,817	382,817

'Only' vocational training omits any college. Std. errors in parentheses, clustered by birth cohort-state of birth.

Comparison across cohort samples

Table 4: Effect of WWII service on Vocational training (0/1) - birth cohort samples

	(1) 1923-1932	(2) 1923-1928	(3) 1923-1930	(4) 1923-1936
Fraction WWII	0.0926***	0.113***	0.102***	0.0819***
	(0.0222)	(0.0265)	(0.0257)	(0.0189)
Fraction Korea	0.115***	0.0974*	0.0968**	0.107***
	(0.0264)	(0.0385)	(0.0296)	(0.0174)
N	192,340	117,991	155,945	264,003

'Only' vocational training omits any college. Std. errors in parentheses, clustered by birth cohort-state of birth.

Same effects for black veterans?

Table 5: Effect of WWII service on Vocational training (0/1) - black men

	(1) All regions	(2) Southern Regions
Fraction WWII	0.0902***	0.0697
	(0.0224)	(0.0380)
Fraction Korea	0.114***	0.0895**
	(0.0266)	(0.0252)
black	-0.0446***	-0.0721***
	(0.00831)	(0.0168)
black=1 × Fraction WWII	0.0207	0.0792
	(0.0140)	(0.0467)
N	192,340	28,897

Std. errors in parentheses, clustered by birth cohort-state of birth.

Multinomial logit – base = no training

Table 6: Effect of WWII service on education decisions

	(1)		
	H_S_	Vocational_training	College
Fraction WWII	0.689***	1.967***	1.807***
	(0.0588)	(0.159)	(0.105)
Fraction Korea	0.881	2.268***	1.768***
	(0.0923)	(0.229)	(0.127)
N	382,817		

Odds ratios reported. Std. errors in parentheses.

Multinomial logit – base = college

Table 7: Effect of WWII service on education decisions

	(1)		
	None	H_S_	Vocational_training
Fraction WWII	0.553***	0.381***	1.088
	(0.0322)	(0.0347)	(0.0948)
Fraction Korea	0.566***	0.498***	1.283*
	(0.0407)	(0.0554)	(0.138)
N	382,817		

Odds ratios reported. Std. errors in parentheses.

Smith-Hughes Act provisions

An Act to provide for the promotion of vocational education; to provide for cooperation with the States in the promotion of such education in agriculture and the trades and industries; to provide for cooperation with the States in the preparation of teachers of vocational subjects; and to appropriate money and regulate its expenditure – February 23, 1917, Ch. 114, §1, 39 Stat. 929

$7 million annually to the States

- Salaries of teachers, supervisors, or directors
  - $3 million → agricultural subjects
  - $3 million → trade, home economics, & industrial subjects
- Preparing teachers, supervisors, and directors
  - $1 million

Fund allocation rules

- Agricultural → ratio of rural pop. to total U.S. rural
- Trade/Home Econ/Industrial → ratio of urban pop. to total U.S. urban
- Teacher training → ratio of population to total U.S.

Smith-Hughes Act provisions (cont.)

Established Federal Board of Vocational Education (1917-1946)

- Unprecedented oversight of secondary education

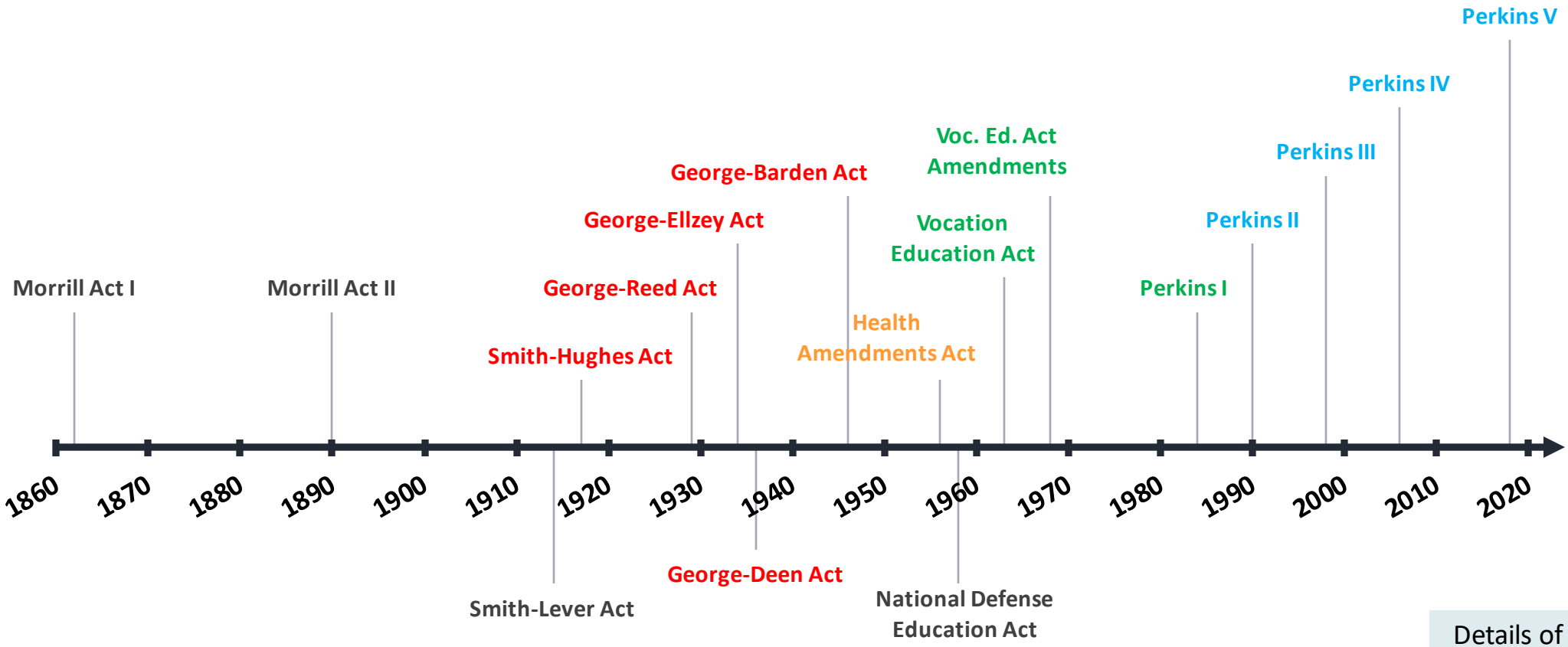
State boards of vocational education

- Prepare plans for fund use
- Annual report to Congress work done + receipts/expenditures
- Match Federal dollar amount

School requirements:

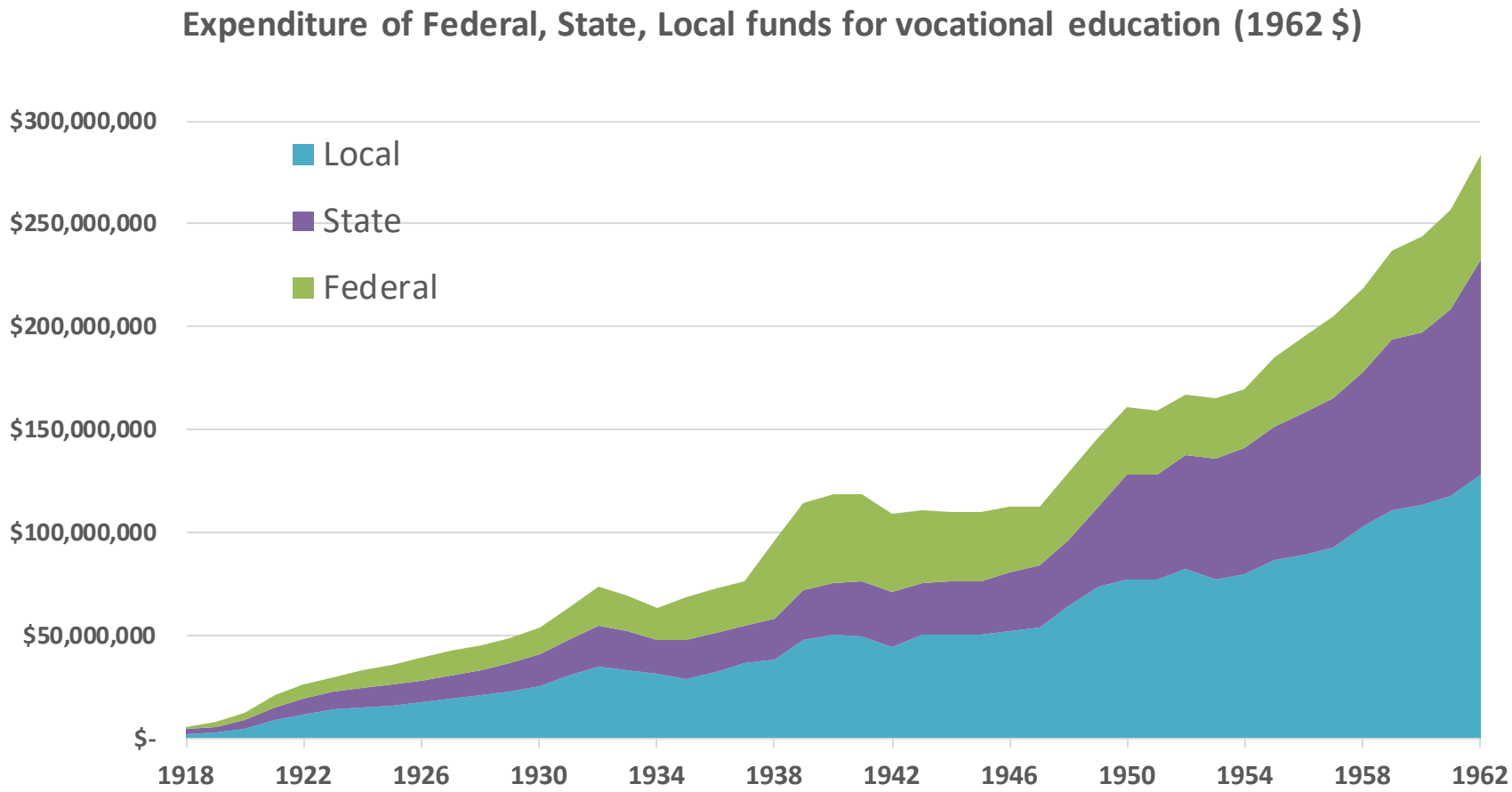
- Under public supervision
- Make students “fit for useful employment”
- Less than college grade
- Students over 14 years (over 16 for evening classes)

Timeline of legislation 1862-2018



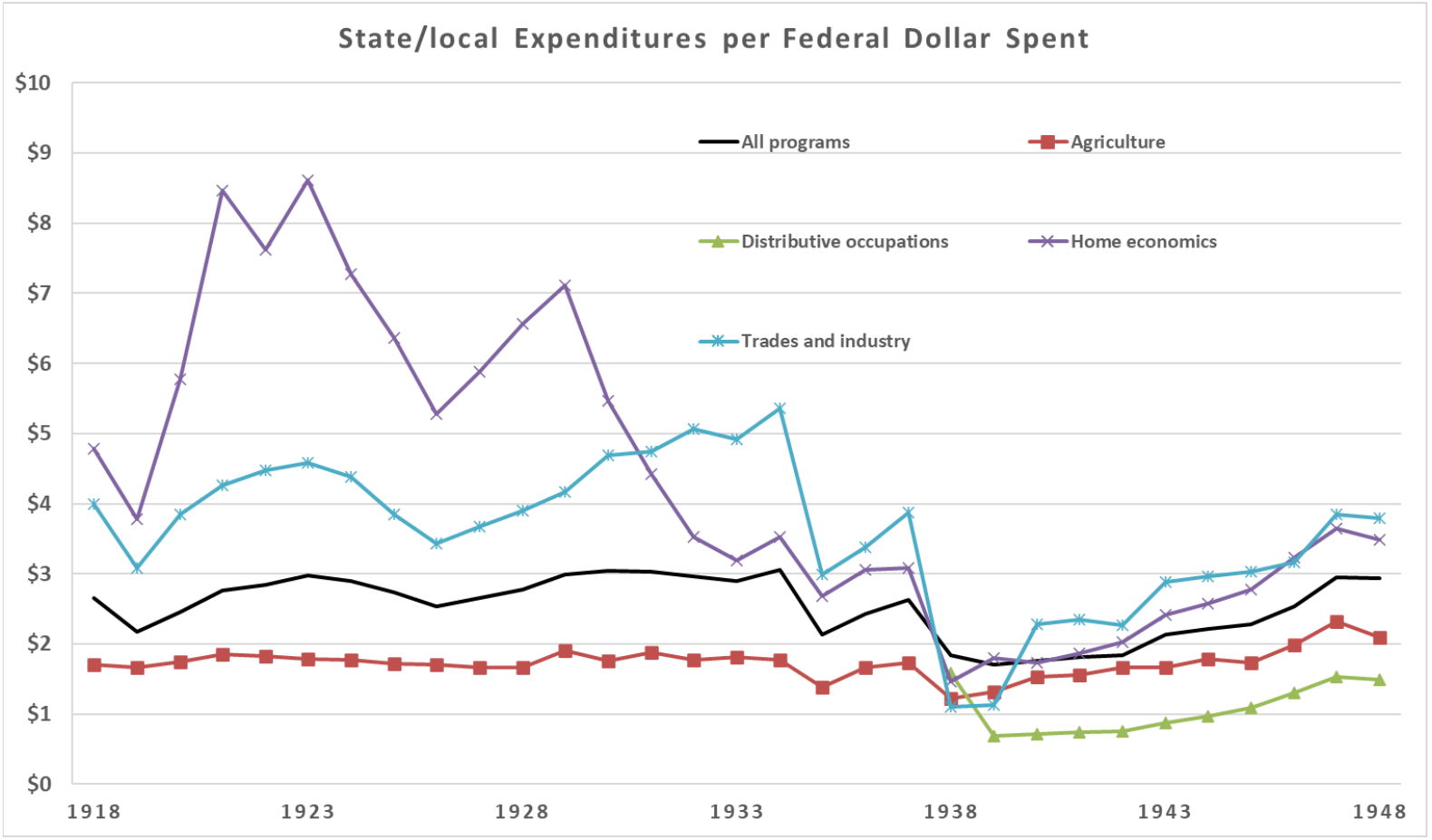
Details of legislation

Use of funds by the States



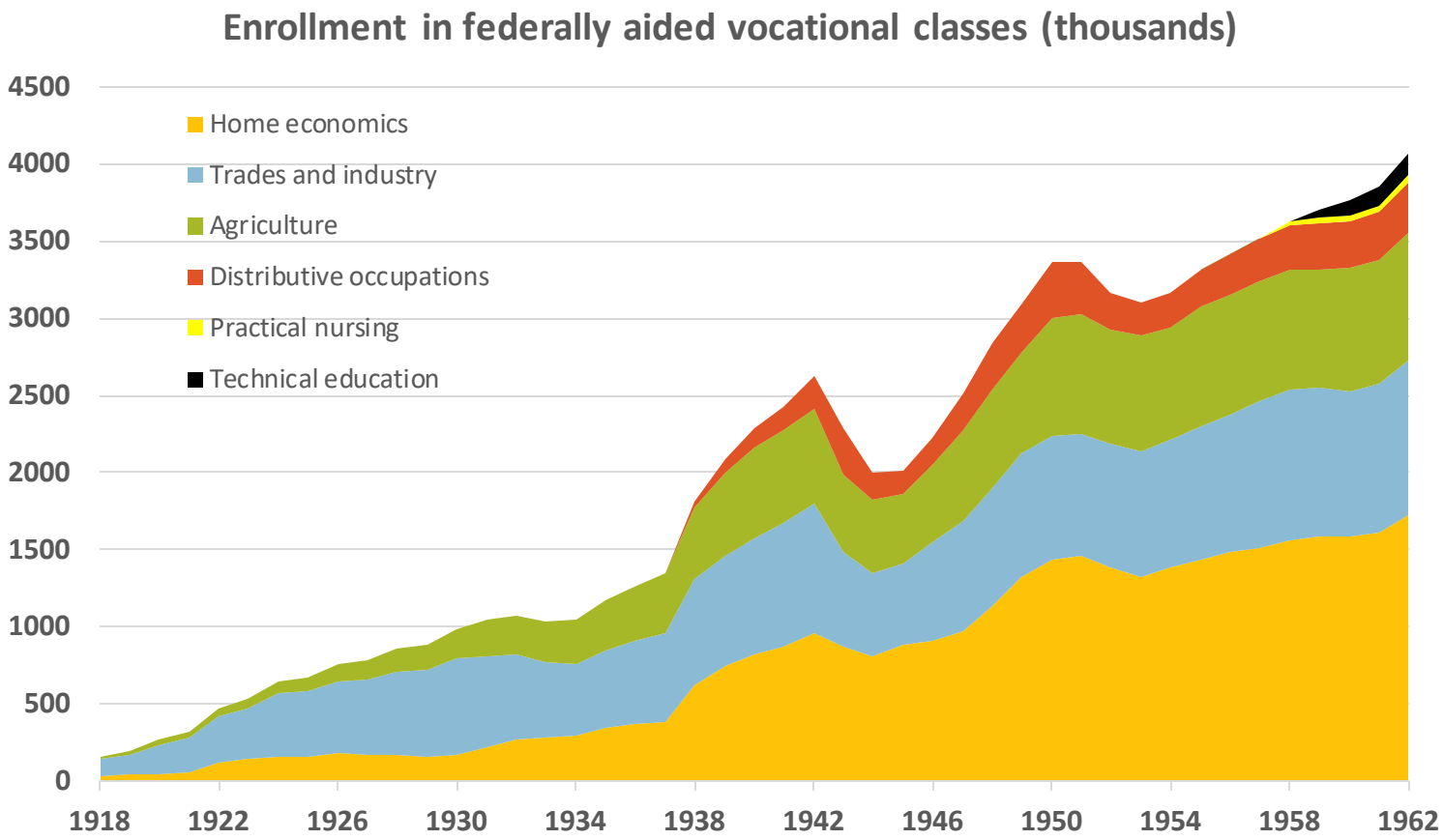
Source: Digest of annual reports of state boards for vocational education to the Office of Education, Division of Vocational and Technical Education (1962).

Expenditures per dollar of Federal



Source: Digest of annual reports of state boards for vocational education to the Office of Education, Division of Vocational Education (1950).

First four decades of enrollment



Including H.S.

Source: Digest of annual reports of state boards for vocational education to the Office of Education, Division of Vocational and Technical Education (1962).

Next steps

- Interaction of Smith-Hughes Act with WWI labor demand
  - E.g., radio operators in Signal Corps.
- State-specific case studies (non-federal legislation)
- Compulsory schooling laws

Appendix

Timeline of legislation 1862-1946

1862 Morrill Land Grant Act

- Federally land gifts to States to open colleges for agriculture and mechanical arts
- 1890: expanded access for Black students

1917 Smith-Hughes Act

- $7 million annual federal aid to states
- Promotion of vocational education in agriculture, trade/industrial education, and home economics
- Explicitly below college level

1929 George-Reed & 1934 George-Ellzey Acts

- Increase of $1 million annually until 1934; then $3 million for three years

1936 George-Deen Act

- Increased to $14 million
- Expanded to "distributive occupations" → e.g., retail sales, store managers, purchasing agents

1946 George-Barden Act

- Increased to $29 million

Back

Timeline of legislation 1958-1984

1958 National Defense Education Act

1962 Manpower Development and Training Act

1963 Vocational Education Act

1968 Vocational Education Amendments

1976 Vocational Education Amendments

1984 Carl D. Perkins Vocational Education Act (Perkins I)

Back

Timeline of legislation 1990-today

1990 Carl D. Perkins Vocational and Applied Technology Act (Perkins II)

1998 Carl D. Perkins Vocational and Technical Education Act (Perkins III)

2006 Carl D. Perkins Career and Technical Education Act (Perkins IV)

2018 Strengthening Career and Technical Education for the 21st Century Act (Perkins V)

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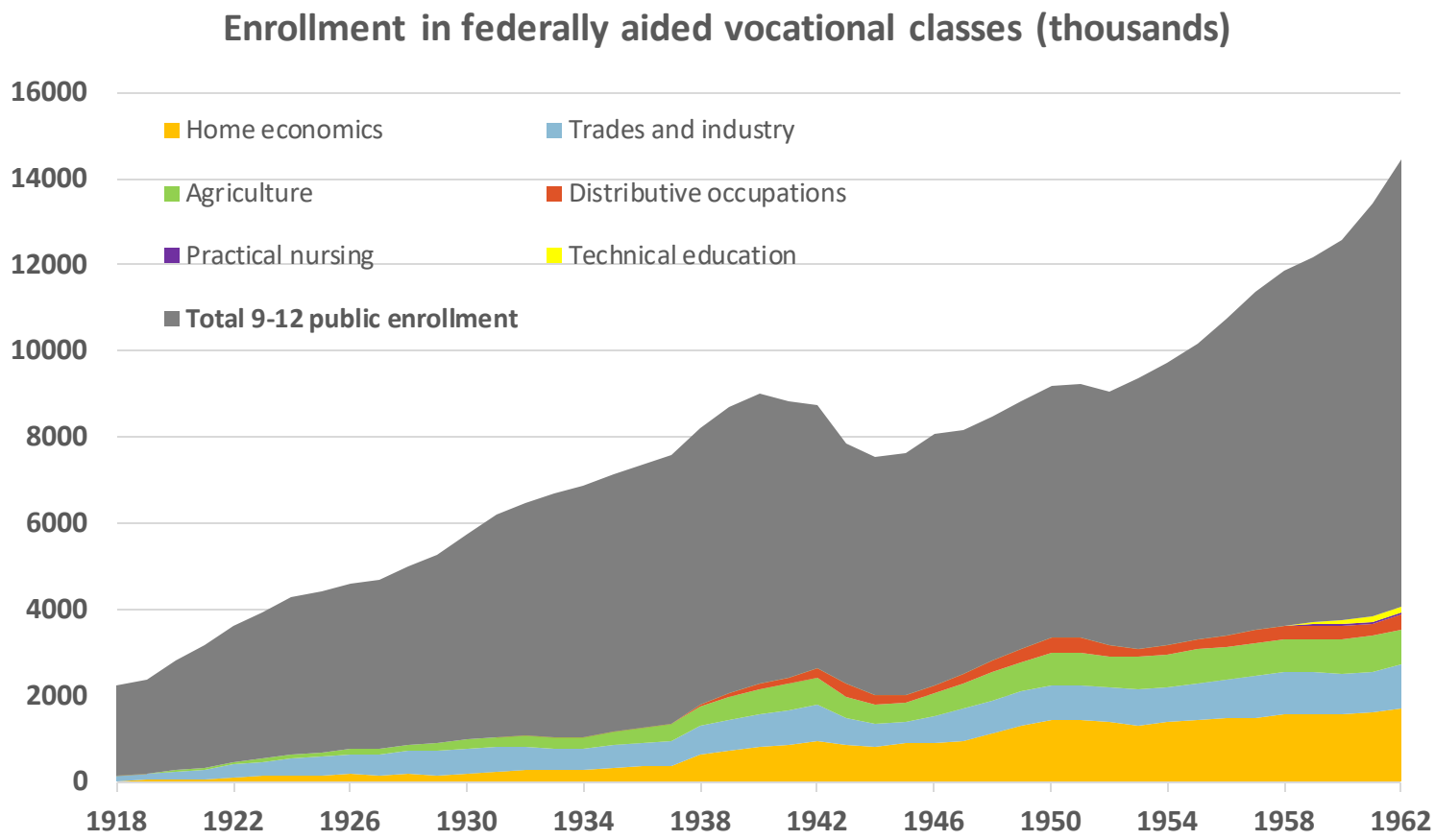
Relative to total H.S. enrollment



Source: Digest of annual reports of state boards for vocational education to the Office of Education, Division of Vocational and Technical Education (1962).

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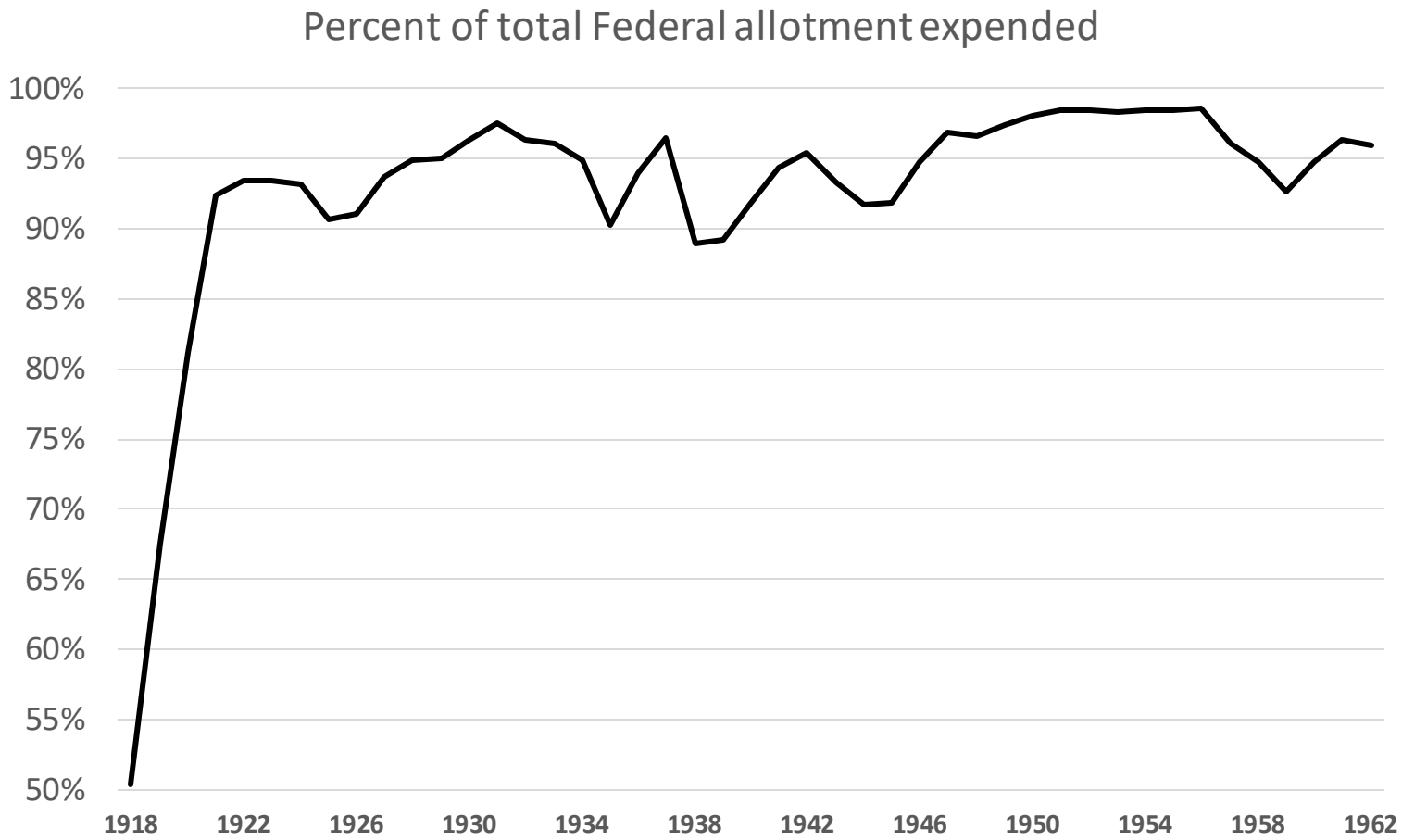
High take up and use of funds



Source: Digest of annual reports of state boards for vocational education to the Office of Education, Division of Vocational and Technical Education (1962).

What kind of training?

Table 2: Type of vocational training - Women

	Vocational training %	Only voc. training %	White %	Black %
Business, office work	48.32	50.62	53.52	27.40
Nursing, health fields	23.68	20.18	18.70	32.12
Trades and crafts	13.51	16.54	16.00	20.84
Engineering, drafting, science technician	0.70	0.55	0.55	0.54
Agriculture, home economics	1.92	1.75	1.56	3.31
Other vocational field	4.43	2.71	2.63	3.34
Field not reported	7.44	7.64	7.04	12.45
N	136,249	98,551	87,622	10,929

Age 25-65, in labor force. 'Only' vocational training omits any college.

Back

Current facts on U.S. upper education

- College wage premium
  - Increasing over time
  - Non-linear in education attainment

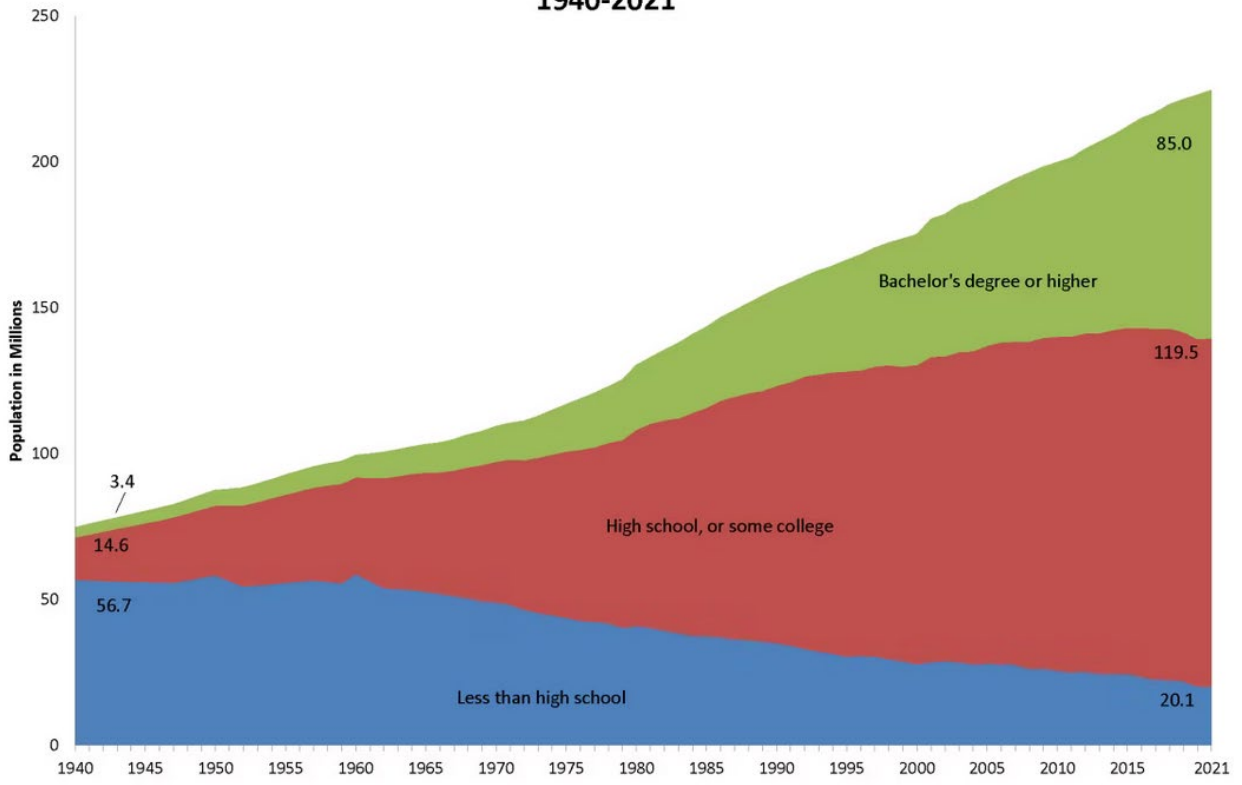
- 2011-2021, approx. 2/3 of high school graduates in enrolled college
  - 2/3 in 4-year schools
  - 1/3 in 2-year school

- Drop-outs after 8 years
  - 38% in 2-years schools
  - 25% in 4-year schools

Source: "Digest of Education Statistics", Table 326.27. U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS)

U.S. educational attainment, 1940-2021

Figure 1: Population Age 25 and Over by Educational Attainment: 1940-2021



Sources: U.S. Census Bureau. 1947, 1952-2002 March Current Population Survey, 2003-2021 Annual Social and Economic Supplement to the Current Population Survey; 1940-1960 Census of Population.For more information on confidentiality protection, sampling error, nonsampling error, and definitions, see <https://www2.census.gov/programs-surveys/cps/techdocs/cpsmar21.pdf>

United States Census Bureau

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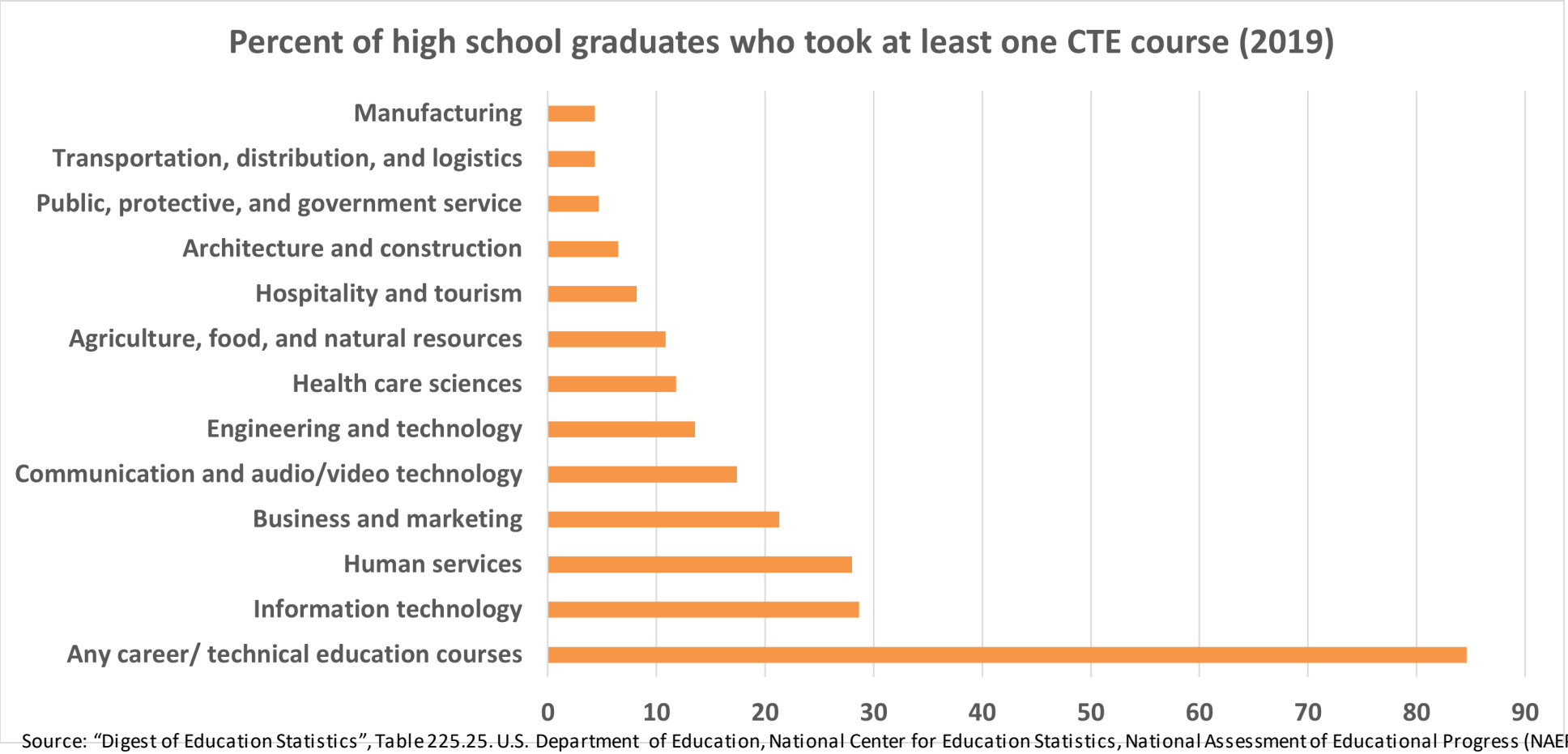
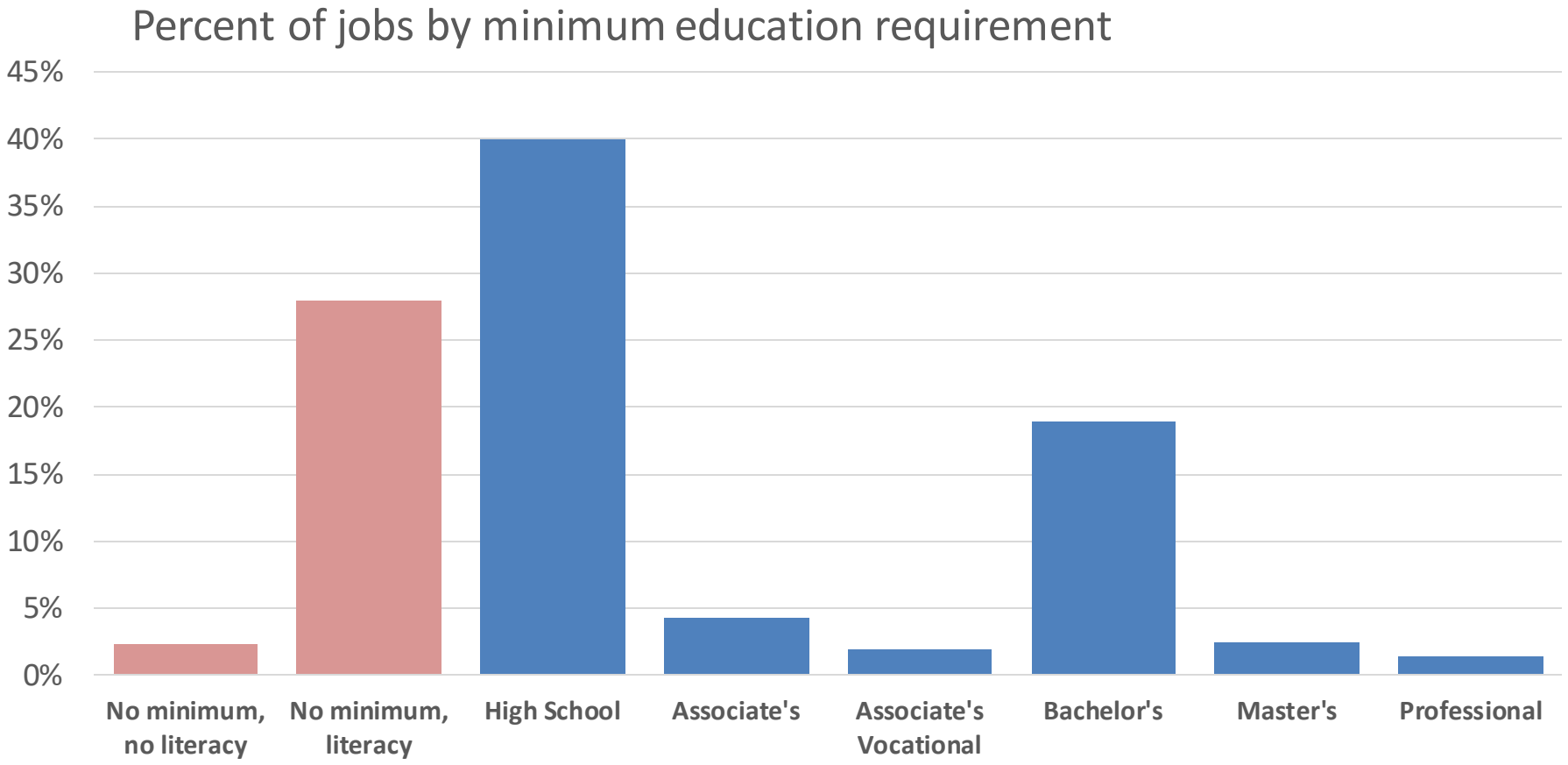
Vocational training is varied



Source: "Digest of Education Statistics", Table 225.25. U.S. Department of Education, National Center for Education Statistics, National Assessment of Educational Progress (NAEP)

Degree requirements in U.S., 2022



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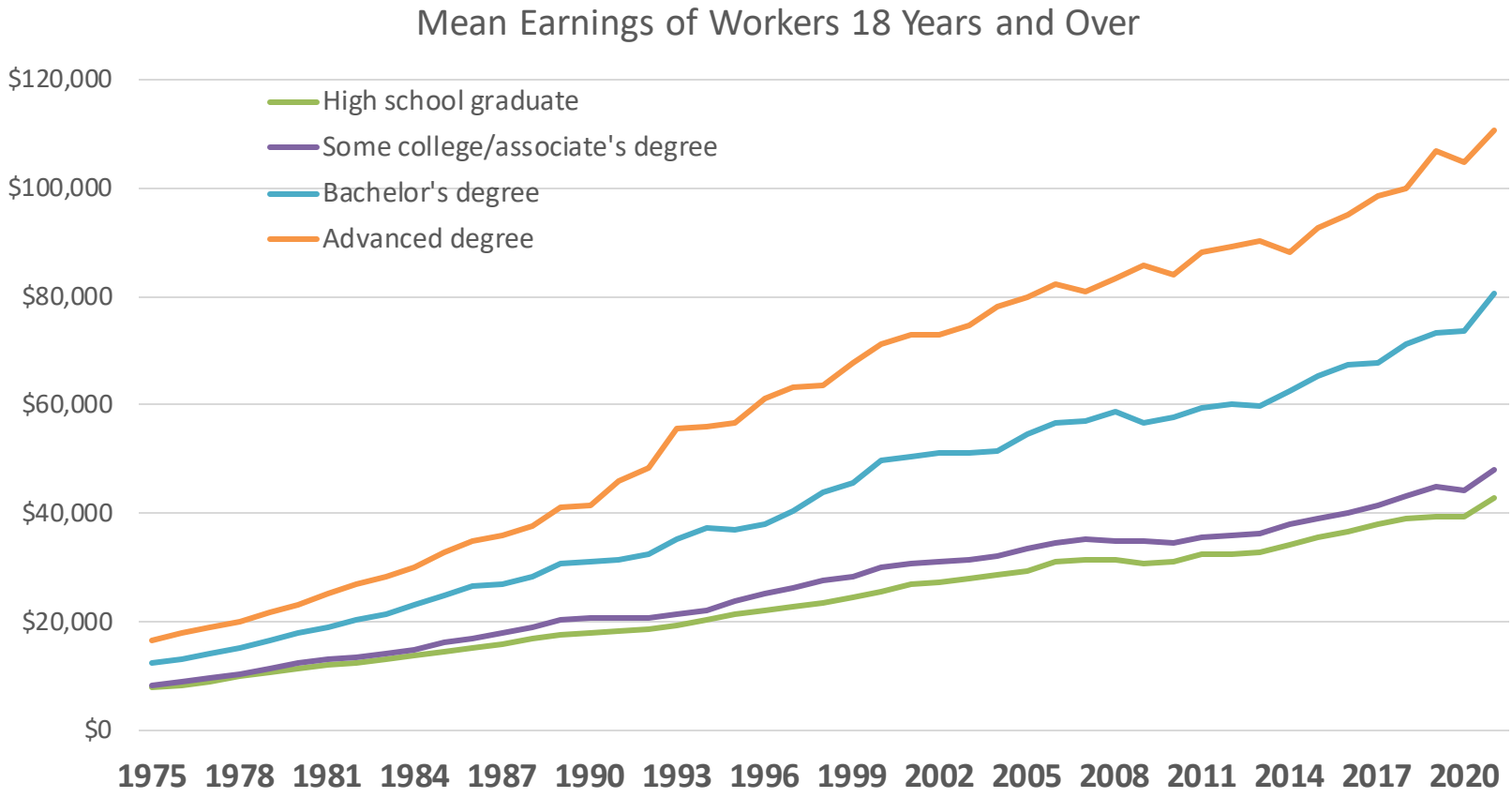
Source: Bureau of Labor Statistics, U.S. Department of Labor, Occupational Requirements Survey (2022), https://www.bls.gov/ors/factsheet/minimum-formal-education.htm

Earnings by educational attainment



Source: U.S. Census Bureau (1975-2020) March Current Population Survey 2003 to 2022 Annual Social and Economic Supplement to the Current Population Survey noninstitutionalized population, excluding members of the Armed Forces living in barracks.

Related literature

Effects of public school funding
- Goldin (2001), Goldin & Katz (2003)
- Bound and Turner (2002)

Investment in human capital/training
- Becker (1962), Spence (1973), Stiglitz (1975)
- Autor et al. (2003), Autor and Dorn (2013), Acemoglu and Autor (2011)
- Acemoglu & Pischke (1998), Bedard (2001), Clark & Martorell (2014)

Returns to vocational education
- Hanushek et al. (2017), Malamud & Pop-Eleches (2010), Oosterbeek & Webbink (2007), Silliman & Virtanen (2022)
- Country-specific: Zilic (2018), Attanasio et al. (2011), Bertrand et al. (2021), Brunello & Rocco (2017), Dionisius et al. (2009), Hartog et al. (2022)

Challenges (Muehlemann & Wolter (2020)):
- Appropriate counterfactual
- Selection
- Outcomes depend on policy objective
- External validity

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