The Effect of Schooling on Wealth Accumulation Approaching Retirement

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Abstract

Education and wealth are positively correlated for individuals approaching retirement. However, because schooling affects not only ability to plan but also labor market outcomes, the direction of the causal effect of schooling on wealth accumulation is an empirical question. We combine third-party reported administrative data on individual wealth holdings and pension claims with a natural experiment expanding access to schooling in Denmark in the 1950s to show that schooling increases pension annuity claims but reduces the ratio of wealth over permanent income for men between 50 and 60 years of age. The effect of schooling on wealth becomes stronger as retirement age approaches and, acting primarily through housing equity, induces leaner and more liquid portfolios. Labor market mechanisms triggered by schooling, such as increased job mobility and better occupational pension benefits, suggest that holding less wealth outside of a pension fund can be a rational strategy for more educated individuals.

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I. Introduction

As social security systems struggle under demographic pressure, sustaining household consumption after retirement increasingly depends on personal savings. However, even with respect to their realized lifetime income, households reach retirement age with extremely different wealth levels (Hendricks, 2007). Schooling explains part of this inequality: In 2013, the median wealth relative to income of a U.S. household whose head held a professional or graduate degree was about 4 times higher than that of a household whose head did not complete high school (Emmons and Noeth, 2015). Non-random inheritances and individual preferences confound this positive correlation. Moreover, not all channels through which education acts in the long run suggest a positive causal relationship from schooling to wealth. By increasing job security and assortative matching in the marriage market (Oreopoulos and Salvanes, 2011), schooling could induce lower wealth accumulation. Both the size and the direction of the causal effect of schooling on wealth accumulation are thus empirical questions.

This paper is the first to provide a comprehensive picture of the causal effect of schooling on wealth accumulation and wealth composition for individuals approaching retirement. To identify the causal effect of schooling on wealth, we combine third-party reported data on individual wealth and pension claims from administrative Danish registers with policy-driven variation in distance to public schools for Danish men born between 1939 and 1951. In the spirit of Card (1995), we use historical geographic data on school locations to compute a measure of geographic distance to the closest public school offering 8^{th} grade between 1953 and 1965 from the parish of birth of each individual in our sample. However, because distance to schooling is likely not random in a cross-section, we augment this measure with policy-induced

school openings and a 1958 reform that established 8th grade teaching in rural municipalities. These institutional changes provide exogenous variation in distance to schools over time for the same parish of birth, conditional on municipality fixed effects and cohort trends by implementation year.

By comparing individuals born in the same municipality but facing different distances to public schools, we show that schooling causally reduces wealth held *outside* of pension funds by the age of 60, and that the positive correlation between schooling and wealth is therefore due to factors such as family background, the likelihood of receiving an inheritance and ability The negative effect of schooling on wealth held outside of a pension fund is partially compensated by an increase in pension annuity claims and is driven by housing equity, inducing leaner and more liquid wealth portfolios. The effects on housing equity are both at the extensive and intensive margin. More educated individuals are less likely to own real estate, renting instead, and leverage more on their assets. These results are robust to a battery of robustness checks that use different specifications (e.g. including municipality of birth cohort trends and municipality of residence fixed effects) and samples (e.g. excluding data after 2007).

Schooling can affect wealth not only by changing saving behaviors, but also mechanically by increasing earnings and income (Card, 2001). Therefore, to isolate the effect of schooling on saving strategies, in this paper we normalize wealth holdings by a measure of permanent income. Our results do not depend on this normalization: Consistently with the results of Devereux and Hart (2010), in our sample we find no effect of schooling on income after fifty.[1] Nonetheless, this normalization provides both a standardized and internation-

[1]Wealth strongly correlates with schooling even with respect to permanent income. Emmons and Noeth (2015) show that the ratio of average wealth over average income for U.S. families with a graduate or professional degree was 5.58; The same ratio for families without a high school degree was 1.43.

ally comparable measure of wealth accumulation and a direct link to lifecycle consumption models (Carroll, 1997, 2009).

Our findings have a positive, rather than normative, interpretation. With respect to the literature studying the effect of financial literacy on retirement preparedness (Lusardi and Mitchell, 2007a,b) and wealth accumulation (Lusardi and Mitchell, 2007a; Van Rooij et al., 2011; Behrman et al., 2012; Hastings et al., 2013), our results do not necessarily imply that individuals take myopic or irrational choices when managing their wealth. Schooling not only is an imperfect proxy for financial literacy but also simultaneously affects cognitive skills (Falch and Sandgren Massih, 2011; Banks and Mazzonna, 2012; Brinch and Galloway, 2012; Carlsson et al., 2015), preferences (Burks et al., 2009; Perez-Arce, 2011) and labor market outcomes (Card, 2001). Therefore, the effect of schooling on wealth accumulation could be driven by a rational adjustment to a changed economic environment.

To validate this argument, we identify labor market mechanisms connecting schooling and wealth. These channels are consistent with our results. Schooling increases labor market mobility, thereby reducing the need for investments in real estate. Moreover, the increase in pension annuity claims is entirely due to occupational pension schemes, suggesting that schooling increases the likelihood of obtaining better jobs in terms of fringe benefits. We do not find evidence of strategic wealth allocation within households despite strong evidence of assortative matching, and no effect of schooling on completed fertility.

Our paper is closely related to the literature estimating causal effects of education on specific wealth components. Cole et al. (2014) use compulsory schooling laws in the United States as an instrument for schooling, and find that schooling increases the probability of direct stock ownership and decreases the probability of debt delinquency and foreclosure. Black et al. (2015) exploit a

rolled-out Swedish schooling reform to show that, while having no effect on the probability of investing in mutual funds and the share of liquid wealth invested in risky assets, schooling increases male direct stock market participation.

In our data we cannot consistently separate direct investments in stocks, mutual funds and bonds, and while we estimate a negative effect on participation in any of these markets, consistently with Black et al. (2015) we do not find any effect of schooling on total financial investmments. Moreover, due to the timing of the Danish school reforms, our sample is on average older than that studied by Cole et al. (2014) and Black et al. (2015), and is representative of males approaching retirement. When estimating separately by age, we show that the point estimate of the effect of schooling on financial investments is positive at the age of 50 and turns negative as age increases.

Our result suggest that general education does not boost wealth accumulation approaching retirement age. Incentivizing personal savings and wealth accumulation would likley require more targeted investment in specific competences and financial literacy. Our results are consistent with the finding that more educated individuals are able to adapt and exploit institutional systems to their advantage when choosing their saving strategies (Chetty et al., 2014).

The paper is organized as follows. Section II presents our data and illustrates the strong correlations between schooling, wealth and intelligence we find in our data. Section III describes our identification strategy and the Danish school reforms providing exogenous variation. Section IV presents our results, and Section V concludes.

II. Data

Our analysis combines historical geographic information with administrative register data on over 250,000 men born in Denmark between 1939 and 1951.

This section describes the content and purpose of each data source.

The administrative data combines information from four groups of registers and constitutes the bulk of our dataset. Demographic and education register data provide information on the highest level of schooling achieved, municipality and parish of birth, civil status and spousal identifier for each individual in our sample. Tax records from 1980 to 2011 provide information on income over the lifecycle. Reports from financial institutions (primarily banks and investment funds) and the real estate register give us a complete overview from 1996 to 2011 of the December 31 market value of financial assets and publicly assessed value of real estate holdings for each individual in our sample. Finally, the pension entitlement register gives us a snapshot of the pension entitlements (in terms of both pension wealth and pension annuity claims) of all individuals turning 60 before 2013.

With the exception of wealth held abroad, the administrative register data is third-party reported and describes the net wealth of both our core sample and their spouses. We use this information to split the total wealth of each individual in our sample into five categories. We distinguish between the amount of wealth held in liquid assets (saving and check accounts), the market value of financial investments (stocks, bonds and mutual funds), real estate value (public evaluations from the administrative housing register), collateralized debts (mostly mortgage) and non-collateralized debts. We compute housing equity as the difference between housing value and collateralized debt.

In our main analysis we normalize wealth components by permanent income, which we compute as a weighted moving average of disposable income in the preceding five tax years.Table 1 presents averages, standard deviations and means of individual wealth holdings over educational levels in both nominal values and normalized by permanent income.

The average man in the sample holds non-pension wealth equivalent to

Table 1
Wealth holdings of Danish males born 1939-1951 (years 1996-2012)

	Nominal values			Over permanent income		
	$< 7^{\text{th}}$ grade	8^{th} grade or more	Tertiary educ.	$< 7^{\text{th}}$ grade	8^{th} grade or more	Tertiary educ.
Perm. income	207.2	238.2	312.3			
	(89.10)	(99.8)	(125.9)			
	[192.5]	[219.9]	[284.6]			
Net Worth	661.8	808.0	1166	2.876	3.191	3.704
	(1515)	(1672)	(1905)	(6.238)	(6.199)	(6.338)
	[247.9]	[446.4]	[756.7]	[1.237]	[1.924]	[2.536]
Liquid assets	90.59	102.6	144.3	0.421	0.423	0.472
	(260.1)	(283.9)	(375.4)	(1.110)	(1.097)	(1.327)
	[21.63]	[28.32]	[45.71]	[0.113]	[0.128]	[0.159]
Housing equity	662.7	795.1	1044	2.881	3.167	3.359
	(1352)	(1474)	(1512)	(5.349)	(5.228)	(5.081)
	[268.0]	[453.7]	[694.6]	[1.292]	[1.917]	[2.281]
- housing value	1015	1223	1600	4.242	4.741	5.059
	(1875)	(1959)	(1879)	(6.539)	(6.366)	(5.979)
	[600.4]	[892.0]	[1258]	[2.974]	[3.829]	[4.148]
- house owner	0.625	0.720	0.827			
Fin. investments	50.15	71.70	151.3	0.202	0.260	0.440
	(334.1)	(459.6)	(751.4)	(1.114)	(1.479)	(2.071)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
- participation	0.282	0.356	0.458			
Unc. Debts	141.7	161.4	173.8	-0.628	-0.658	-0.567
	(405.0)	(465.8)	(581.4)	(1.732)	(1.840)	(2.064)
	[44.23]	[55.24]	[50.16]	[-0.239]	[-0.257]	[-0.176]
# observations	793156	2078053	803776	793156	2078053	803776

NOTE: Standard deviations in parentheses, medians in brackets. Nominal values are in thousands Danish Kroner (DKK), adjusted for inflation to 2010 prices. In December 2010 the exchange rate from USD to DKK was 5.57.

less than four years of permanent income, and has a high debt burden even after the age of 50. Housing equity represents most of the assets in our data: Over 50% of the sample invests more than 90% of their personally held assets in real estate. [2] As schooling increases net worth grows both at the average and at the median and the portfolio composition changes. More educated individuals invest more in the financial markets, hold relatively less liquid assets and leverage more on their real estate.

However this data, which we observe annually, does not include wealth held in pension funds and pension claims, which are important resources for sustaining consumption after retirement. We observe pension wealth and pension annuity claims only once, in the year an individual turns 60. Table 2 shows that the median male Dane by that age accumulates about 40% of his assets in pension funds. This wealth originates both from mandated employer pension contributions and from voluntary individual private contribution schemes.[3] In contrast, Danes accumulate virtually all claims to pension annuities via mandated employer contributions.Thereby, that the expected annuity with respect to permanent income increases with education suggests that people with more schooling secure jobs with better fringe benefits and where employers offer more competitive packages in terms of pension contributions.[4]

To identify the causal effect of education on wealth accumulation approaching retirement, we combine historical and geographical information on school openings with individual information on the parish of birth. Access to 8^{th} grade schooling in Denmark in the mid 20^{th} century did not solely depend on

[2]These results are consistent with the description of wealth and debt of Danish households by Andersen et al. (2014).

[3]While contributions to pension funds are tax deductibles, they entail a significant loss in liquidity, as withdrawing money from a pension account before retirement incurs a penalty of 60% of the amount withdrawn.

[4]Using event studies of individuals who switch firms, Chetty et al. (2014) show that people rarely adjust their savings in response to changes in mandated contributions by the employer. Total savings increase by 0.8 DKK for every DKK contributed by the employer.

Table 2
Wealth holdings of Danish males born 1939-1951 at the age of 60

	Nominal values			Over permanent income		
	$< 7^{th}$ grade	8^{th} grade or more	Tertiary educ.	$< 7^{th}$ grade	8^{th} grade or more	Tertiary educ.
Perm. income	207.2	238.2	312.3			
	(89.10)	(99.8)	(125.9)			
	[192.5]	[219.9]	[284.6]			
Non-pension assets	1156	1397	1896	4.865	5.423	5.971
	(2041)	(2160)	(2229)	(7.152)	(7.055)	(6.945)
	[685.2]	[1004]	[1443]	[3.410]	[4.327]	[4.791]
Pension wealth	440.3	709.4	1152	1.370	2.261	3.088
	(725.7)	(1086)	(1727)	(2.162)	(3.091)	(4.377)
	[222.2]	[365.6]	[642.8]	[0.728]	[1.333]	[1.964]
- by employer	190.1	381.9	631.3	0.621	1.215	1.692
	(443.6)	(818.7)	(1311)	(1.238)	(2.225)	(3.031)
	[92.90]	[131.7]	[185.6]	[0.354]	[0.536]	[0.615]
Annuities (per year)	19.17	32.39	111.5	0.068	0.117	0.349
	(43.29)	(65.39)	(224.4)	(0.176)	(0.244)	(0.785)
	[6.395]	[7.134]	[82.04]	[0.009]	[0.020]	[0.209]
- by employer	18.81	31.16	107.0	0.067	0.113	0.338
	(43.07)	(64.32)	(224.1)	(0.175)	(0.241)	(0.785)
	[6.134]	[6.426]	[70.38]	[0.007]	[0.016]	[0.172]
# observations	605312	1818882	746730	793156	2078053	803776

NOTE: Standard deviations in parentheses, medians in brackets. Nominal values are in thousands Danish Kroner (DKK), adjusted for inflation to 2010 prices. In December 2010 the exchange rate from USD to DKK was 5.57.

whether a middle school existed within a municipality. In areas of the country where municipalities were smaller in size, children could easily attend 8^{th} grade in the neighboring town. In areas where parish and municipal areas are larger, the distance to a school offering 8^{th} grade could have been long even within a single municipality.

We use our historical location data to calculate minimum distance as the crow flies between the closest public school offering 8^{th} grade and the residence of an individual, proxied with the location of the church of the parish

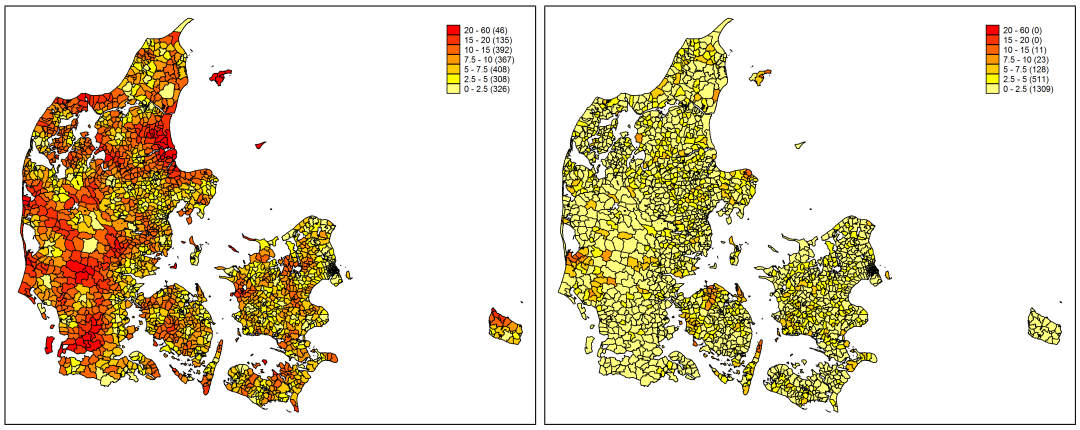
of birth. In 1953 the average distance to these public school for boys finishing 7^{th} grade was approximately 5 kilometers. However, the heterogeneity in distance across parishes was still substantial, and the goal of universal access to secondary education was far from achieved. One out of five children finishing 7^{th} grade lived more than ten kilometers from the closest public school, and the proportion of pupils attending 8^{th} grade in these areas was 15 percentage points below the national average (67.5%). The government took action to alleviate this disparity, enforcing school constructions and later changing the structure of primary and secondary schools in Denmark to provide universal access to secondary education in the countryside. These interventions provide us with policy-induced changes in minimum distance to public schools within a parish over time as an instrument for schooling.

III. Identification

During the mid 20^{th} century Denmark progressively reformed its education system to expand access to primary schooling. While 7^{th} grade attendance was mandatory, and a school offering 7^{th} grade teaching existed in every municipality, schools that offered 8^{th} grade teaching were fewer and scattered across the country. To remedy these inequalities, in 1937 the government required all 82 existing "market towns", or *købstæder*,[5] to build a school that offered at least 8^{th} grade teaching. However, primarily because of World War II, the reform implementation was delayed and rolled out over the years until 1958, when the government reformed the primary school system by mandating that 8^{th} and 9^{th} grade teaching be available in all Danish municipalities (Arendt, 2005, 2008).

[5]These were towns with enough economical or historical importance to be granted the status of "market town", which entailed a higher degree of administrative autonomy than that of other towns.

Figure 1.—Distance to closest public school offering 8^{th} grade (parish level)



(a) 1953 **(b) 1959**

NOTE: Maps produced from data by the Digital Atlas of Danish Historic Administrative Geography (digdag.dk), a research project financed by the Ministry of Education and Science under the National Program for Research Infrastructure.

These school openings had a dramatic impact on the average distance pupils had to travel in order to attend 8^{th} grade. Figure 1 shows how successful openings of middle schools throughout the country and the 1958 reform drastically increases access to 8^{th} grade education for most Danish parishes. In 1953 more than five hundred parishes were more than 10 kilometers away from the closest public school, but by 1959 this number decreased to eleven.

Because cross-sectional distance to the closest public school across municipalities is unlikely to be random, we exploit these policy-driven changes in distance to schools to identify the causal effect of schooling on wealth accumulation. However, municipalities might strategically decide to build a public school at a specific time. To control for these confounding correlations and isolate the policy-driven changes in access to schooling, we not only control in all our regressions for municipality fixed effects, but we also allow for different cohort linear trends between municipalities receiving access to 8^{th} grade teaching in different years. Because rural municipalities—those most affected

by the reforms—are typically large in size, we further split these cohort trends within a municipality between the main and secondary parishes in terms of population.

Thus, we allow for 22 unique cohort linear trends and about a thousand municipality fixed effects.[6] We further condition our analysis on year and cohort fixed effects, estimating the model

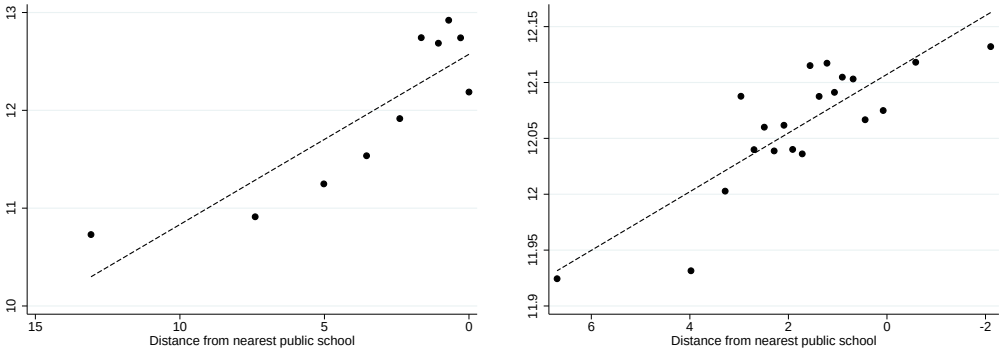
$$Y_{i,t} = S_i\beta + \Psi_i\gamma + \nu_i, \tag{1}$$

where Ψ_i represents the set of fixed effect and cohort trends. If $S_i \mid \Psi_i \not\perp \nu_{i,t}$, OLS estimation of this model returns a biased estimate of β. However, as we argue that policy-induced changes in the distance to closest public school $Z_i \mid \Psi_i$ is independent on $\nu_{i,t}$, instrumental variable estimation consistently estimates β, which measures a Local Average Treatment Effect (LATE) on the complier population.

Figure 2 visualizes our first stage non-parametrically. The left panel of the figure plots unconditional average length of schooling by ventile of distance to closest public school. The difference in average years of schooling between the closest and farthest 5% of individuals in our sample is approximately of 2 years of schooling. However, much of this correlation is due to cross-sectional differences across municipalities. Isolating the effect of the policy-induced variation in distance to closest public school, the right panel of Figure 2 shows averages conditional on the set of fixed effects and cohort trends in equation (1). While, consistent with our expectations, the correlation between distance to school and years of schooling decreases sharply after conditioning, the relationship is still clearly negative and, as Table A.1 in the Appendix shows, significant. As a placebo, we also regress schooling on distance to the closest

[6] In Table A.4 we replicate our main results allowing for municipality-specific trends instead.

Figure 2.—First stage regressions in graphs



(a) Length of schooling, unconditional **(b) Length of schooling, conditional**

private school offering 8^{th} grade and find no significant effect (see Table A.2 in the Appendix).

We run our regressions using either a quadratic polynomial in distance to schooling (F-statistic of 20) or a dummy indicating the presence of a public school within a 2.5 kilometers radius (F-statistic of 53) as instruments. The discrete instrument helps characterizing our complier population. Having a public school within a 2.5 kilometer radius increases the probability of attending 8^{th} grade by 3.86% (the proportion of compliers among treated is 3.84%). While these numbers stress how our results have a strict LATE interpretation, these complier probabilities are common in IV studies of returns to schooling (Angrist and Krueger, 1991; Acemoglu and Angrist, 2000).

Moreover, by exploiting changes in distance to schools we estimate a LATE that has particular policy relevance. While studies exploiting compulsory school reform typically estimate LATEs on the compliers that are least willing to attend school in the population (Oreopoulos, 2006), our complier population lies much closer to the median. The always takers in our sample are about 75% of the population, and the never takers are about 22%.

IV. Results

Table 3 presents our estimates of the effect of schooling on the wealth holdings of men aged between 45 and 62 between 1996 and 2011. The first three columns of the Table show the LATE of schooling on average total wealth normalized by individual permanent income and on all its separate components.[7] The last three columns shows the effect of schooling on the distribution of wealth within a cohort at a specific age. For each outcome we present the results of an OLS regression and of two IV regressions where we use respectively quadratic distance to the closest school offering 8^{th} grade and a dummy indicating the presence of such a school within a 2.5 kilometers radius. We condition all regressions on the set of fixed effects and cohort trends presented in Section III to isolate the policy-induced, exogenous variation in distance to school, and we allow for arbitrary correlation in the error terms within parish of birth.

While wealth and all its components correlate positively with schooling, our identification strategy reveals that the causal effect of schooling on wealth over permanent income is negative, and that thereby the positive correlation is due to self-selection and omitted confounders such as patience and inheritance. By decomposing total net worth into its major components, we show that the majority of this negative effect is due to housing equity. Part of this effect acts at the extensive margin: Schooling significantly decreases the probability of owning real estate.

Liquid assets also decrease by between 6.5% and 9% of permanent (annual) income per year of schooling. While in nominal terms the reduction in liquid asset held is much smaller than the reduction in housing equity, schooling affects the two outcomes similarly in terms of distribution. One additional

[7] Figure A.2 in the Appendix presents reduced-form results graphically.

Table 3
Effect of schooling on wealth holdings

	Effect on the average			Effect on rank (0-100)		
	OLS	IV (quad.)	IV (disc.)	OLS	IV (quad.)	IV (disc.)
Net Worth	0.114 **	-0.789 **	-0.629 **	1.297 **	-4.253 **	-3.713 **
	(0.007)	(0.258)	(0.210)	(0.040)	(1.436)	(1.203)
Liquid assets	0.008 **	-0.090 **	-0.065 **	0.602 **	-3.078 **	-2.745 **
	(0.001)	(0.029)	(0.023)	(0.024)	(0.918)	(0.752)
Housing equity	0.076 **	-0.681 **	-0.584 **	1.202 **	-3.905 **	-3.289 **
	(0.006)	(0.214)	(0.186)	(0.037)	(1.255)	(1.096)
- housing value	0.114 **	-0.870 **	-0.769 **	1.274 **	-3.823 **	-3.246 **
	(0.007)	(0.281)	(0.246)	(0.038)	(1.301)	(1.155)
- house owner	0.027 **	-0.047 *	-0.036 *			
	(0.001)	(0.019)	(0.017)			
Fin. investments	0.023 **	-0.019	0.020	1.089 **	-1.615	-1.014
	(0.001)	(0.041)	(0.032)	(0.019)	(1.031)	(0.783)
- participation	0.021 **	-0.038 +	-0.028 +			
	(0.000)	(0.020)	(0.015)			
Unc. Debts	0.008 **	0.002	0.001	0.220 **	-1.218 +	-1.223 *
	(0.001)	(0.036)	(0.032)	(0.014)	(0.712)	(0.598)
First stage F-stat		20.611	53.667		20.611	53.667

NOTE: Standard errors clustered at the parish of birth level in parentheses; ** $p < 0.01$, * $p < 0.01$, + $p < 0.1$. All regression include cohort trends by implementation year and rural versus urban areas and municipality of birth, year and cohort fixed effects. IV regressions in columns two and five use quadratic polynomial of distance to the closest public school offering 8^{th} grade as instrument for schooling; IV regressions in columns four and six, a dummy indicating the presence of such a school within a 2.5 kilometers radius.
†Computed on a sample of real estate owners only.

year of schooling at the 8^{th} grade margin moves individuals about 3 percentage points downwards in the distribution of both housing equity and liquid assets.

In contrast, schooling does not significantly affect the amount of wealth invested in financial markets. While the proportion of people investing in financial markets decreases, average financial investment does not vary significantly, suggesting that intensive and extensive margin responses move in opposite directions for our compliers.

Table 4
Effect of schooling on wealth composition

	Effect on the average			Effect on rank (0-100)		
	OLS	IV (quad.)	IV (disc.)	OLS	IV (quad.)	IV (disc.)
Liquid assets	-0.024 **	0.036 *	0.027 +	-1.338 **	1.390	0.961
	(0.001)	(0.016)	(0.015)	(0.033)	(0.932)	(0.878)
Fin. inv.	0.002 **	0.001	0.004	0.997 **	-1.200	-0.659
	(0.000)	(0.004)	(0.003)	(0.017)	(0.916)	(0.717)
Housing value	0.022 **	-0.036 *	-0.031 *	1.079 **	-1.702 *	-1.436 +
	(0.001)	(0.015)	(0.015)	(0.032)	(0.822)	(0.833)
Equity to value†	0.000	-0.022 **	-0.019 **	0.004	-2.410 **	-2.060 **
	(0.000)	(0.007)	(0.006)	(0.020)	(0.703)	(0.618)
First stage F-stat		21.040	54.366		21.040	54.366
First stage F-stat†		29.037	70.729		29.037	70.729

NOTE: Standard errors clustered at the parish of birth level in parentheses; ** $p < 0.01$, * $p < 0.01$, + $p < 0.1$. All regression include cohort trends by implementation year and rural versus urban areas and municipality of birth, year and cohort fixed effects. IV regressions in columns two and five use quadratic polynomial of distance to the closest public school offering 8^{th} grade as instrument for schooling; IV regressions in columns four and six, a dummy indicating the presence of such a school within a 2.5 kilometers radius.
†Computed on a sample of real estate owners only.

Tables 4 and 5 further characterize the effect of schooling on wealth holdings in terms of portfolio composition and wealth distribution. Table 4 focuses on how savers invest their assets, and shows that the combination of the effects in Table 3 induces more liquid wealth portfolios and higher leverage for those investing in the real estate market. The equity-to-value ratio of owned real estate decreases by approximately 2 percentage points per year of schooling on a sample of real estate owners. Because we estimate the impact of schooling on equity-to-value ratios on a conditional sample, this result cannot be interpreted as a causal effect. Nonetheless, these results show that schooling not only decreases individual wealth accumulation over the lifetime, but it also changes its qualitative composition.

Table 5 estimates the effect of schooling on the probability of belonging to

Table 5
Effect of schooling on the probability of belonging to each quintile in the distribution of a specific wealth component

Quintile	0-20%	20-40%	40-60%	60-80%	80-100%
	Panel A: Wealth outcomes				
Net Worth	0.032 *	0.023 *	0.011	-0.014	-0.052 **
	(0.013)	(0.009)	(0.007)	(0.010)	(0.018)
Liquid assets	0.010	0.023 **	0.021 **	-0.001	-0.053 **
	(0.007)	(0.008)	(0.007)	(0.006)	(0.014)
Housing equity	0.015 +	0.026 *	0.030 **	-0.012	-0.059 **
	(0.008)	(0.010)	(0.009)	(0.010)	(0.017)
- if owner	0.032 **	0.002	-0.004	-0.018 *	0.000
	(0.009)	(0.006)	(0.007)	(0.008)	(0.014)
Fin. investments			0.038 *	-0.035 **	-0.003
			(0.019)	(0.009)	(0.013)
- if participant	-0.001	-0.025 **	-0.007	0.004	0.037 *
	(0.010)	(0.007)	(0.005)	(0.005)	(0.015)
Unc. Debts	-0.005	0.023 **	0.012 +	-0.014 *	-0.016 *
	(0.008)	(0.009)	(0.006)	(0.007)	(0.007)
	Panel B: Pension outcomes				
Non-pension assets	0.015	0.046 *	0.005	-0.001	-0.052 **
	(0.012)	(0.019)	(0.009)	(0.009)	(0.018)
Pension wealth	0.006	0.011	-0.004	-0.010	0.002
	(0.008)	(0.015)	(0.010)	(0.010)	(0.013)
Annuities (per year)		0.010	-0.036 **	-0.021 *	0.046 **
		(0.013)	(0.010)	(0.010)	(0.010)

each of the quintiles in the distribution of each wealth component, characterizing in detail the distributional effects leading to the estimates in Table 3. The negative effect of schooling is not homogenous across the wealth distribution, but concentrated in the highest quintile. One year of schooling decreases the probability of belonging to the top 20% of the wealth distribution by about 5%. This negative change is reflected by an increase in the probability of having less wealth than the median man of the same birth cohort and in the same observation year.

Consistent with the results in Table 3, the negative effect of schooling on housing equity at both the intensive and extensive margin on drives these results. Even restricting the sample to house owners, schooling removes savers from the top 20% of the distribution of housing equity, placing them in the bottom quantiles instead. This is in stark contrast to the effect of schooling on financial investments. While Table 3 shows that schooling slightly decreases participation in financial markets, more educated investors are less likely to belong to the second quintile of the distribution, and more likely to belong to the fourth. Because we estimate these results on a conditional sample, these results do not estimate treatment effects. Nonetheless, Table 5 shows that the effect of schooling on financial investments combines intensive and extensive margin responses of opposing sign.

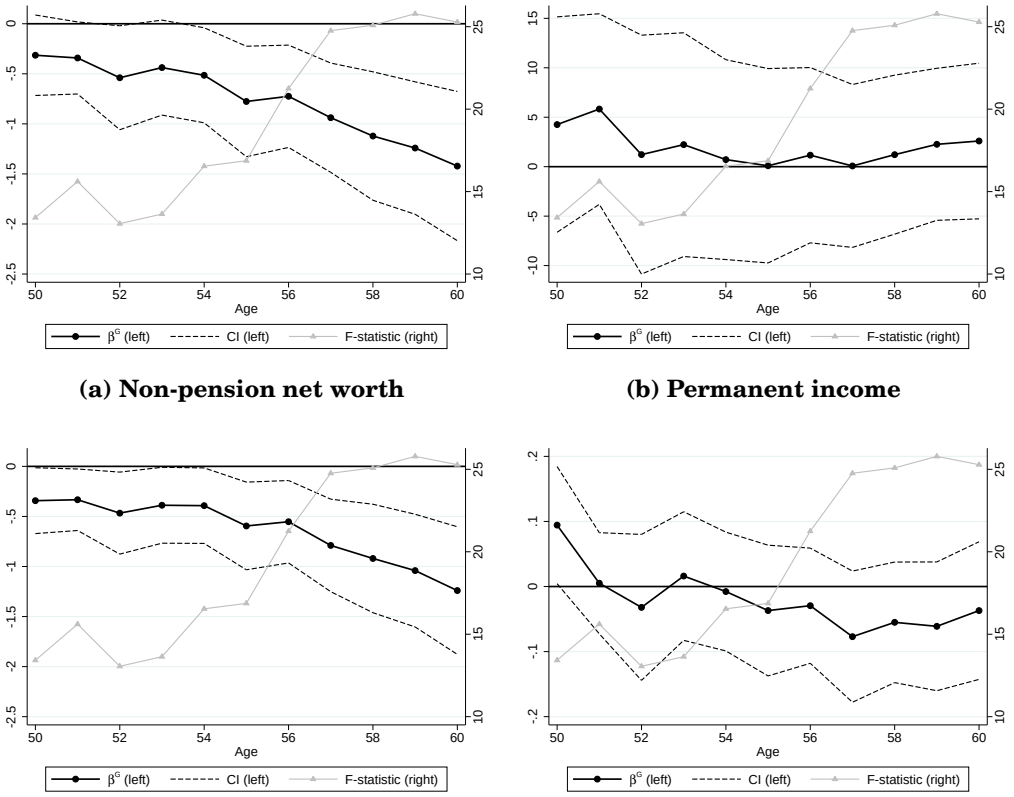
We find suggestive evidence that the negative effect of schooling on wealth holdings after the age of 50 is due to faster depletion of assets when approaching retirement rather than to a slower accumulation of assets in the early- and mid-life working age. Figure 3 shows how our results change as individuals age. The negative effect of schooling on wealth is stronger at older ages, driven primarily by a depletion of housing equity when approaching retirement. We also cannot reject that schooling has a positive effect on financial investments at the age of 50, a result consistent with Black et al. (2015) finding that schooling increases stock market participation on a younger sample.

The top right panel of Figure 3 shows that permanent income does not drive our results, as schooling has no effect on permanent income paths. Moreover, we find no evidence of schooling causing differential trends in house ownership and exposure to uncollateralized debts.[8]

As wealth correlates positively with education at any age, our results imply that the omitted variable bias is of the expected sign. Our identification

[8]Table A.3 in the Appendix reports results over age category for each wealth component.

Figure 3.—Effects of schooling over age



(a) Non-pension net worth **(b) Permanent income**

(c) Housing equity **(d) Financial investments**

NOTE: The figure estimates the effect (solid black line) and confidence intervals (dashed black line) of schooling separately by age, using a quadratic polynomial in distance to public schools as an instrument for schooling. The gray line plots the first-stage F-statistics for each regression. The scale of the graphs is in years of permanent income except for that in the top right panel, which is in thousands DKK. Table A.3 reports the effect of schooling by age bins.

strategy reveals that unobservable factors such as intergenerational transmission of wealth—e.g. through inheritance (Bowles and Gintis, 2002; Boserup et al., 2014)—and individual preferences and are responsible for the positive association between schooling and wealth held before retirement age. These results are robust to a battery of robustness and sensitivity checks. We replicate the same qualitative results using different specifications (i.e. allowing for municipality-specific cohort trends) and different samples (e.g. excluding renters or farmers). The results of these robustness checks appear in Table A.4.

Several mechanisms can explain why schooling causes lower wealth held outside pension funds before retirement. More years of schooling leads to later entry into the labor market, effectively subtracting years of savings from the total wealth accumulated at any given age. Higher qualifications can lead to better jobs in terms of job security and pension benefits, decreasing the need for precautionary savings and accelerating asset depletion at older ages. In the remainder of this section we identify some of these mechanisms in our data.

Table 6 reports the effect of schooling on pension rights accumulated before the age of 60 in our sample. As a comparison, we also report the effect of schooling on total non-pension assets accumulated by that age. While non-pension assets, consistent with the results in Table 3, decrease with schooling, pension wealth does not change significantly. However, the value of pension annuities to be paid after retirement increase by about 3.7% per year of schooling. This positive effect on annuities is almost entirely due to employer-based contributions determined by employment contracts, suggesting that schooling has a positive effect on job quality in terms of fringe benefits.

The positive effect of schooling on employment-based pension annuities reduces the incentive to prepare for retirement, and crowds out the savings of

Table 6
Effect of schooling on pension holdings (60 years of age)

	Prop. of permanent income			Rank in distribution (0-100)		
	OLS	IV (quadratic)	IV (discrete)	OLS	IV (quadratic)	IV (discrete)
Non-pension assets	0.128 **	-1.511 **	-1.398 **	1.148 **	-3.983 **	-3.489 **
	(0.012)	(0.468)	(0.403)	(0.042)	(1.447)	(1.179)
Pension wealth	0.139 **	-0.076	-0.021	1.505 **	-0.277	-0.134
	(0.003)	(0.114)	(0.106)	(0.019)	(0.939)	(0.820)
- by employer	0.081 **	0.057	0.053	0.927 **	1.230	0.682
	(0.002)	(0.066)	(0.061)	(0.024)	(0.752)	(0.658)
Annuities (per year)	0.022 **	0.037 **	0.033 **	1.483 **	1.813 *	1.623 *
	(0.000)	(0.008)	(0.007)	(0.037)	(0.765)	(0.721)
- by employer	0.020 **	0.034 **	0.030 **	1.263 **	1.357 +	1.112
	(0.000)	(0.008)	(0.007)	(0.035)	(0.778)	(0.714)
First stage F-stat		21.731	58.082		21.731	58.082

NOTE: Standard errors clustered at the parish of birth level in parentheses; ** $p < 0.01$, * $p < 0.01$, + $p < 0.1$. All regression include cohort trends by implementation year and rural versus urban areas and municipality of birth, year and cohort fixed effects. IV regressions in columns two and five use quadratic polynomial of distance to the closest public school offering 8^{th} grade as instrument for schooling; IV regressions in columns four and six, a dummy indicating the presence of such a school within a 2.5 kilometers radius.

the most financially sophisticated members of the population (Chetty et al., 2014). However, this mechanism alone cannot explain the entirety of the negative effect of schooling on wealth.[9] We explore the role of labor market outcomes and household formation in Table 7.

In the top panel of Table 7 we focus on labor market mechanism, computed from the age of 40 through 49 for all individuals in our sample. We test whether schooling causally impacts average gross income, its standard deviation, the probability to receive unemployment benefits and the likelihood of changing the municipality of work. We find that schooling has a positive impact on average gross income during one's forties, but not on income and un-

[9]Even assuming a zero discount rate and that all these annuities were perpetual, the effect of schooling on annuity claims would take more than 38 years to compensate the negative effect on wealth held outside of pension funds.

Table 7
Mechanisms: Effect of schooling on labor market outcomes and household composition

	OLS	IV (quadratic)	IV (discrete)
	Labor market mechanisms (40-49 years of age)		
Personal income - avg.	18.70 **	16.25 **	20.29 **
	(0.300)	(5.705)	(4.774)
Personal income - std. dev.	-0.007 **	-0.027	-0.003
	(0.000)	(0.021)	(0.017)
Unemployment risk	-0.013 **	0.002	-0.004
	(0.000)	(0.008)	(0.007)
Job mobility	-0.003 **	0.015 **	0.013 **
	(0.000)	(0.005)	(0.005)
# observations	364873	364873	364873
First stage F-stat		25.166	58.986
	Income and household composition (50-60 years of age)		
Permanent income	10.22 **	1.530	4.436
	(0.173)	(4.409)	(3.474)
N. kids	0.016 **	-0.038	-0.037
	(0.001)	(0.035)	(0.032)
Single	-0.021 **	0.027 *	0.014
	(0.000)	(0.013)	(0.012)
# observations	3634071	3634071	3634071
First stage F-stat		20.611	53.667
	Spouse outcomes (married men only)		
Spouse schooling	0.361 **	0.533 **	0.544 **
	(0.003)	(0.087)	(0.087)
Spouse wealth	0.038 **	-0.037	0.003
	(0.001)	(0.034)	(0.031)
Spouse house ownership	0.016 **	0.017	0.034 **
	(0.000)	(0.013)	(0.013)
# observations	2628403	2628403	2628403
First stage F-stat		21.344	55.878

NOTE—Standard errors clustered at the parish of birth level in parentheses; ** $p < 0.01$, * $p < 0.01$, + $p < 0.1$. All regression include cohort trends by implementation year and rural versus urban areas and municipality of birth, year and cohort fixed effects. IV regressions in columns two and five use quadratic polynomial of distance to the closest public school offering 8^{th} grade as instrument for schooling; IV regressions in columns four and six, a dummy indicating the presence of such a school within a 2.5 kilometers radius. The results in the top panel are estimated on a cross-section of all males in the sample. The results in the middle panel are computed on the full panel dataset. The results in the bottom sample are computed conditional on being married or in a registered partnership.

employment risk. However, schooling increases job mobility. Because a higher geographical mobility makes housing equity less attractive, this mechanism contributes to explaining our findings on wealth held outside of a pension funds, effects that are primarily driven by reductions in housing equity and home ownership rates.

Conditional on being married, we also find strong evidence of positive assortative matching, but no evidence of strategic wealth allocation within the couple. These results support our arguments in two ways. First, by finding income effects in the 40's and assortative matching effects consistent with the existing literature on returns to schooling, these results support our identification strategy. Second, these results show that labor market mechanisms such as labor mobility and pension benefit from employers explain part of the total negative effect on wealth accumulation. We have demonstrated that schooling is a large-scale intervention that, by affecting the economic environment over the lifetime of an individual, can significantly affect realised saving patterns.

V. Conclusions

This paper is the first to exploit policy-induced variation in the supply of schooling, measured with the distance to the closest public school offering 8^{th} grade, to identify the causal effect of schooling on wealth accumulation approaching retirement. We show that while wealth over permanent income correlates positively with schooling, this association is due to unobserved confounders such as patience and intergenerational transfers such as inheritance. The total amount of wealth accumulated between 50 and 60 years of age, in terms of individual permanent income, decreases with schooling. Robustness checks reveal that our findings are not due to market fluctuations in real estate prices (e.g. due to the 2008 financial crisis, or differences across municipalities) or

due to outliers, and are robust to different specifications.

We show that the majority of the effect of schooling on reducing wealth over permanent income originates from reduced housing equity, thereby inducing leaner and more liquid portfolios. Moreover, we identify some of the labor market mechanisms potentially explaining this negative effect. Higher schooling causes not only higher pension annuities through employer contributions, but also greater job mobility, making lumpy investments in housing equity less attractive.

These results show how schooling affects individual economic choices in multiple ways over a lifetime, and suggest that the effects of schooling on saving trajectories has broader consequences than on the under/over-saving margin and ability to plan due to increased literacy. We show that increased savings and greater wealth accumulation are not caused by increased schooling, and that schooling in fact reduced wealth levels at retirement. Inducing individuals to save appropriately for retirement likely requires more specific investments in financial literacy, targeted in view of the consequences of general schooling for retirement preparedness.

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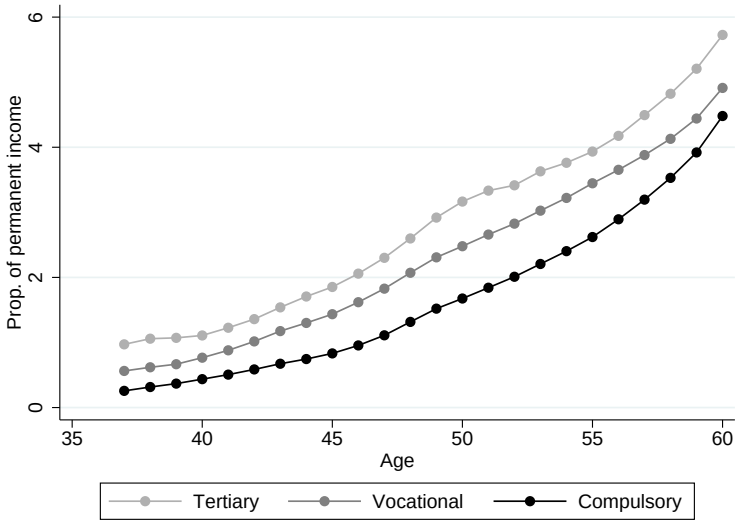
Figure A.1.—Lifecycle wealth accumulation over education type

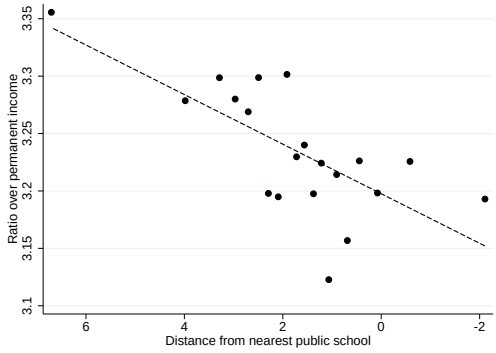


Appendix

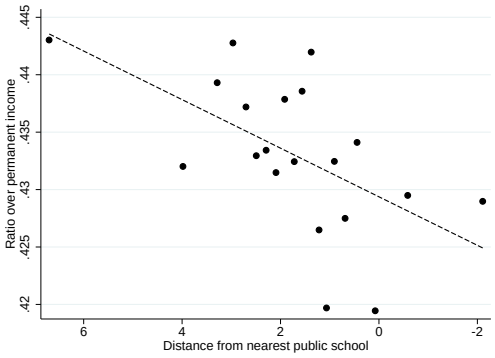
Table A.1
First stage: Effect of distance from public school on years of schooling

	Wealth sample (full)			Pension sample (age 60)		
	Linear	Quadratic	Discrete	Linear	Quadratic	Discrete
Distance (km)	-0.023 **	-0.068 **		-0.023 **	-0.071 **	
	(0.004)	(0.012)		(0.004)	(0.011)	
Distance squared		0.309 **			0.310 **	
		(0.065)			(0.061)	
Distance $\leq$ 2.5Km			0.299 **			0.321 **
			(0.041)			(0.042)
# Observations	3634071	3634071	3634071	364881	364881	364881
# clusters	1964	1964	1964	1927	1927	1927
F-statistic	32.630	20.611	53.666	36.294	25.158	58.927

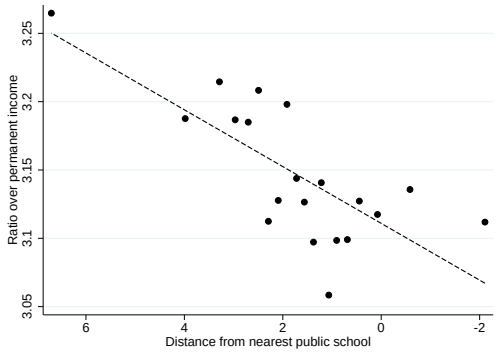
Figure A.2.—Reduced form regressions



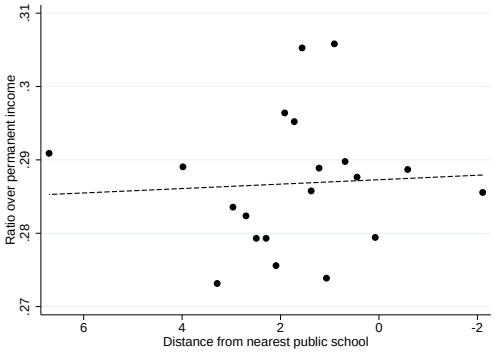
(a) Net personal wealth over permanent income



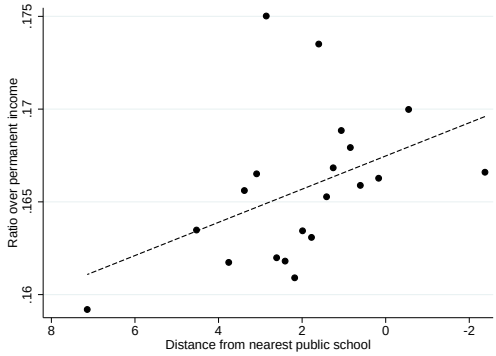
(b) Liquid assets over permanent income



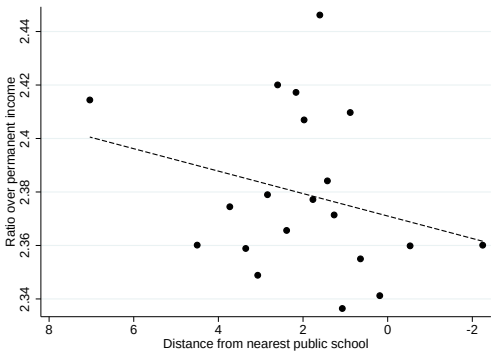
(c) Housing equity over permanent income



(d) Financial investments over permanent income



(e) Pension annuities over permanent income



(f) Pension wealth over permanent income

Table A.2
First stage, placebo: Effect of distance from private school on years of schooling

	Wealth sample (full)			Pension sample (age 60)		
	Linear	Quadratic	Discrete	Linear	Quadratic	Discrete
Distance (km)	-0.004	0.009		-0.005	-0.001	
	(0.004)	(0.015)		(0.004)	(0.016)	
Distance squared		-0.054			-0.018	
		(0.057)			(0.063)	
Distance $\leq$ 2.5Km			0.214 **			0.248 **
			(0.071)			(0.072)
# Observations	3634071	3634071	3634071	364881	364881	364881
# clusters	1964	1964	1964	1927	1927	1927
F-statistic	1.059	1.347	9.156	1.552	1.058	12.005

Table A.3
Effect of schooling on wealth by age

	Age at which the effect is estimated					
	50-51	52-53	54-55	56-57	58-59	60
Net Worth	-0.330 $^{+}$	-0.489 *	-0.653 *	-0.836 **	-1.182 **	-1.422 **
	(0.188)	(0.249)	(0.258)	(0.266)	(0.327)	(0.380)
Liquid assets	-0.025	-0.050	-0.071 *	-0.075 *	-0.134 **	-0.170 **
	(0.027)	(0.037)	(0.033)	(0.031)	(0.036)	(0.044)
Housing equity	-0.338 *	-0.430 *	-0.499 *	-0.678 **	-0.981 **	-1.240 **
	(0.159)	(0.198)	(0.206)	(0.220)	(0.276)	(0.325)
- housing value	-0.479 *	-0.658 *	-0.723 **	-0.836 **	-1.162 **	-1.503 **
	(0.225)	(0.286)	(0.280)	(0.279)	(0.340)	(0.399)
- house owner	-0.055 *	-0.053 *	-0.042 *	-0.038 *	-0.043 *	-0.047 **
	(0.024)	(0.026)	(0.020)	(0.017)	(0.017)	(0.017)
Fin. investments	0.045	-0.003	-0.023	-0.054	-0.058	-0.037
	(0.037)	(0.051)	(0.047)	(0.046)	(0.047)	(0.054)
- participation	-0.026	-0.052 $^{+}$	-0.049 *	-0.039 *	-0.040 *	-0.044 *
	(0.026)	(0.029)	(0.023)	(0.018)	(0.018)	(0.019)
Unc. Debts	-0.012	-0.005	-0.060	-0.029	-0.009	0.025
	(0.049)	(0.054)	(0.051)	(0.042)	(0.042)	(0.048)
	5.141	1.783	0.361	0.608	1.728	2.597
	(5.116)	(5.862)	(5.027)	(4.302)	(3.966)	(4.015)
First stage F-stat	14.860	13.629	16.847	23.279	25.510	25.282

NOTE— Standard error clustered at the parish of birth level in parentheses. All regressions instrument schooling with a quadratic polynomial distance to closest public school and include municipality of birth, age, year and cohort fixed effects and cohort trends by year of school opening in the municipality and parish rank (main vs secondary).

Table A.4
Robustness checks

	Baseline	Before 2008	Only 2000	Cut top 25% of wealth	Never self-employed	Participate in fin. mkts.	Home howners	Residence FEs	Municip. trends
	Panel A: Wealth outcomes								
Net Worth	-0.789 **	-0.743 **	-0.792 **	-0.292 **	-0.413 *	-0.552 *	-0.625 **	-0.839 **	-0.744 **
	(0.258)	(0.238)	(0.240)	(0.102)	(0.210)	(0.269)	(0.203)	(0.255)	(0.161)
Liquid assets	-0.090 **	-0.088 **	-0.090 **	-0.041 *	-0.062 *	-0.053	-0.084 **	-0.093 **	-0.062 **
	(0.029)	(0.028)	(0.029)	(0.018)	(0.030)	(0.032)	(0.024)	(0.030)	(0.019)
Housing equity	-0.681 **	-0.636 **	-0.631 **	-0.260 **	-0.314 *	-0.574 *	-0.556 **	-0.714 **	-0.645 **
	(0.214)	(0.195)	(0.187)	(0.080)	(0.158)	(0.236)	(0.173)	(0.210)	(0.135)
- housing value	-0.870 **	-0.832 **	-0.751 **	-0.375 **	-0.256	-0.740 *	-0.656 **	-0.892 **	-0.842 **
	(0.281)	(0.259)	(0.235)	(0.140)	(0.187)	(0.296)	(0.213)	(0.272)	(0.175)
- house owner	-0.047 *	-0.048 *	-0.048 *	-0.050 *	-0.033	-0.018 +		-0.044 *	-0.036 **
	(0.019)	(0.019)	(0.019)	(0.023)	(0.021)	(0.010)		(0.018)	(0.012)
Fin. investments	-0.019	-0.020	-0.046	0.008	0.013	0.026	-0.012	-0.023	-0.005
	(0.041)	(0.041)	(0.047)	(0.011)	(0.041)	(0.062)	(0.038)	(0.041)	(0.026)
- participation	-0.038 +	-0.041 *	-0.026	-0.036 +	-0.018		-0.024	-0.039 *	-0.030 *
	(0.020)	(0.020)	(0.019)	(0.019)	(0.020)		(0.015)	(0.020)	(0.013)
Unc. Debts	0.002	0.001	-0.025	0.002	-0.050	0.048	0.027	-0.009	-0.032
	(0.036)	(0.036)	(0.044)	(0.053)	(0.042)	(0.036)	(0.023)	(0.037)	(0.027)
First stage F-stat	20.611	20.681	21.577	14.914	14.096	28.210	28.834	21.529	41.002
Observations	3634071	3375038	333977	2723887	3352051	1317998	2630853	3634071	3634071
	Panel B: Pension outcomes								
Pension wealth	-0.076	-0.183	-0.381	0.024	-0.142	0.111	0.044	-0.052	-0.004
	(0.114)	(0.130)	(0.278)	(0.096)	(0.140)	(0.137)	(0.106)	(0.107)	(0.074)
Annuities	0.037 **	0.032 **	0.013	0.033 **	0.030 **	0.050 **	0.049 **	0.038 **	0.036 **
	(0.008)	(0.009)	(0.021)	(0.010)	(0.010)	(0.010)	(0.009)	(0.008)	(0.006)
First stage F-stat	21.731	18.364	5.278	15.115	14.955	21.707	25.149	25.338	47.310
Observations	284160	211142	20245	178564	261462	120455	215806	284160	284160

NOTE—