American Mobility and the Expansion of Public Education

John Parman, Northwestern University

January 22nd, 2008

Introduction

"Education then, beyond all other devices of human origin, is a great equalizer of the conditions of men."
– Horace Mann, 1848

In the first half of the 20th century, the American public education system went through a massive expansion, with access to public schools and the quality of those schools dramatically improving. However, this same period witnessed a major decline in intergenerational mobility. This paper uses historical data to explain why mobility declined as the public education system expanded and became more egalitarian.

Brief Summary of Results

- Income mobility substantially declined during the introduction and expansion of public grammar schools and high schools.
- Communities with greater access to public graded schools were less mobile than communities with poor school access.
- Persistence in the tails of income distribution was significantly higher in communities greater access to graded schools.
- As schools improved, people of at all income levels increased educational attainment but the increases for wealthy families were much larger than those for poor families.

Outline of Presentation

- Overview of mobility and public education over the 20th century
- Data sources and the construction of an intergenerational dataset
- Comparisons of income mobility between 1915 and 2001
- Mobility estimates conditional on school quality and access
- Elasticity of educational investments with respect to income and school quality/access
- Concluding remarks

American Intergenerational Mobility

- Modern estimates put American income mobility roughly equivalent to or below that of other developed countries (Solon, 2002).
- Occupational and wealth mobility studies revealed relatively high mobility at the turn of the century (Ferrie, 2005).
- A major decline in occupational mobility occurred over the first half of the 20th century.
- Earnings data have never been available to estimate income mobility in the first half of the 20th century.

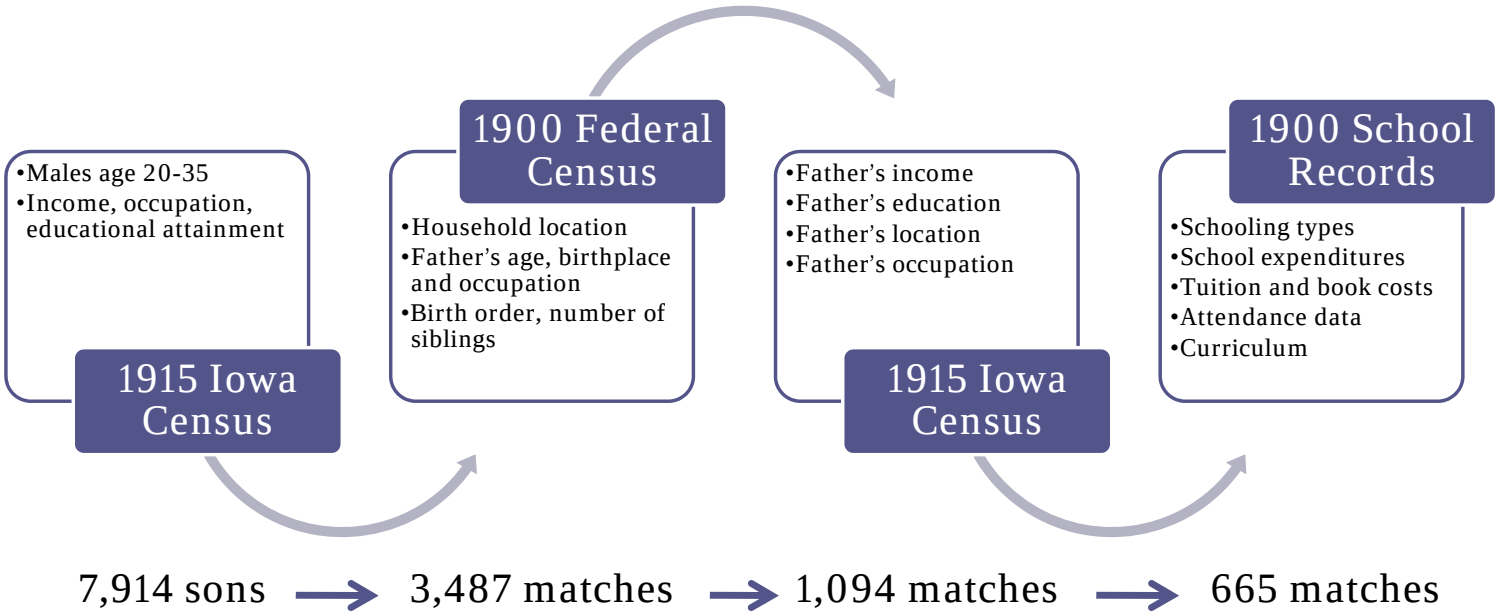
The Transition to Modern Schools

- The first half of the 20th century was also a period of dramatic change in the American educational system.
- Common schools were being replaced by graded schools and high schools.
- Compulsory schooling and child labor laws were introduced.
- There were high returns to education at the time, particularly for high school.
- Transition in Iowa was rapid and early: the number of graded classrooms in Iowa went from 4,520 in 1894 to 6,458 by 1904 (the school-age population grew by less than 4 percent over the same period).

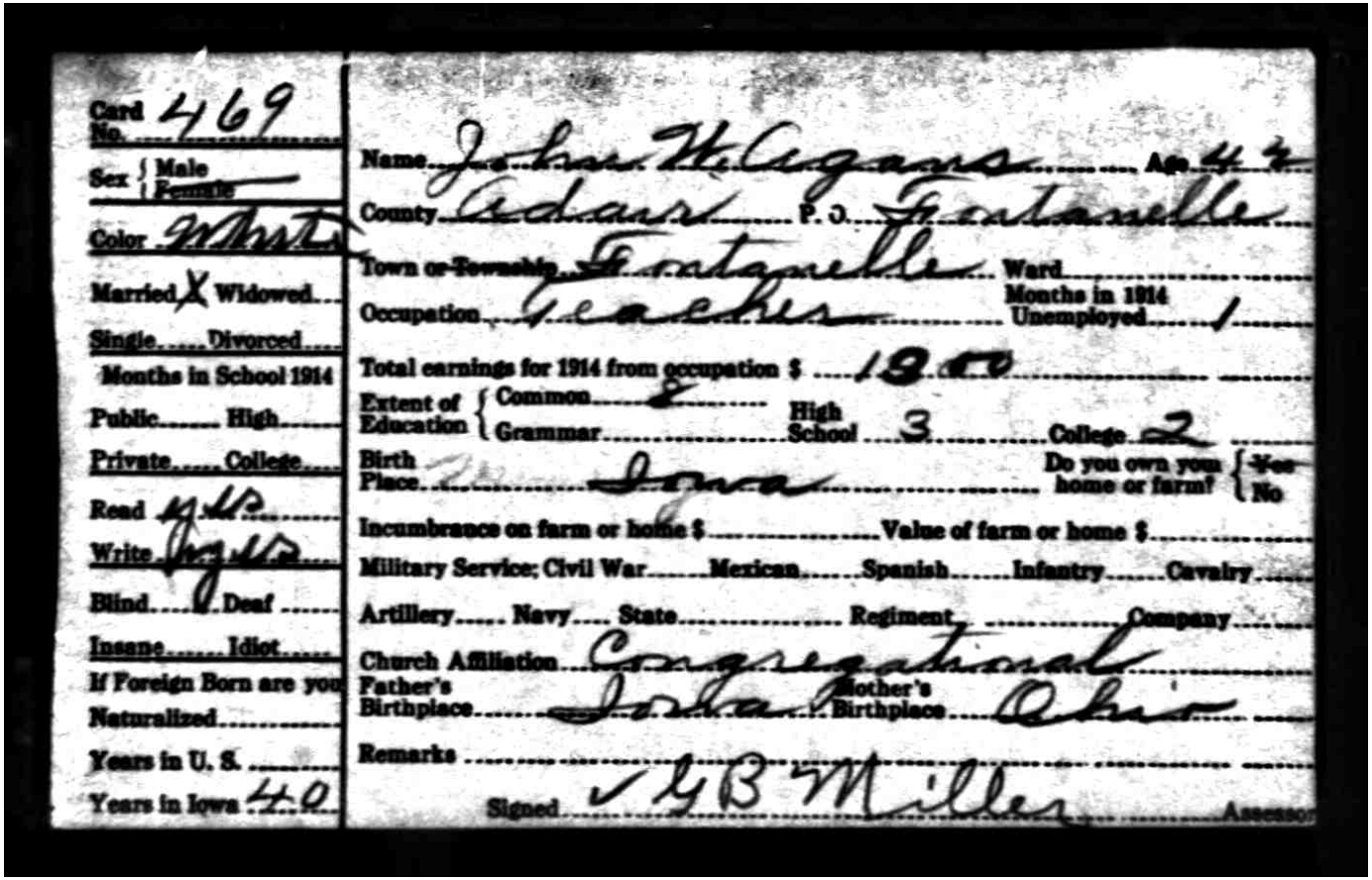
Data Sources

- **1915 Iowa State Census**
  - Occupation and annual earnings
  - Years of education by type: common school, grammar school, high school and college
  - Religion, months unemployed, value of farm or home, years in US, years in Iowa, birthplace
- **1900 Federal Census**
  - Family characteristics: location, number of siblings, birth order
  - Father's birthplace, age, occupation
- **Reports of the County Superintendents of Schools**
  - Distribution of school types by township
  - School district finances: taxes, instructional expenditures, capital expenditures
  - Attendance rates, graduation rates, teacher salaries, textbooks used, tuition

Matching Procedure



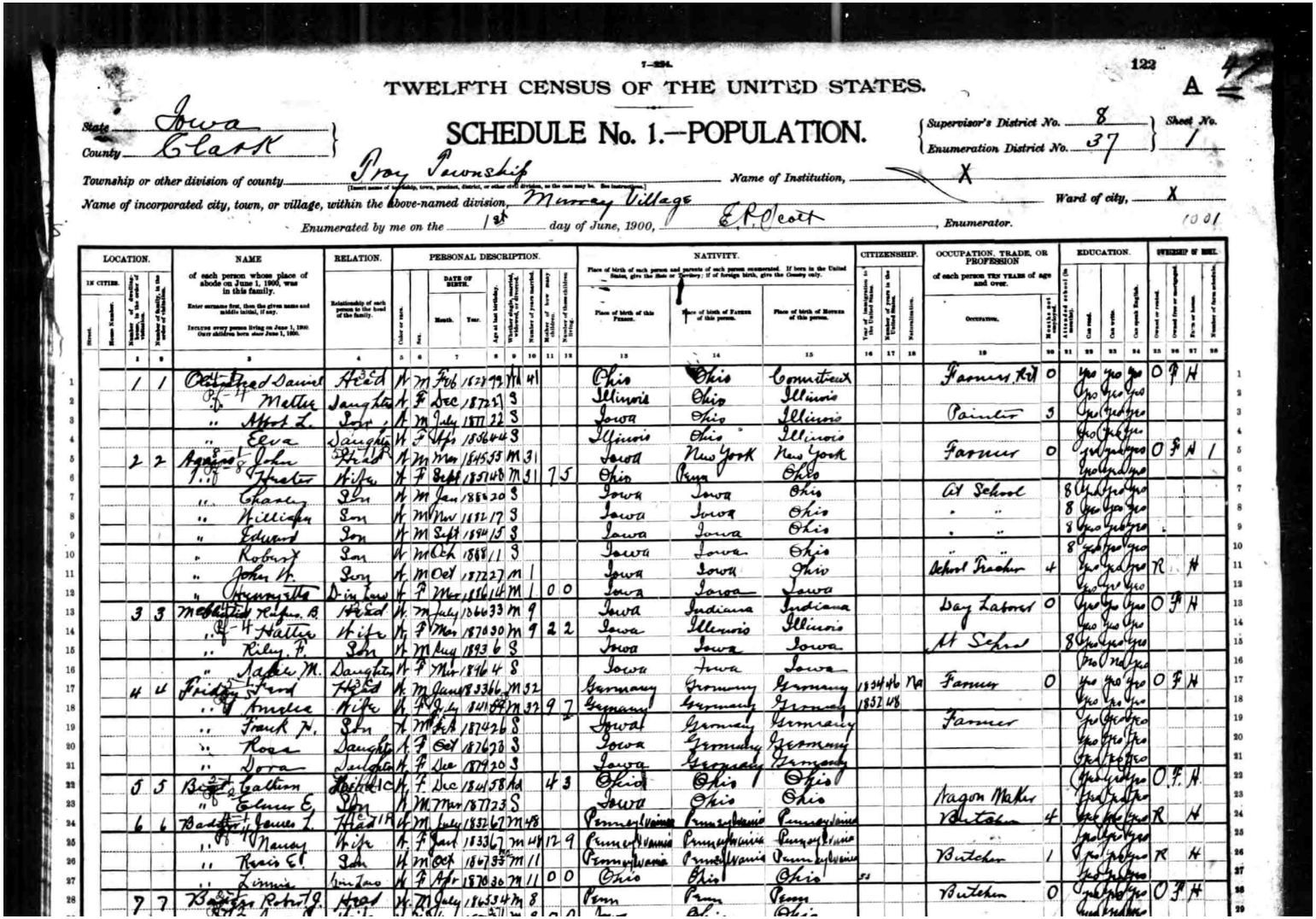
Iowa Census Records



Card No. 469
Sex { Male / Female
Color White
Married X Widowed
Single Divorced
Months in School 1914
Public High
Private College
Read yes
Write yes
Blind Deaf
Insane Idiot
If Foreign Born are you Naturalized
Years in U. S.
Years in Iowa 40

Name John H. Cagans Age 44
County Cedar P. O. Fontanelle
Town or Township Fontanelle Ward
Occupation Teacher Months in 1914 Unemployed 1
Total earnings for 1914 from occupation $ 1200
Extent of Education { Common 8 / Grammar
High School 3 College 2
Birth Place Iowa
Do you own your home or farm? { Yes / No
Incumbrance on farm or home $ Value of farm or home $
Military Service: Civil War Mexican Spanish Infantry Cavalry
Artillery Navy State Regiment Company
Church Affiliation Congregational
Father's Birthplace Iowa Mother's Birthplace Ohio
Remarks
Signed ✓ G B Miller Assessor

Federal Census Records



TWELFTH CENSUS OF THE UNITED STATES.

SCHEDULE No. 1.—POPULATION.

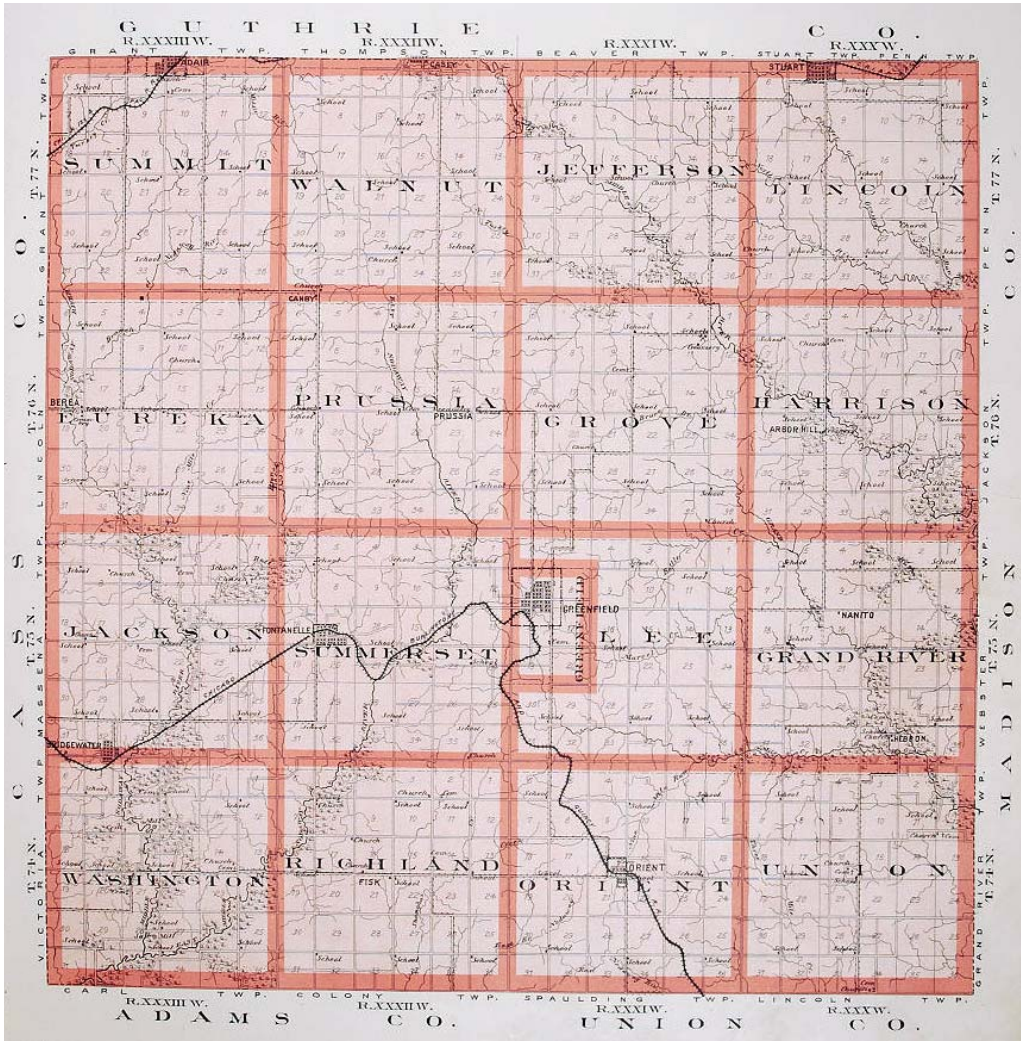
State Iowa
County Clark
Township or other division of county Troy Township
Name of incorporated city, town, or village, within the above-named division, Murray Village
Supervisor's District No. 8
Enumeration District No. 37
Sheet No. 1
Name of Institution, X
Ward of city, X
Enumerated by me on the 1st day of June, 1900, E. R. Scott, Enumerator.

122 A

LOCATION.	NAME of each person whose place of abode on June 1, 1900, was in this family.	RELATION.	PERSONAL DESCRIPTION.	NATIVITY.	CITIZENSHIP.	OCCUPATION, TRADE, OR PROFESSION	EDUCATION.	OWNERSHIP OF HOME.
Street. / House Number. / Number of dwelling house in order of visitation. / Number of family in the order of visitation.	Enter surname first, then the given name and middle initial, if any. Include every person living on June 1, 1900. Omit children born since June 1, 1900.	Relationship of each person to the head of the family.	Color or race. / Sex. / DATE OF BIRTH: Month. / Year. / Age at last birthday. / Whether single, married, widowed, or divorced. / Number of years married. / Mother of how many children. / Number of these children living.	Place of birth of this Person. / Place of birth of Father of this person. / Place of birth of Mother of this person.	Year of immigration to the United States. / Number of years in the United States. / Naturalization.	Occupation. / Months not employed.	Attended school (in months). / Can read. / Can write. / Can speak English.	Owned or rented. / Owned free or mortgaged. / Farm or house. / Number of farm schedule.
1 / 1	Christopher Daniel	Head	M M Feb 1827 73 M 41	Ohio / Ohio / Connecticut		Farmer Ret	0 / yes yes yes	O F H
	Mattie Daughter	Daughter	F F Dec 1857 3 S	Illinois / Ohio / Illinois			yes yes yes	
	Albert L. Son	Son	M M July 1877 22 S	Iowa / Ohio / Illinois		Painter	3 / yes yes yes	
	Elva Daughter	Daughter	F F Apr 1884 4 S	Illinois / Ohio / Illinois			yes yes yes	
2 2	Agnes John	Head	M M Mar 1845 55 M 31	Iowa / New York / New York		Farmer	0 / yes yes yes	O F N 1
	Hester	Wife	F F Sept 1851 48 M 31 7 5	Ohio / Penn / Ohio			yes yes yes	
	Charley	Son	M M Jan 1888 20 S	Iowa / Iowa / Ohio		At School	8 / yes yes yes	
	Killian	Son	M M Nov 1892 17 S	Iowa / Iowa / Ohio		" "	8 / yes yes yes	
	Edward	Son	M M Sept 1894 5 S	Iowa / Iowa / Ohio		" "	8 / yes yes yes	
	Robert	Son	M M Oct 1888 11 S	Iowa / Iowa / Ohio			8 / yes yes yes	
	John H.	Son	M M Oct 1877 27 M 1	Iowa / Iowa / Ohio		School Teacher	4 / yes yes yes	R H
	Gwynnyth	Dau in law	F F Mar 1886 14 M 1 0 0	Iowa / Iowa / Iowa			yes yes yes	
3 3	Mc[illegible] Ralph B.	Head	M M July 1866 33 M 9	Iowa / Indiana / Indiana		Day Laborer	0 / yes yes yes	O F H
	Hattie	Wife	F F Mar 1870 30 M 9 2 2	Iowa / Illinois / Illinois		At School	8 / yes yes yes	
	Riley P.	Son	M M Aug 1893 6 S	Iowa / Iowa / Iowa			yes yes yes	
	Jackie M.	Daughter	F F Mar 1896 4 S	Iowa / Iowa / Iowa			yes no yes	
4 4	Friday Fred	Head	M M June 1836 64 M 32	Germany / Germany / Germany	1854 46 NA	Farmer	0 / yes yes yes	O F H
	Amelia	Wife	F F July 1841 59 M 32 9 7	Germany / Germany / Germany	1857 43		yes yes yes	
	Frank N.	Son	M M Feb 1874 26 S	Iowa / Germany / Germany		Farmer	yes yes yes	
	Rosa	Daughter	F F Oct 1876 23 S	Iowa / Germany / Germany			yes yes yes	
	Dora	Daughter	F F Dec 1879 20 S	Iowa / Germany / Germany			yes yes yes	
5 5	Boggs Coalition	Boarder	M F Dec 1841 58 Wd 4 3	Ohio / Ohio / Ohio			yes yes yes	O F H
	Elmer E.	Son	M M Mar 1877 23 S	Iowa / Ohio / Ohio		Wagon Maker	yes yes yes	
6 6	Baldwin James L.	Head	M M July 1837 62 M 38	Pennsylvania / Pennsylvania / Pennsylvania		Butcher	4 / yes yes yes	R H
	Nancy	Wife	F F Jan 1833 67 M 38 12 9	Pennsylvania / Pennsylvania / Pennsylvania			yes yes yes	
	Rees E.	Son	M M Oct 1867 32 M 11	Pennsylvania / Pennsylvania / Pennsylvania		Butcher	1 / yes yes yes	R H
	Lizzie	Daughter	F F Apr 1870 30 M 11 0 0	Ohio / Ohio / Ohio	50		yes yes yes	
7 7	Barger Robert G.	Head	M M July 1865 34 M 8	Penn / Penn / Penn		Butcher	0 / yes yes yes	O F H

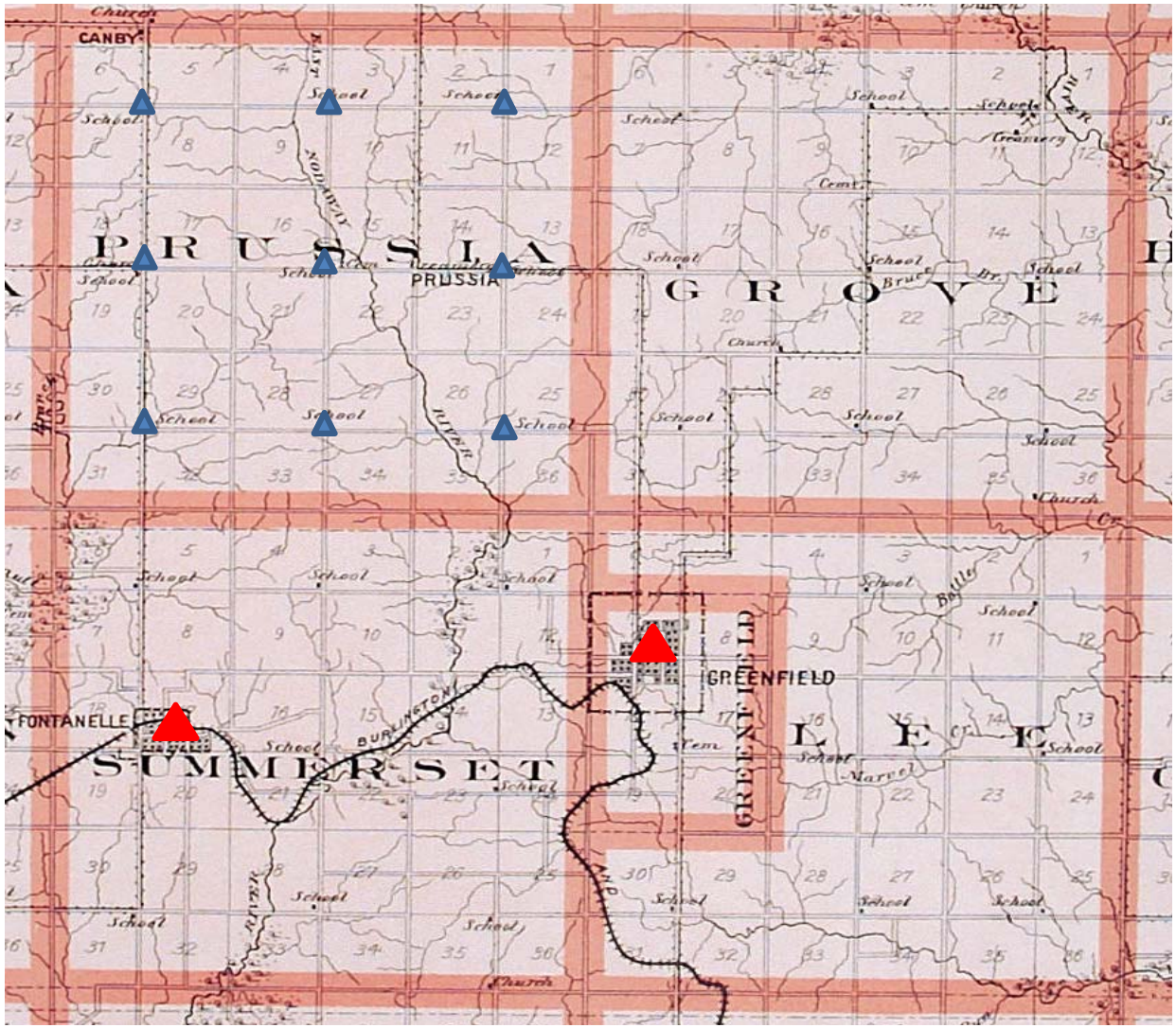
Iowa School Districts

Figure 1: Map of Adair County, IA with township divisions shown, 1904.
Source: Huebinger, Melchoir, "Atlas of the state of Iowa." Davenport, IA: Iowa Publishing Co., 1904.

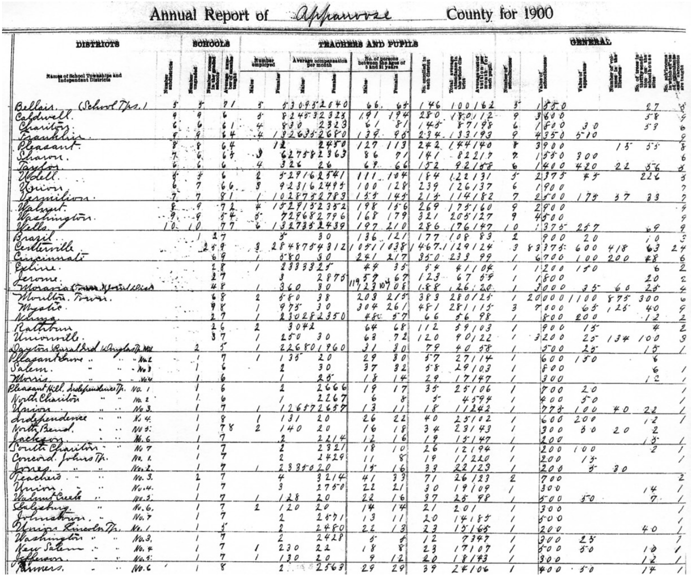


Iowa School Districts

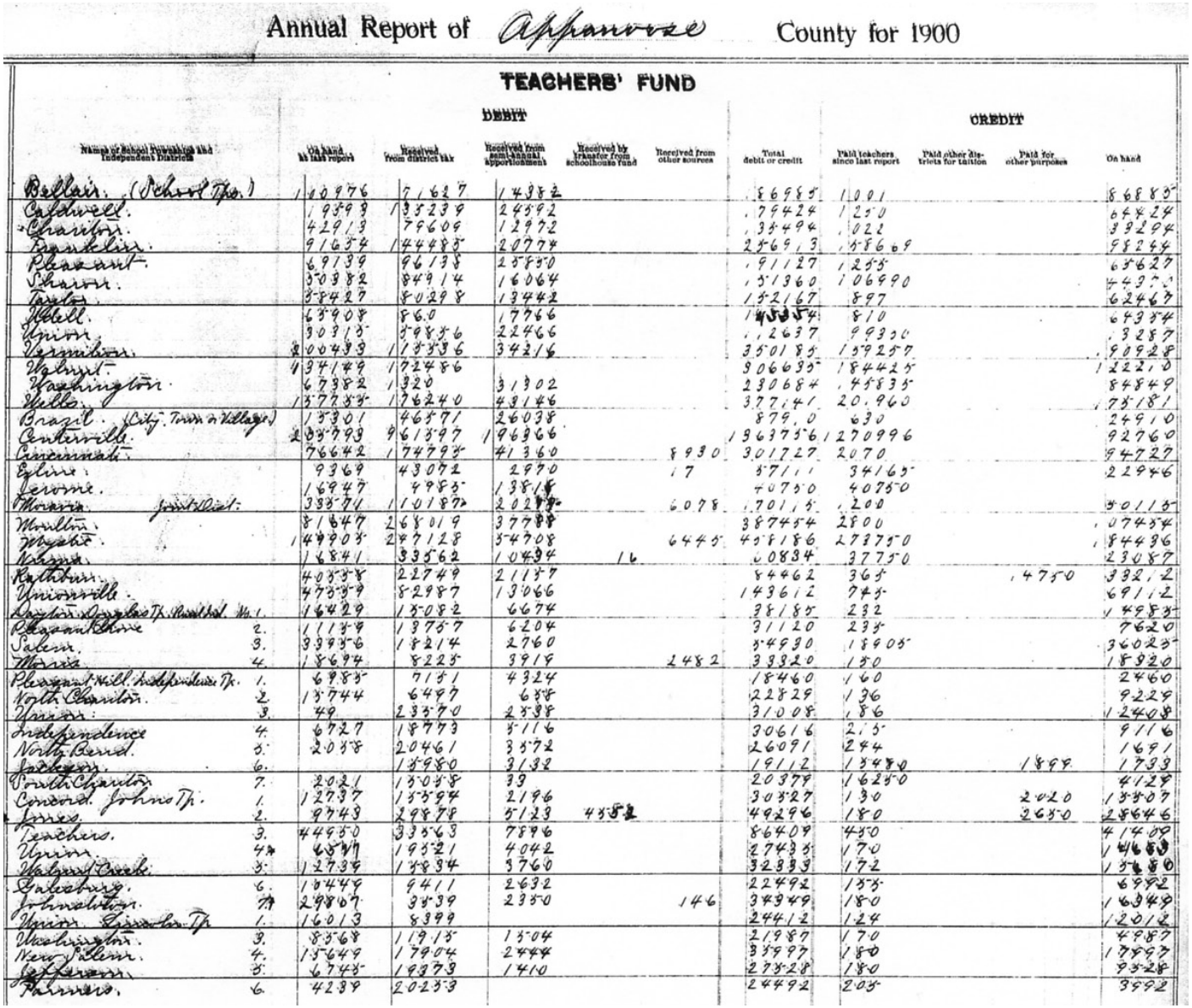
Figure 2: Detail of Prussia, Grove, Summerset and Lee townships in Adair County. *Source: Huebinger, Melchoir, "Atlas of the state of Iowa." Davenport, IA: Iowa Publishing Co., 1904.*



County Superintendent Records



County Superintendent Records



Annual Report of Appanoose County for 1900

TEACHERS' FUND

Name of School Township and Independent Districts		DEBIT: On hand as last report	Received from district tax	Received from semi-annual apportionment	Received by transfer from schoolhouse fund	Received from other sources	Total debit or credit	CREDIT: Paid teachers since last report	Paid other districts for tuition	Paid for other purposes	On hand
Bellair. (School Tp.)		1 00976	7 1627	1 4382			86985	1001			86885
Caldwell.		1 9399	1 33239	24592			79424	1250			64824
Chariton.		42913	79604	12972			35494	1022			33294
Franklin.		91654	1 44485	20774			256913	158609			98244
Pleasant.		69139	96138	25850			91127	1255			65627
Sharon.		30982	84914	16064			51360	106990			44334
Taylor.		38427	80298	13442			152167	897			62467
Webb.		63908	860	17766			1 44554	810			64354
Union.		30313	39856	22466			12637	99330			33287
Vermillion.		200433	1 33336	34216			350185	139257			90928
Walnut.		434149	1 72486				306635	184425			122210
Washington.		67382	1320	31302			230684	45835			84849
Webb.		1 57733	1 76240	43146			377141	20960			75181
Brazil. (City, Town or Village)		15301	46571	26038			879.0	630			24910
Centerville.		2 03793	9 61397	1 96366			1 96375 6	1 70996			92760
Cincinnati.		76642	1 74795	41360		8930	301727	2070			94727
Eyline.		9369	43072	2970		17	55711	34165			22946
Jerome.		16947	4985	13818			40750	40750			
Moravia. Joint Dist.		38374	1 01872	20279		6078	701455	200			50115
Moulton.		81647	2 68019	37788			387454	2800			07454
Myrtle.		1 49903	2 97128	54708		6445	49 4186	27375 0			84436
Numa.		16841	33562	10494	16		60834	37750			23087
Rathbun.		40338	22749	21137			84462	365		4750	33212
Unionville.		47339	82987	13066			143612	745			69112
Center Douglas Tp. Rural Dist. No. 1.		16429	15082	6674			38185	232			14983
Pleasant Grove.	2.	11139	13757	6204			31120	235			7620
Salem.	3.	33935	18214	2760			34930	18905			36023
Morris.	4.	18694	8225	3918		2482	33320	150			18920
Pleasant Hill Independent Dist.	1.	6985	7151	4324			18460	160			24460
North Chariton.	2.	13744	6497	6858			22829	136			9229
Union.	3.	49	23370	25858			31008	186			12408
Independence	4.	6727	18773	5116			30616	2150			9116
North Bend.	5.	2058	20461	35372			26091	244			16891
Jackson.	6.		15980	3132			19112	13480		1898	17733
South Chariton	7.	20321	13058	99			20377	16250			41278
Concord. Johns Tp.	1.	12737	15594	2196			30327	130		2020	13507
Jones.	2.	9743	29878	5123	4552		49296	180		2650	25646
Teachers.	3.	44450	33563	7896			86409	4450			41409
Union.	4.	65877	19321	4042			27433	1700			14663
Walnut Creek.	5.	12736	19834	3760			32893	1732			15850
Galesburg.	6.	10449	9411	2632			22492	1350			6992
Johnsville.	7.	29807	3539	2350		146	34949	1800			16949
Union Grove Tp.	1.	16013	8399				24412	1224			12012
Unclassified.	3.	8568	11915	1504			21987	1700			4987
New Salem.	4.	13649	17904	2444			33997	1800			15997
Jefferson.	5.	6745	19373	1410			27528	1800			9528
Partners.	6.	4238	20253				24492	2035			3992

Sample Statistics

Table 1: Summary statistics for Iowa father-son sample, 1915

Father's income observed for all	yes	no	no
Father's education observed for all	yes	yes	no
Father's occupation observed for all	yes	yes	yes
	(1)	(2)	(3)
Son's log annual earnings	6.26	6.32	6.44
	(.67)	(.69)	(.66)
Father's log annual earnings	6.68	6.68	6.68
	(.76)	(.76)	(.76)
Son's age	25.3	26.4	27.0
	(5.4)	(6.0)	(5.1)
Father's age	57.0	59.0	60.2
	(7.4)	(8.4)	(8.9)
Son's years of education	9.1	9.1	9.2
	(2.5)	(2.6)	(2.7)
Father's years of education	7.9	7.8	7.8
	(2.7)	(2.6)	(2.6)
No. observations	1094	1480	3487

Notes: All values are for the year 1915. Standard deviations are given in parentheses. An observation is considered one father-son pair.

School District Characteristics

Table 2: School district characteristics for counties in the Goldin-Katz sample, 1900

	Townships in rural counties	Townships in urban counties
Ungraded schools	6.62	6.10
	(5.70)	(5.94)
Classrooms in graded schools	3.67	10.60
	(7.59)	(42.41)
Months in school year	7.93	7.95
	(1.42)	(1.75)
Number of children of school age	387	1245
	(422)	(3431)
Percentage of children enrolled	83.2	70.4
	(16.7)	(25.5)
Monthly tuition	2.00	1.84
	(.64)	(.54)
Volumes in library	208	394
	(558)	(1215)
Taxes per child	9.93	7.97
	(3.94)	(3.66)
Spending per child	12.52	10.08
	(5.24)	(5.09)
Number of districts	116	48

Measuring Mobility

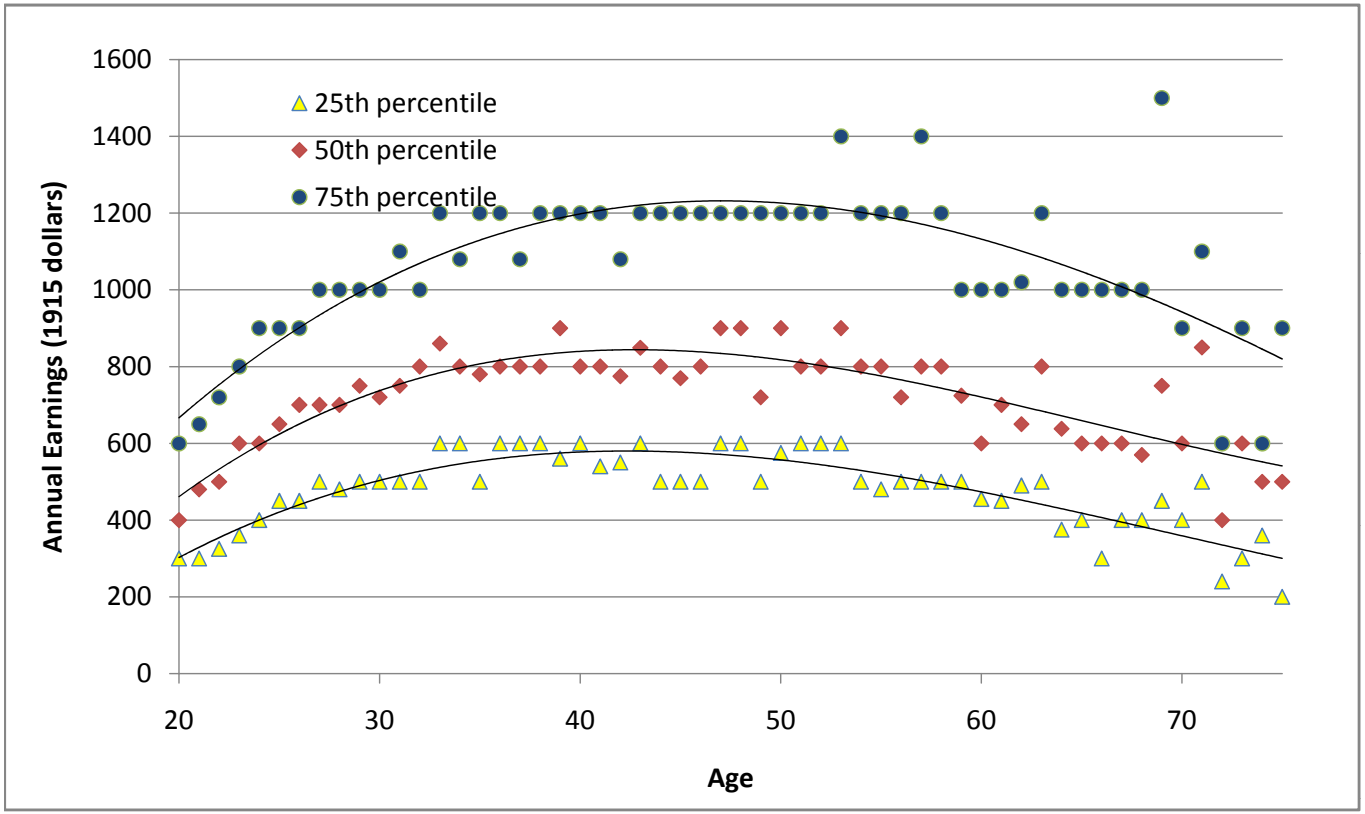
- Location, occupation and earnings data allow for several measures of mobility.
- Earnings data offer a unique opportunity to get income mobility estimates comparable to modern studies.
- Simplest income mobility measure is the intergenerational income elasticity:

$$\ln y_{i,s} = \alpha + \eta \ln y_{i,f} + \epsilon_i$$

- Problems arise when using a single observation of annual income as a proxy for average annual income over the lifetime.

Earnings Over the Life Cycle

Figure 3: 25th, 50th and 25th annual earnings percentiles by age, Iowa, 1915.



Estimating the Intergenerational Income Elasticity

- Include age controls for both the son and father.
- Interact son's age with father's income to allow for the intergenerational income elasticity to vary with age.
- Construct comparable modern estimates by using an equivalent age range and income measure.
- Estimation equation:

$$\ln y_{i,s} = \alpha + \eta_1 \ln y_{i,f} + \eta_2 \ln y_{i,f} A_{i,s} + \eta_3 \ln y_{i,f} A_{i,s}^2 + \beta_1 A_{i,s} + \beta_2 A_{i,s}^2 + \beta_3 A_{i,f} + \beta_4 A_{i,f}^2 + u_i$$

Intergenerational Income Elasticities, 1915 and 2001

Table 3: Intergenerational Income Elasticities, 1915 and 2001

Sample	Elasticity
Iowa, full sample	0.109
	(0.030)
PSID, 20-35	0.289
	(0.037)
PSID, 25-40	0.312
	(0.034)

Standard errors given in parentheses.

Comparability of Results

Several issues need to be addressed regarding the comparability of the 1915 and 2001 intergenerational income elasticities, even once comparable income measures and age ranges are chosen.

- The Iowa sample contains a large number of farmers with volatile incomes.
- The Iowa sample does not include individuals that moved out of the state between 1900 and 1915.
- Fathers and sons may be incorrectly matched in the Iowa data.

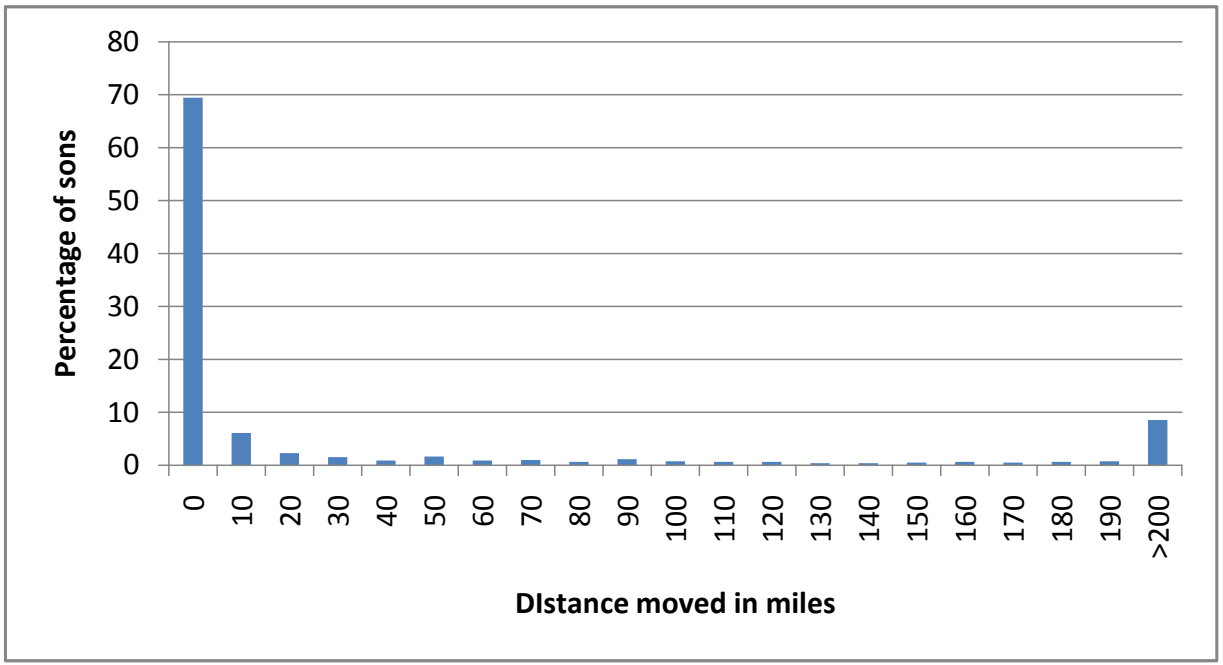
Farmers and the Mobility Estimates

Table 4: Intergenerational Income Elasticities with and without Farmers

Sample	Observations	Elasticity
Full sample	1094	0.109
		(0.030)
Excluding farmer fathers	708	0.151
		(0.044)
Excluding farmer sons	713	0.179
		(0.031)
Excluding both farmer fathers and farmer sons	619	0.167
		(0.037)

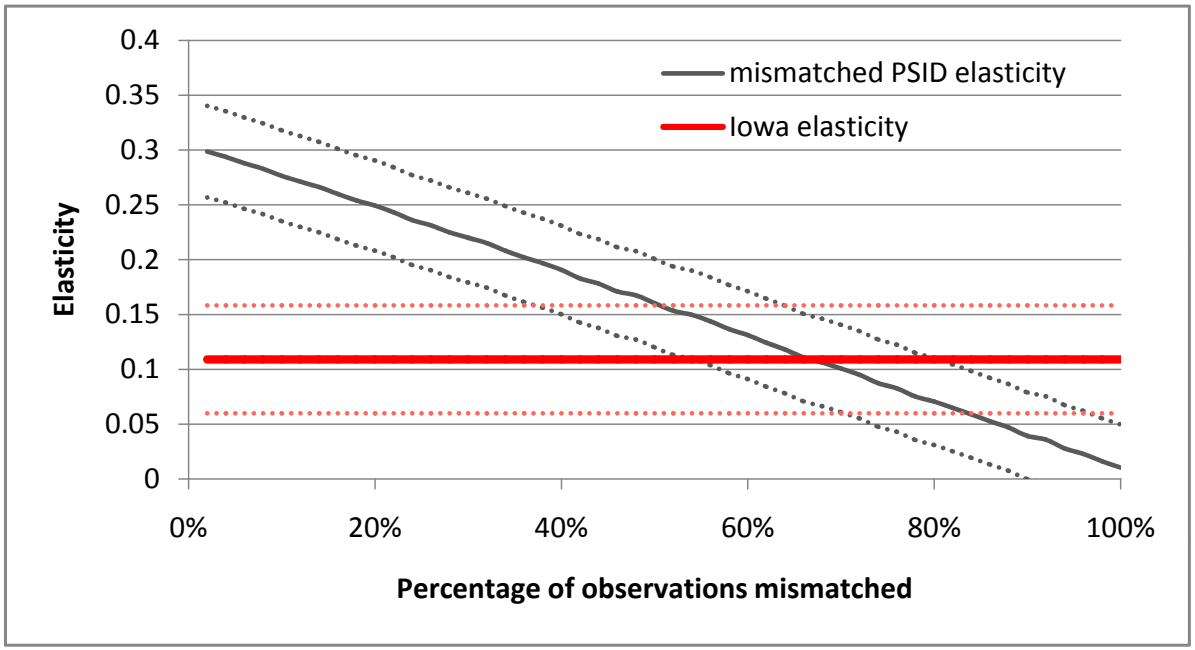
Out of State Migration

Figure 4: Distribution of sons by distance moved between 1900 and 1915.



Mismatching in the Iowa Sample

Figure 5: Intergenerational income elasticity estimates from the PSID by percentage of observations that are mismatched.



Variation in Mobility Across School Districts

- Test for differences in mobility across school districts of different qualities
- Include an interaction of a measure of school district quality with father's income in the elasticity regressions:

$$\ln y_{i,s} = \alpha + \eta_1 \ln y_{i,f} + \eta_2 \ln y_{i,f} A_{i,s} + \eta_3 \ln y_{i,f} A_{i,s}^2 + \eta_4 \ln y_{i,f} E_i + \cdots + u_i$$

- Wide range of school measures available covering both the quality of schools in a district and the level of school access in a district
- Measures used include spending per student, graded and ungraded classrooms per square mile, student-teacher ratios, district tax levels, and tuition levels

Effect of Schools on Intergenerational Income Elasticity

Table 6: Coefficients for school quality/access interaction terms

	Earnings x Schooling Measure Coefficient	
School Measure	Urban Districts	Rural Districts
graded schools dummy	--	-.044
	--	(.059)
spending per student	0.024	.012
	(.068)	(.008)
classrooms per sq. mile	-.033	.230
	(.009)	(.128)
graded classrooms	-.027	.275
per sq. mile	(.008)	(.111)
student-teacher ratio	-.000	-.004
	(.000)	(.001)
subsidy per student	.000	.017
	(.011)	(.004)

Standard errors in parentheses

Effect of Schools on Intergenerational Income Elasticity

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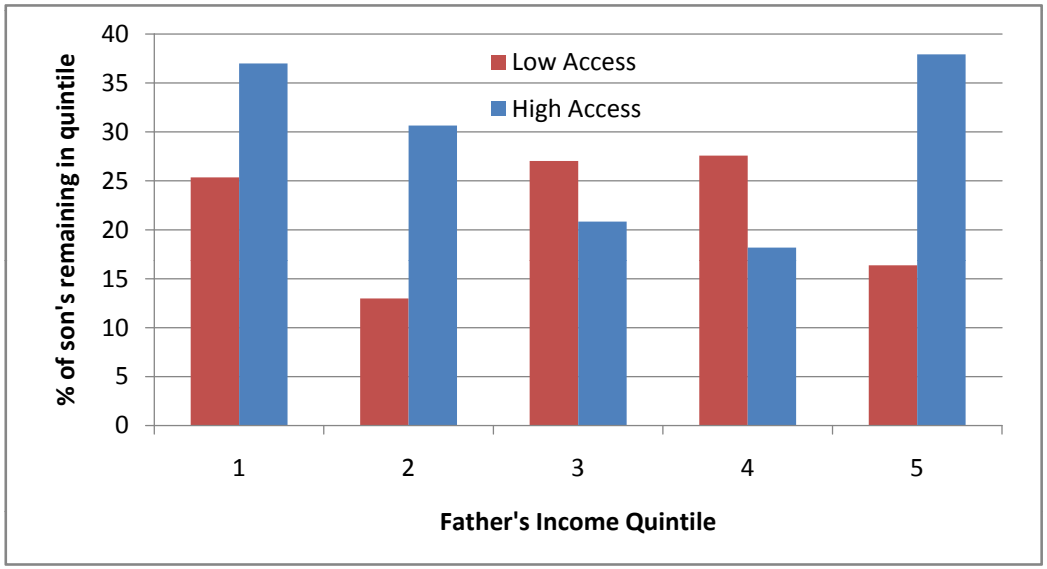
	(.000)	(.001)
subsidy per student	.000	.017
	(.011)	(.004)

Standard errors in parentheses

Mobility Throughout the Income Distribution and School Access

Figure 6: Percentage of sons remaining in their father's income quintile.



Accounting for Declining Mobility

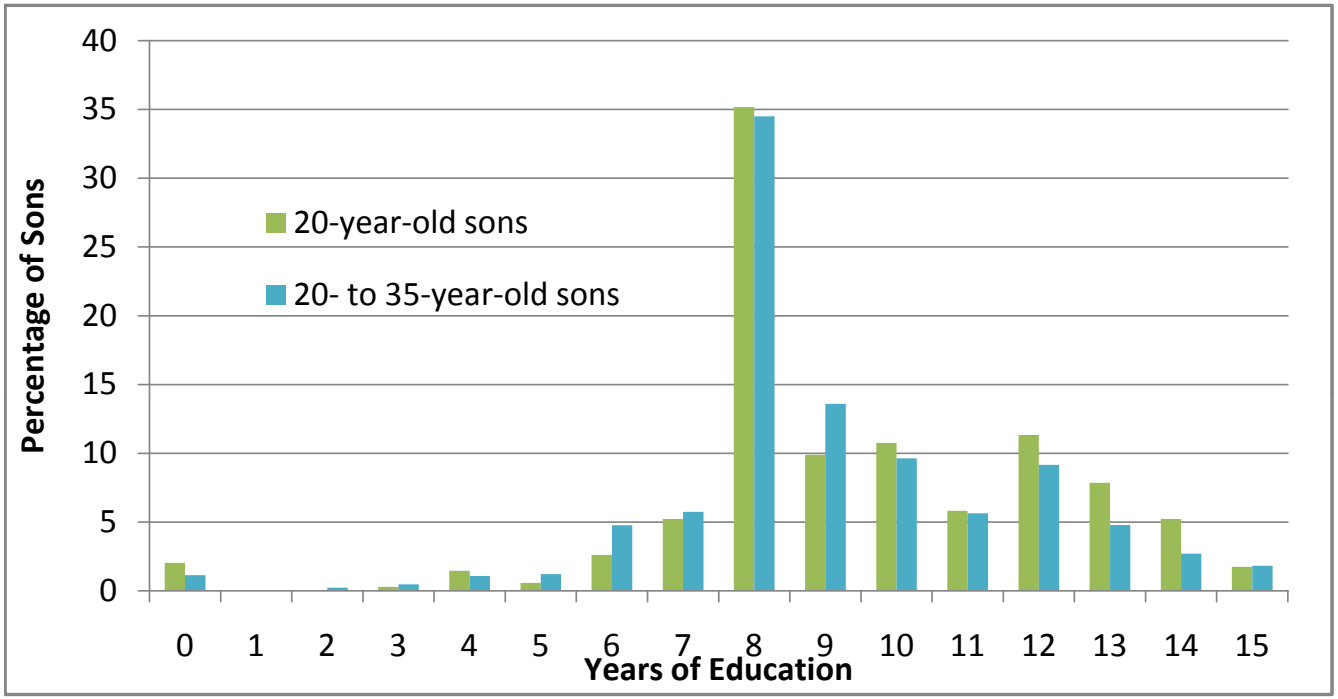
- Better schools, particularly in terms of access, were reducing mobility.
- Better school access led to greater persistence in both the poor and wealthy tails of the income distribution.
- Ex ante, returns to schooling were the same regardless of family background.
- Differences in utilization of the improving schools is a promising explanation of the mobility decline.

Predicting Educational Attainment

- Use parental income, local school characteristics, and individual characteristics to estimate years of schooling.
- Estimate an ordered probit with years of schooling as the dependent variable.
- Include interactions of school characteristics with parental income to capture differences in the elasticity of educational attainment with respect to school quality/access between poor and wealthy families.

Distribution of Years of Education

Figure 7: Distribution of sample sons by total years of educational attainment and age in 1915.



Effects of School Access on Attainment

Predicted years of high school conditional on income and school access:

	Low Access
Wealthy Family	.8085
Poor Family	.5658

Effects of School Access on Attainment

Predicted years of high school conditional on income and school access:

	High Access		Low Access	ΔEdu
Wealthy Family	1.0645	-	.8085	.2560
Poor Family	.6184	-	.5658	.0526

Effects of School Access on Attainment

Predicted years of high school conditional on income and school access:

	High Access		Low Access	ΔEdu
Wealthy Family	1.0645	-	.8085	.2560
Poor Family	.6184	-	.5658	.0526

.2034

Effects of School Quality on Attainment

Predicted years of high school conditional on income and school quality:

	Low Quality
Wealthy Family	.7528
Poor Family	.4177

Effects of School Quality on Attainment

Predicted years of high school conditional on income and school quality:

	High Quality		Low Quality	ΔEdu
Wealthy Family	1.0827	-	.7528	.3299
Poor Family	.7202	-	.4177	.3025

Effects of School Quality on Attainment

Predicted years of high school conditional on income and school quality:

	High Quality		Low Quality	ΔEdu
Wealthy Family	1.0827	-	.7528	.3299
Poor Family	.7202	-	.4177	.3025

.0274

Concluding Remarks

- Income mobility dropped dramatically over the 20th century.
- During the expansion of graded schools and high schools, expanding access to public education led to lower mobility and increased persistence in the tails of the income distribution.
- Wealthy families had very elastic demands for education relative to poor families.
- Poor families gained from expanding public education in absolute terms but fell behind in relative terms.

Extensions

- Cross sectional data prevent reaching strong conclusions about the overall, long term impact of educational institutions on American mobility.
- Incorporating the pace of school expansion and the dynamics of changes in mobility patterns would give a better sense of the lasting effects of public education reform.
- The effects on mobility of alternative educational institutions need to be considered.
- Policy relevance to the subsidization of higher education in the US and the expansion of primary and secondary education in developing countries.