Credit Constraints, Family Constraints and Optimal Policies to Reduce Inequality and Promote Productivity

Flavio Cunha
University of Chicago

James J. Heckman
University College London
and University of Chicago

IDEI 11th Annual Conference

Toulouse, France
November 19, 2004

Lecture Today Based on a Book:

"Inequality in America: What Role for Human Capital Policies?"

(with Alan Krueger)

MIT Press, 2003

and

"The Productivity Argument for Investing in Young Children"

(with D. Masterov)

Committee on Economic Development,
Paper #5
September 2004

at http://jenni.uchicago.edu/Invest/

and

"The Technology of Skill Formation"

(with Flavio Cunha)

presented at

Minnesota Fed, October 2003;
AEA meetings, San Diego, January 2004;
SEDC meetings, Florence, July 2004

Main Points of Lecture

- Growth of inequality in the labor market is a serious problem in many countries.
- The labor market is the major source of income for most persons in most countries.
- Differences in abilities and skills (education, post-school training, cognitive and noncognitive skills) are the major source of inequality in modern society.

- Recent studies of the economics of skill formation show that abilities are a major determinant of schooling attainment, job training and returns to these activities.

- Ability is multifaceted and consists of both cognitive abilities (e.g., IQ) and noncognitive abilities (e.g., persistence, motivation, self-discipline and the like).

- Ability gaps open up early, long before formal schooling begins.

- The major source of inequality in modern society is the inequality of family opportunities provided children.

- Understanding this fact and the dynamics of the human skill formation process has major consequences for the way we think about policy.

- Policies that reduce inequalities of environments reduce inequality among the children from those environments and raise their productivity.

- For policies directed toward the very young, there is no equity/efficiency trade-off.

- Conventional policy discussions about skill formation are off the mark.

- They ignore the dynamic nature of the skill formation process.

- Schools cannot remedy years of neglect by families.

- The economic returns to marginal reductions in pupil/ teacher ratios and teacher pay increases are small at current levels of expenditure.

- Tuition reduction programs targeted to disadvantaged families are unlikely to go far in alleviating schooling gaps by race.

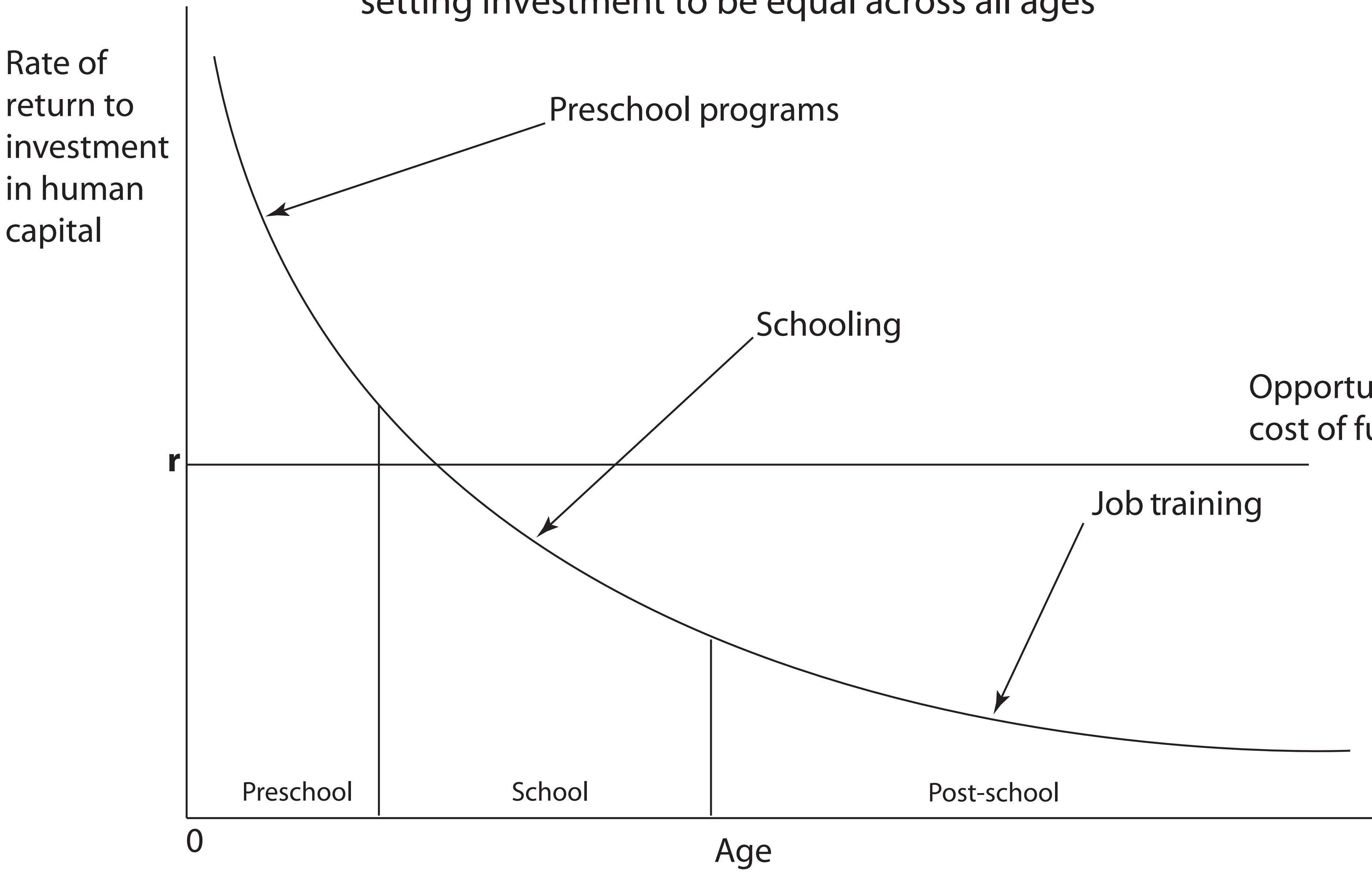
- Job training and second chance remediation programs have, at best, modest effects.

- Highest returns are to early interventions that set the stage for and create the abilities needed for success in life.

Major Theme of Lecture:

- Skill begets skill
- Both a theoretical and an empirical proposition
- At current levels of spending, most societies underinvest in early years for disadvantaged persons

Rates of return to human capital investment initially setting investment to be equal across all ages



Rates of return to human capital investment initially setting investment to be equal across all ages

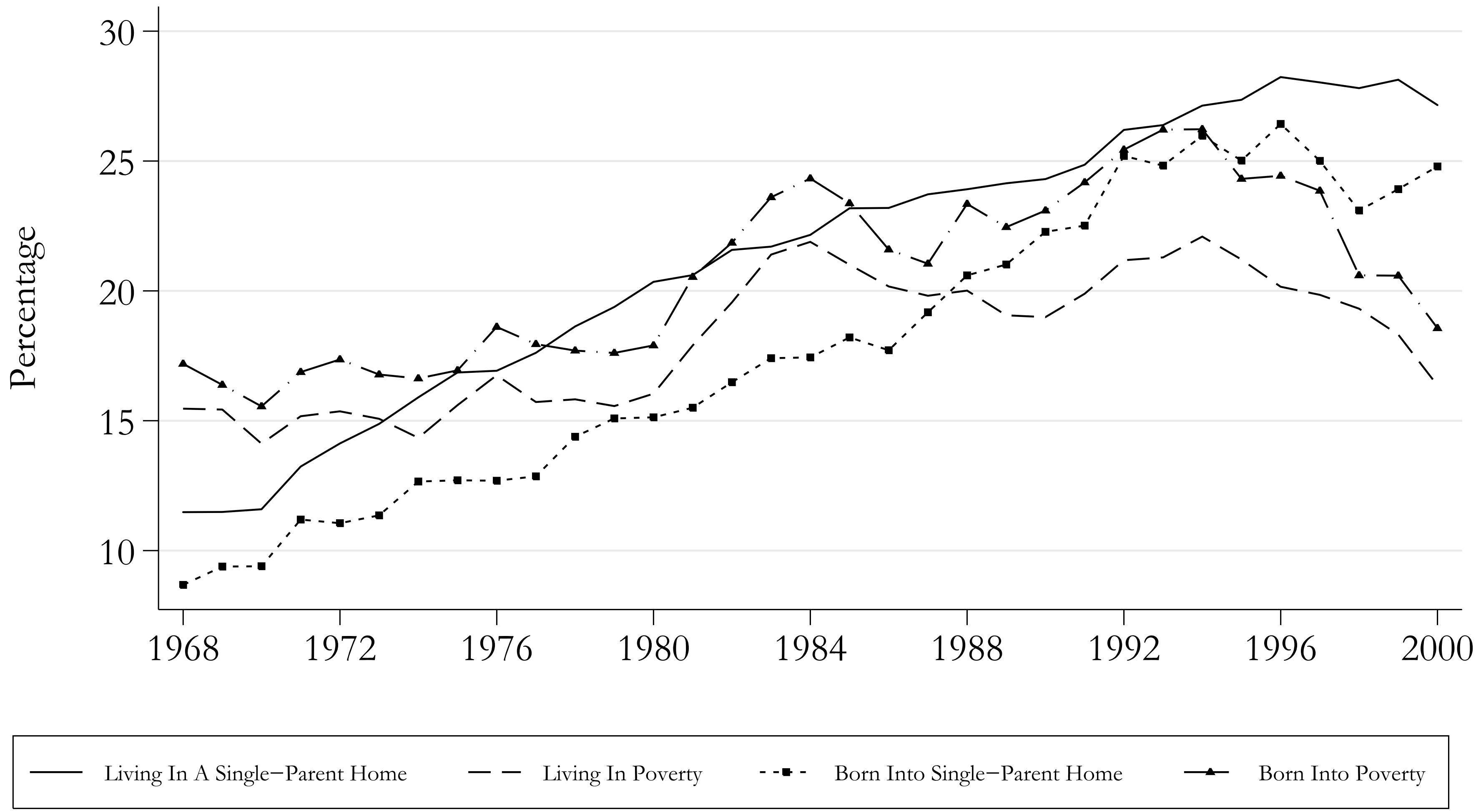
- In U.S. and in many countries around the world, families are producing relatively more children exposed to adverse environments.

- These adverse environments have substantial impacts on the children.

- Early remediation can ameliorate these environments.

Figure 1

Percentage of All Children Born Or Living In Adverse Environments In Each Year, 1968−2000



Source: Current Population Survey Annual March Supplement, 1968−2000. Poverty is defined as living in a household with income below the federal poverty line, which is adjusted for age and number of family members. Single−parent homes include cohabiting partners.

1 No Equity/Efficiency Tradeoff

- U.S. and many other countries face major problems in terms of the growth in the level and quality of its labor force and in terms of crime.

- On productivity grounds alone, one can craft a case for early interventions.

- Education and skills are major determinants of productivity growth and crime

Slowdown in Labor Force Growth

- Quantity of workers: Growth has slowed down.
- Quality of workers has declined.
- GEDs are 17% of all newly certified high school graduates, but they perform at the level of dropouts.
- De Long et al. (2003) estimate that the slowdown in labor force quality growth will reduce the productivity growth of labor by 0.18-0.29% per year.

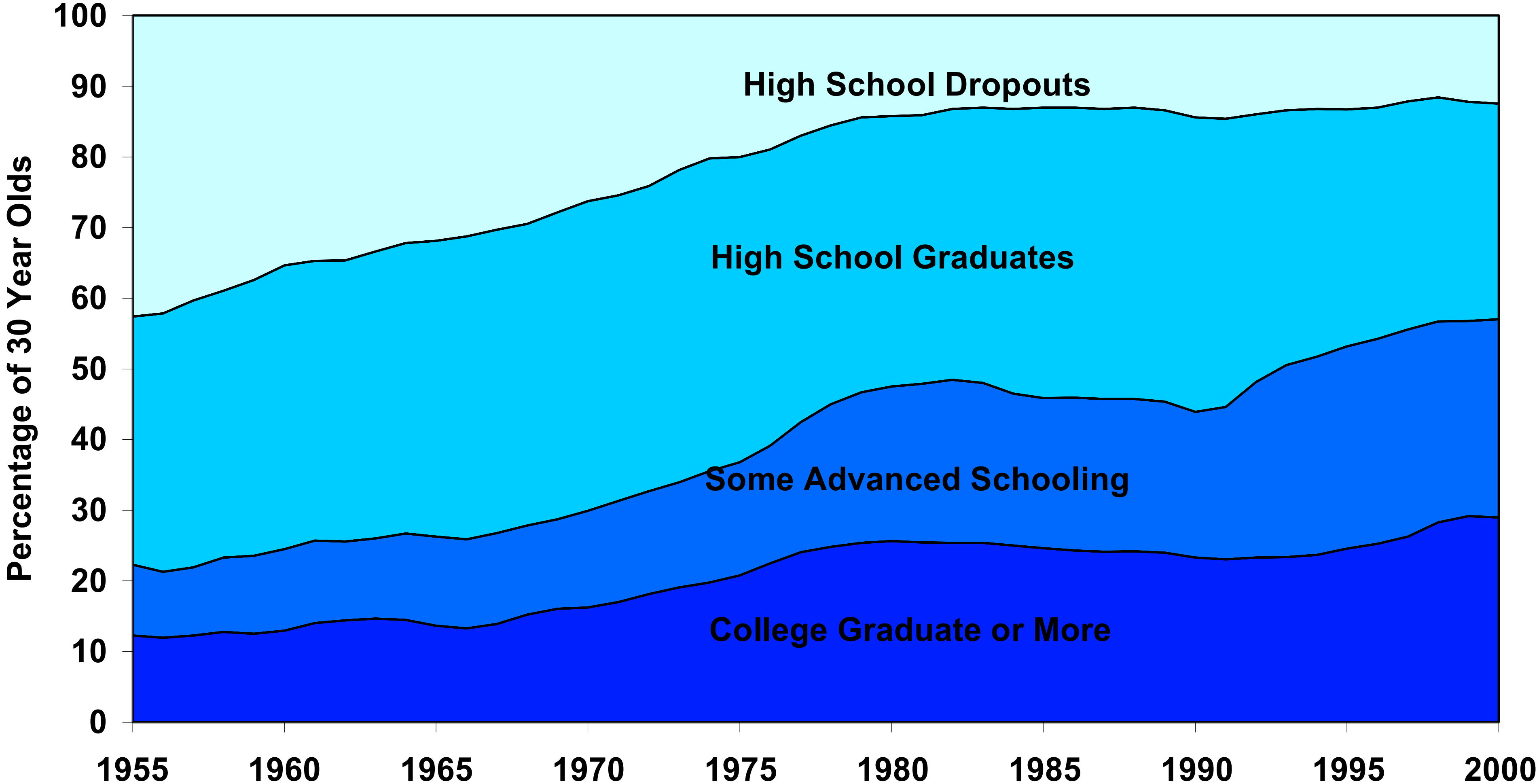
Table 1
Characteristics of the Labor Force Aged 25 and Over and Components of Change 1980, 2000, 2020
(Millions of Workers)

	Labor Force in 1980	Growth 1980 -2000	Labor Force in 2000	Growth 2000 -2020	Labor Force in 2020
Age					
25-54	**65.0**	**35.1**	**100.1**	**3.0**	**103.1**
55-64	**11.8**	**2.2**	**14.0**	**12.5**	**26.5**
65+	**3.0**	**1.4**	**4.4**	**4.0**	**8.4**
Total	***79.8***	***38.7***	***118.5***	***19.4***	***137.9***
Race/Ethnicity/Nativity					
White Non-Hispanic – Native	**63.0**	**21.5**	**84.5**	**2.6**	**87.1**
Black Non-Hispanic – Native	**7.6**	**4.6**	**12.2**	**2.8**	**15.0**
Hispanic – Native	**2.5**	**2.3**	**4.8**	**6.8**	**11.6**
Other Non-Hispanic – Native	**0.8**	**1.0**	**1.8**	**1.2**	**3.0**
Hispanic – Foreign Born	**1.8**	**4.5**	**6.3**	**2.8**	**9.1**
Non-Hispanic – Foreign Born	**4.1**	**4.8**	**8.9**	**3.3**	**12.2**
Total	***79.8***	***38.7***	***118.5***	***19.4***	***137.9***
SUMMARY					
Native White Workers 25-54	**50.8**	**19.3**	**70.1**	**-7.7**	**62.4**
Native White Workers 55 & Over	**12.2**	**2.2**	**14.4**	**10.3**	**24.7**
Workers of Color 25-54	**9.4**	**7.3**	**16.7**	**7.7**	**24.4**
Workers of Color 55 & Over	**1.6**	**0.5**	**2.1**	**3.0**	**5.1**
Foreign Born Workers	**5.9**	**9.4**	**15.3**	**6.0**	**21.3**
Total	***79.8***	***38.7***	***118.5***	***19.4***	***137.9***

Source: Ellwood (2001).

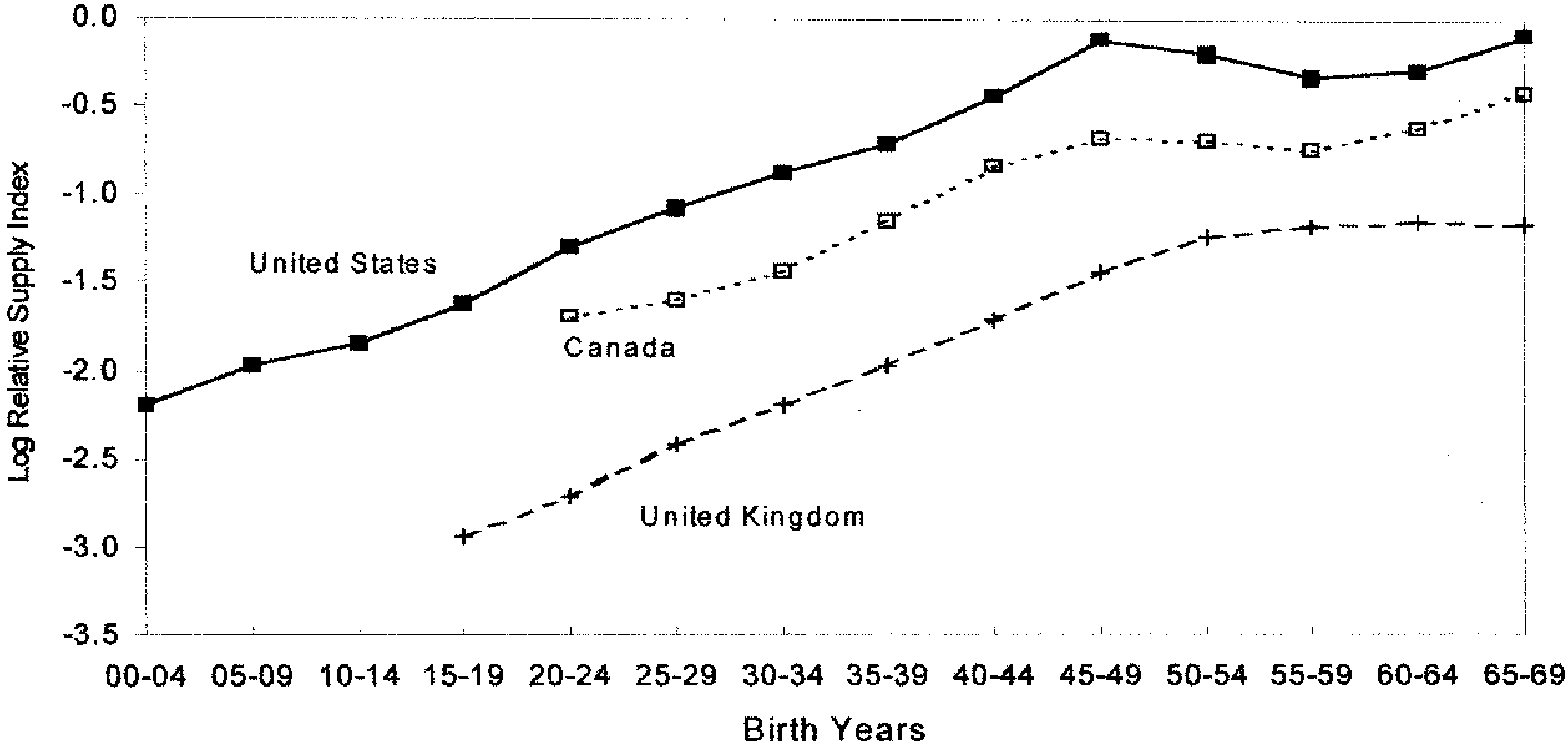
Figure 2

Percent Distribution of Education Among 30 Year Olds By Year



Source: Annual March CPS Data. Three Year Centered Moving Averages (Ellwood, 2001)

Figure 3



Relative Supply of College-Educated Workers by Cohort

Table 2

Educational Characteristics of the Labor Force

Age 25 and Over

1980, 2000, 2020

	Labor Force in 1980	**Growth 1980 -2000**	Labor Force in 2000	**Growth 2000 -2020**	Labor Force in 2020
Education					
Less Than High School	**17.3**	**-5.3**	**12.0**	**0.9**	**12.9**
High School Only	**31.5**	**6.3**	**37.8**	**3.8**	**41.6**
Some Schooling Beyond High School	**13.8**	**19.1**	**32.9**	**6.2**	**39.1**
College Degree or More	**17.3**	**18.5**	**35.8**	**7.7**	**43.5**
Total	***79.8***	***38.7***	***118.5***	***18.6***	***137.1***
% With College Degree	*21.6%*		*30.2%*		*31.7%*

*Assumes that subsequent cohorts have same education at age 25 as the cohort age 25 in 2000.

Source: Ellwood (2001).

- Arguably, the dropout rate is understated in the U.S.

Crime

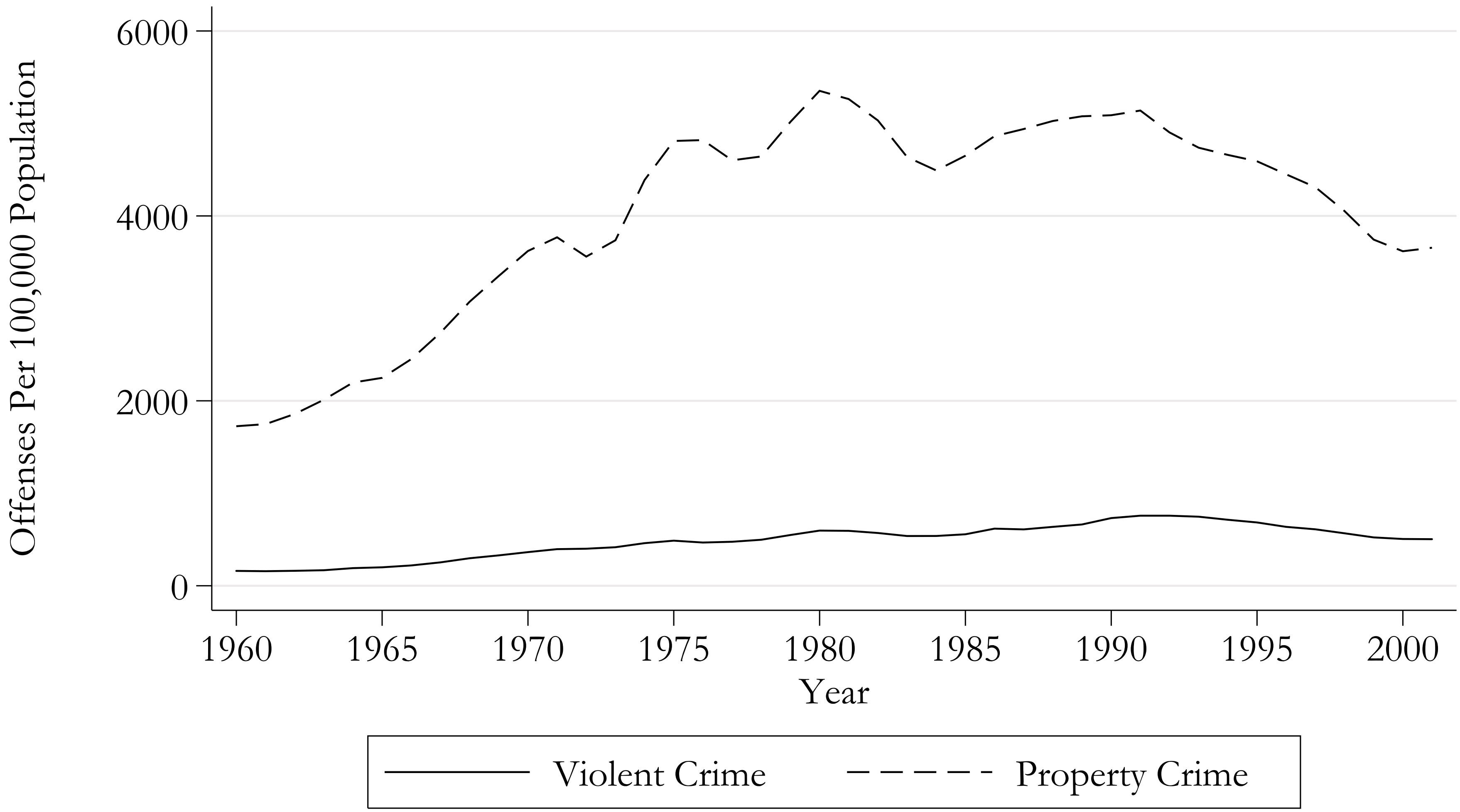
- Anderson (1999): the net cost of crime is \$1.3T per year.
- Per capita cost is \$4,818 per year.
- Violent and property crime levels are still high, despite large declines in recent years.
- Crime reduction is extremely expensive.
- Adult correctional population is still increasing.
- Spending on the criminal justice system is still increasing.

Table 3. Aggregate Burden Of Crime

Crime-induced Production ($ billion)	464
Opportunity Costs ($ billion)	152
Risks to Life And Health ($ billion)	672
Transfers ($ billion)	706
Gross Burden ($ billion)	1,995
Net of Transfers ($ billion)	1,289
Per Capita ($)	4,818

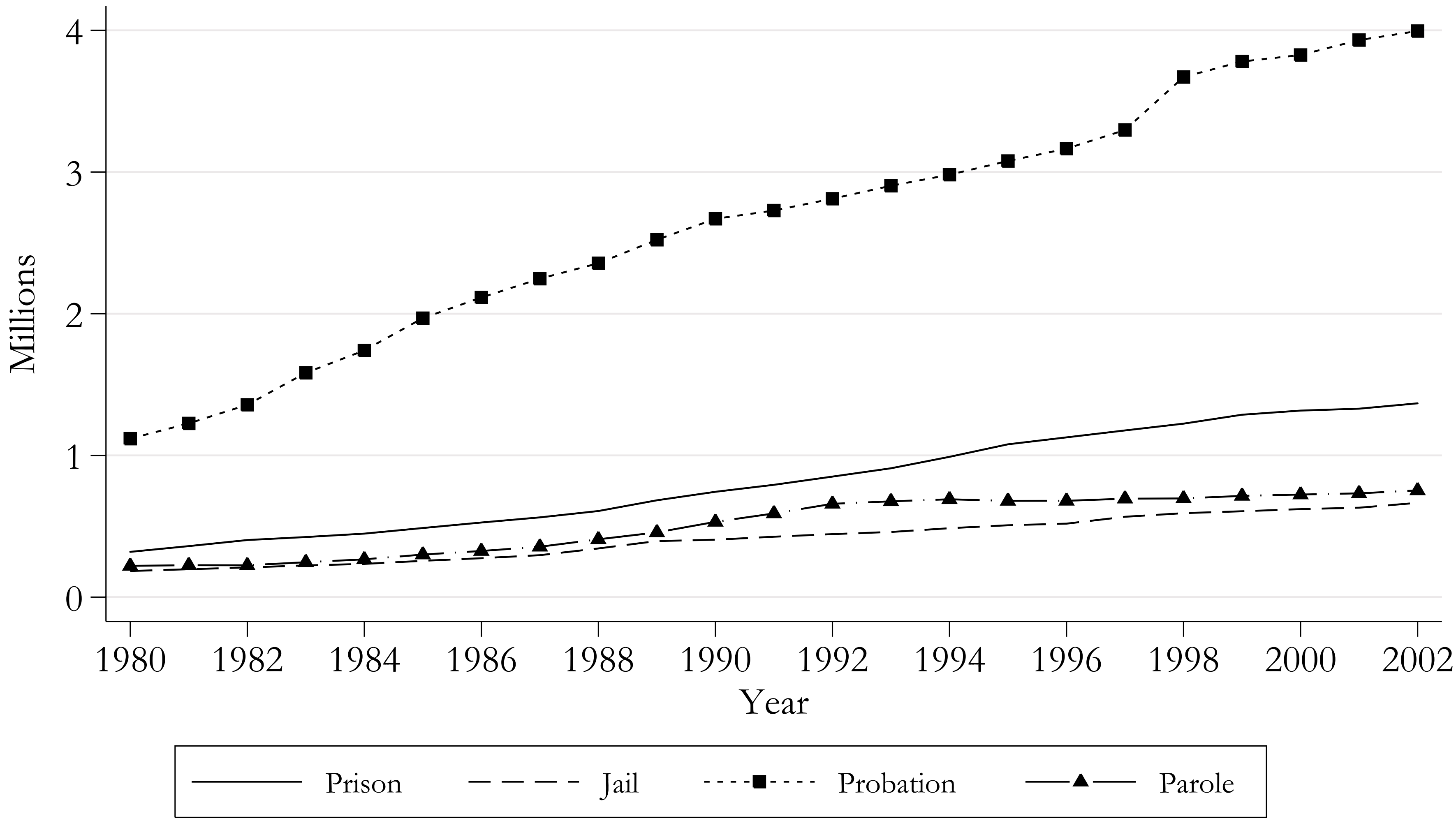
Source: Anderson (1999). All figures inflated to $2004 using the CPI.

Figure 4a
Reported Violent and Property Crime Rates, 1960−2001
Data from Uniform Crime Reports



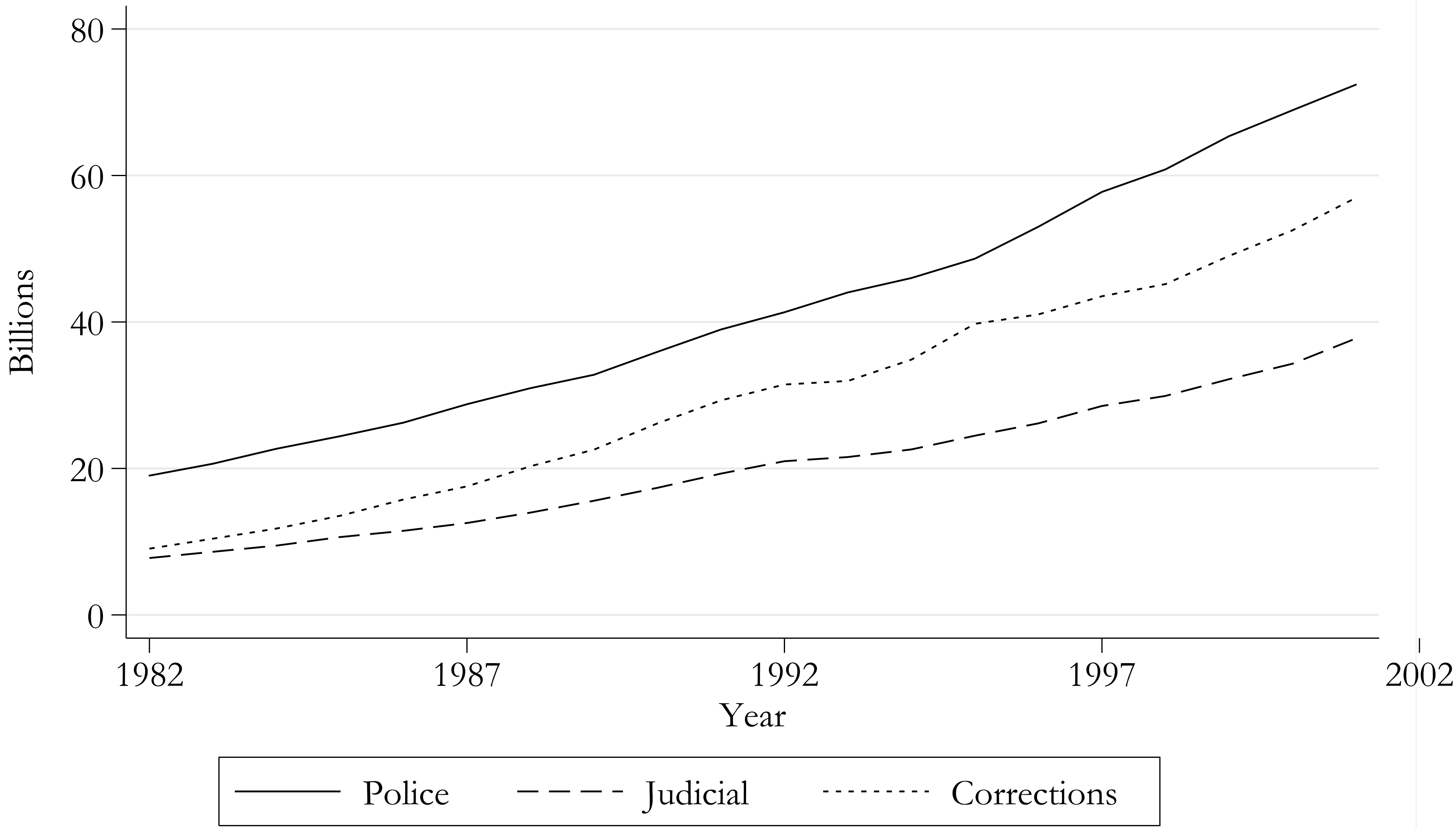
Note: The murder and nonnegligent homicides that occurred as a result of the events of September 11, 2001 are not included.

Figure 4b
Adult Correctional Population, 1980−2002



Note: Probation is court ordered community supervision. Prison consists of confinement in a state or federal correctional facility for more than 1 year or longer. Jail is confinement in a local facility while pending trial, awaiting sentencing, serving a sentence less than 1 year, or awaiting transfer to another facility after conviction. Parole is community supervision after a period of incarceration. Data from BJS Correctional Surveys

Figure 4c
Total Direct Expenditures By Criminal Justice Function, 1982−2001



Source: Justice Expenditure and Employment Extracts.

Education and Crime

- Strong negative relationship between education and participation in crime
- Early interventions reduce crime
- Using changes in compulsory schooling laws, Lochner and Moretti (2004) show that education is a better policy than additional police or incarceration

- Levitt (1997): An additional sworn police officer in a large U.S. city reduces annual costs of crime by $200,000 per year (2004 $). It costs $80,000 per year in salary.

- Lochner and Moretti (2004): In steady state, it costs $15,000 per year in terms of direct costs to reduce crime by the same amount.

Figure 5

Regression-Adjusted Probability of
Incarceration, by Years of Schooling

WHITES

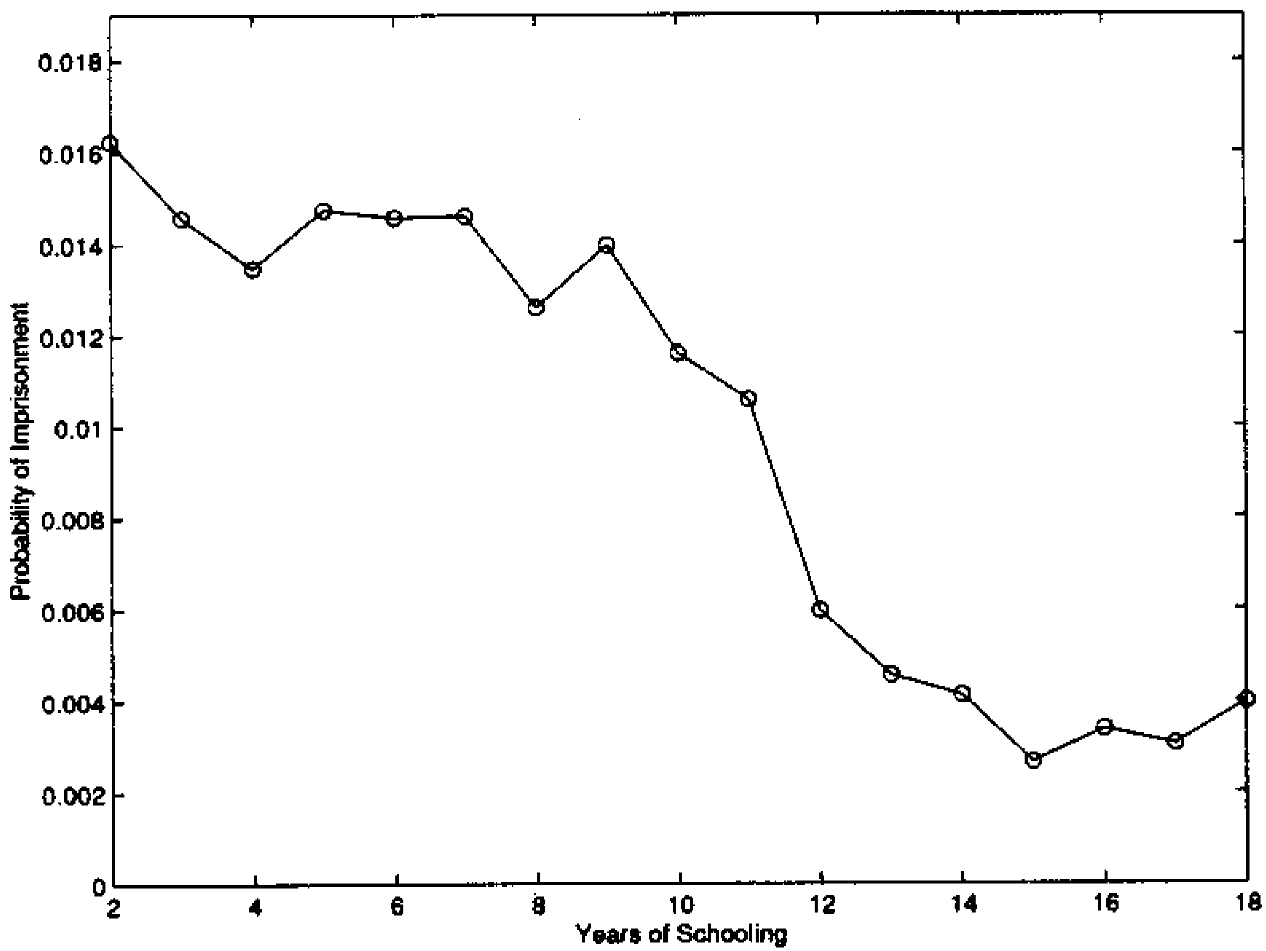
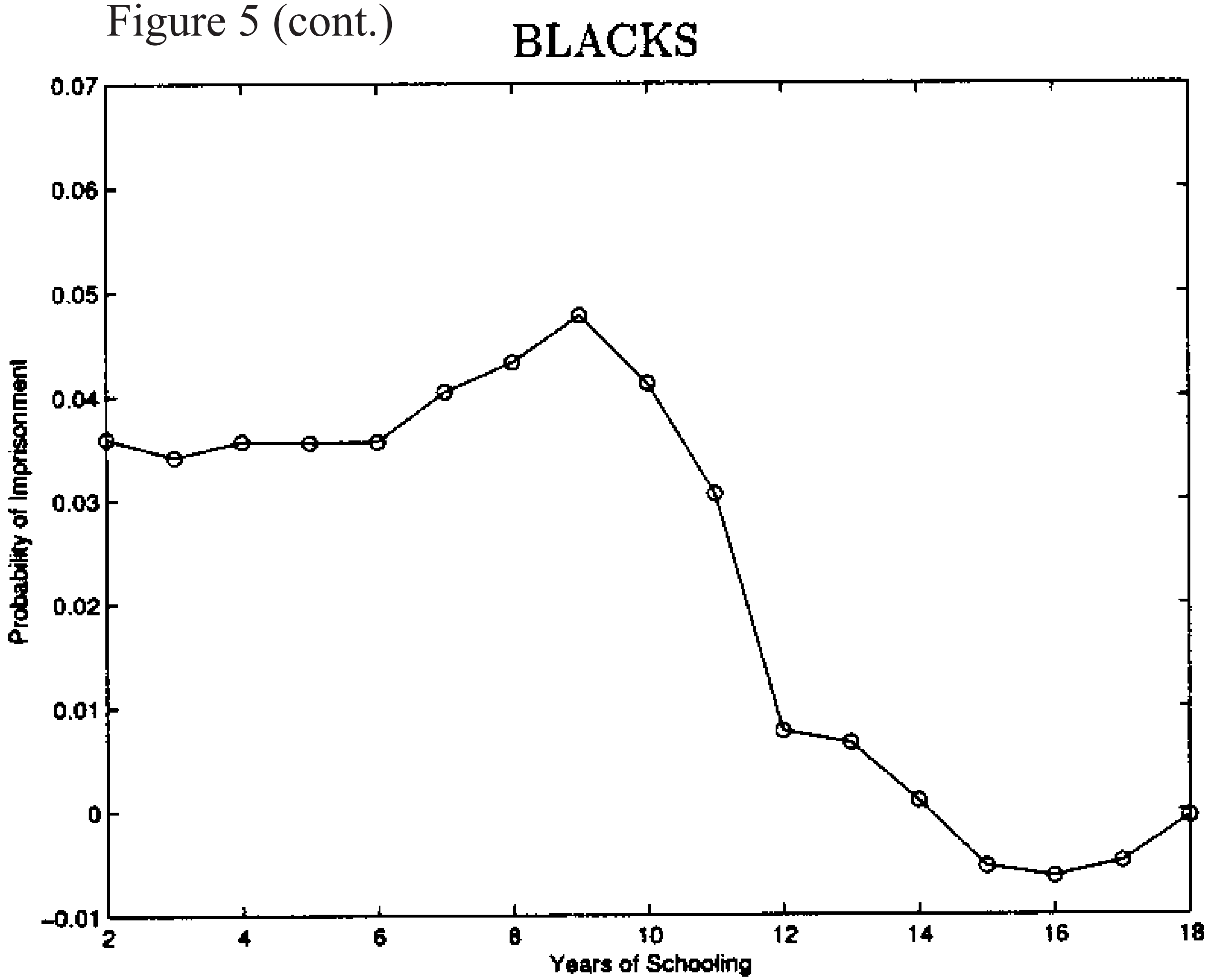


Figure 5 (cont.)



Source: Lochner (2004)

- Early abilities and motivations vitally affect success in schooling.

- There is evidence that early intervention programs are highly successful in fighting crime.

Table 4

Effects of Early Intervention Programs

Program/Study	Cost[a]	Program Description	Pre-delinquency Crime
Abecedarian Project[b] (Ramey et al. (1988))	N/A	Full-time year-round classes for children from infancy through preschool	No Effect
Houston PCDC[b] (Johnson (1988))	N/A	Home visits for parents for two years; child nursery care four days per week in year two (Mexican Americans)	Rated less aggressive and hostile by mothers (ages 8–11)
Perry Preschool Program[b] (Schweinhart, Barnes and Weikart (1993))	$19,162	Weekly home visits with parents; intensive high-quality preschool services for one to two years	2.3 versus 4.6 lifetime arrests by age 27; 7% versus 35% arrested 5 or more times
Syracuse University Family Development (Lally, Mangione and Honig (1988))	$54,483	Weekly home visits for family; day care year round	6% versus 22% had probation files; offenses were less severe
Yale Experiment	$33,319	Family support; home visits and day care as needed for thirty months	Rated less aggressive and pre-delinquent by teachers and parents (age 12½)

Note: All comparisons are for program participants versus non-participants. [a]Costs valued in 2004 dollars. [b]Studies used a random assignment experimental design to determine program impacts. Data from Donohue and Siegelman (1998), Schweinhart, Barnes and Weikart (1993), and Seitz (1990) for the impacts reported here. N/A indicates not available.

Source: Heckman, Lochner, Smith and Taber (1997).

Table 5. Estimated Social Benefits Of Increasing High School Completion Rates By 1 Percent

	Estimated Change In Crime	Social Benefits
Violent Crimes:		
Murder	-373	$1,457,179,565
Rape	1,559	-$179,450,969
Robbery	918	-$11,116,176
Assault	-37,135	$475,045,373
Property Crimes:		
Burglary	-9,467	$12,052,009
Larceny/Theft	-35,105	$8,958,962
Motor Vehicle Theft	-14,238	$22,869,192
Arson	-469	$23,637,635
Total:	-94,310	$1,809,175,590

Notes: Victim costs and property losses taken from Table 2 of Miller *et al.* (1996). Incarceration costs per crime equal the incarceration cost per inmate, $17,027 (U.S. Department of Justice, 1999), multiplied by the incarceration rate (U.S. Department of Justice, 1994). Total costs are calculated as the sum of victim costs and incarceration costs less 80% of the property loss (already included in victim costs) for all crimes except arson. Total costs for arson are the sum of victim costs and incarceration costs since there is no transfer of property between victim and criminal. Estimated changes in crimes adjusts the arrest effect by the number of crimes per arrest. The social benefits is the estimated change in crimes times the total cost per crime. All dollar figures are adjusted to $2004 using the CPI. Source: Lochner and Moretti (2004).

- Education is thus an important determinant of crime and productivity

- What determines education?

2 The Importance of Parental Resources

1. Parental Lifetime Resources are important in determining schooling and lifetime achievement.

2. The timing of resource availability is not important.

Thus, credit constraints in the college going years not major determinant of schooling achievement.

3. Family environments have deteriorated in U.S. and other countries.

A. Family Income Strongly Correlated with Education and Skill Attainment

B. How to Interpret the Correlation?

C. Conditioning on Ability and Family Background Eliminates Racial and Current Family Income Schooling Gaps

D. Only 8% Constrained in a Short Run Sense

E. Gaps in Ability Open Up Early

F. Depend on Family Background

G. Focus on Family Income in College-Going Years May be Inappropriate

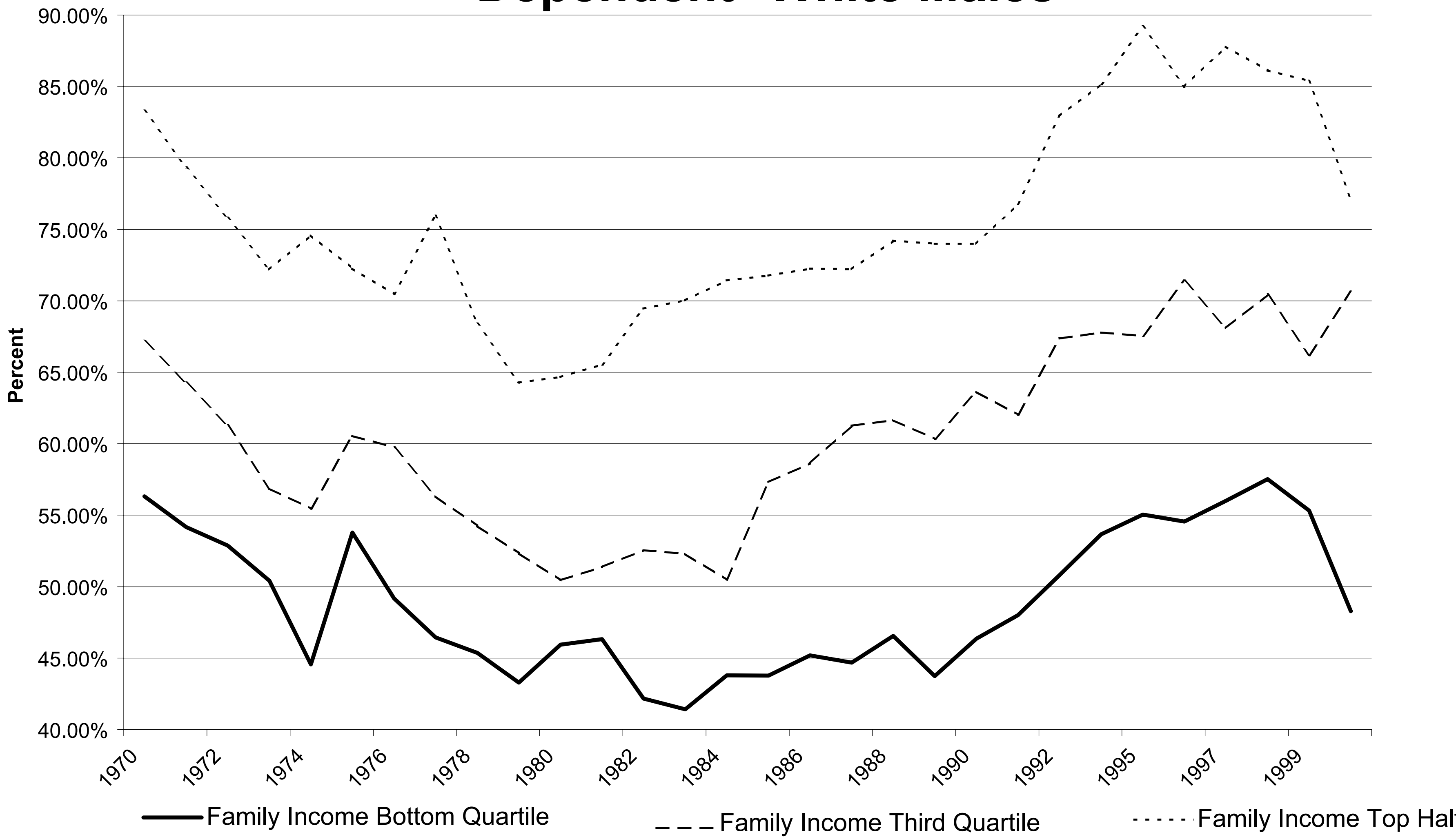
H. Gains to Tuition Subsidy Big for a Targeted Group

I. But there is still a Relatively Weak Effect of Tuition Subsidy on Overall Skill Formation

Figure 6

College Participation, 18 to 24 Yrs, HS Grads and GED Holders

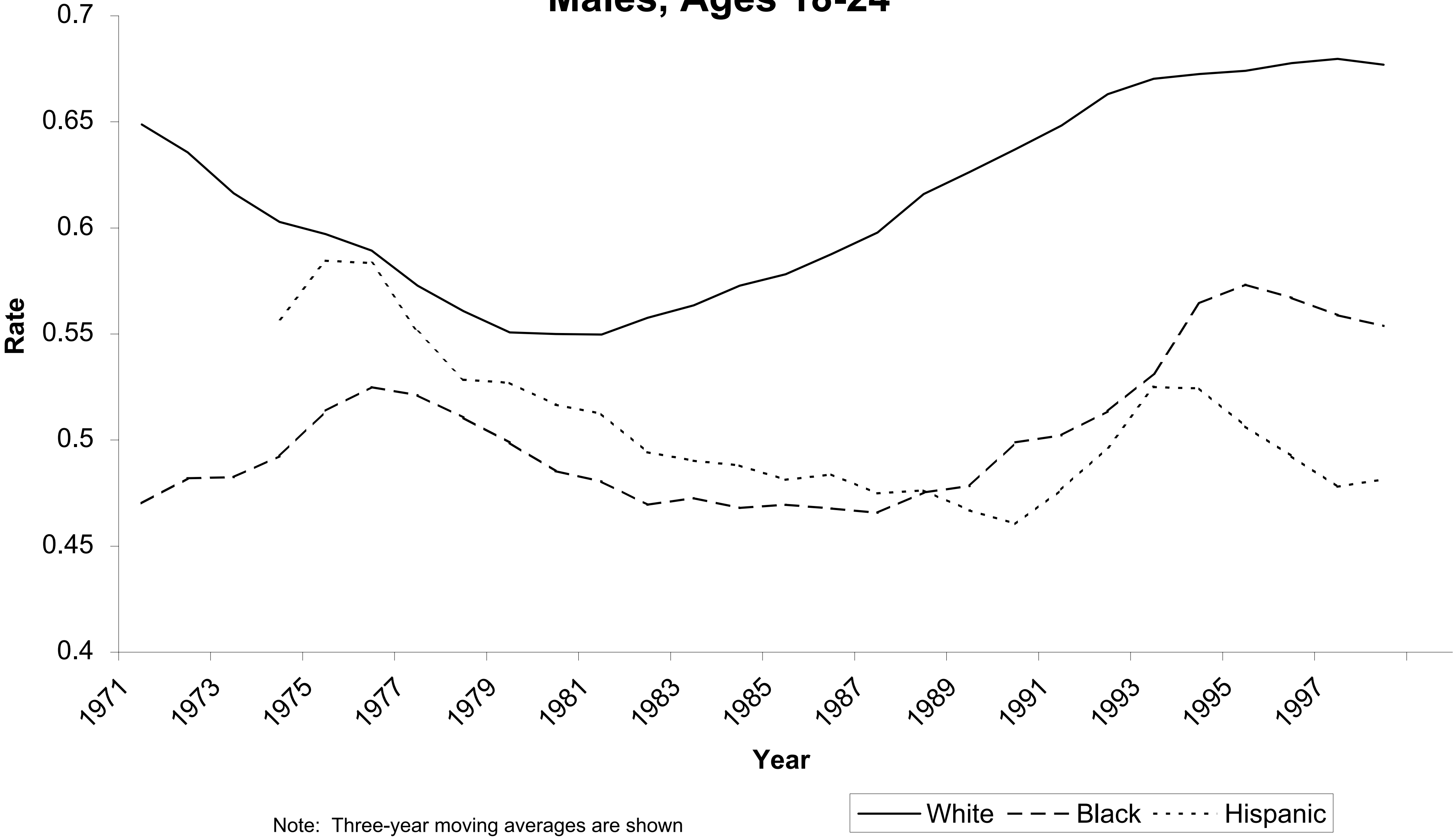
Dependent* White Males



Source: These numbers were computed from the CPS P-20 School Reports and the October CPS.

*Dependent is living at parental home or supported by parental family while at college.

Figure 7. College Participation by Race
Dependent High School Graduates and GED Holders
Males, Ages 18-24



Note: Three-year moving averages are shown

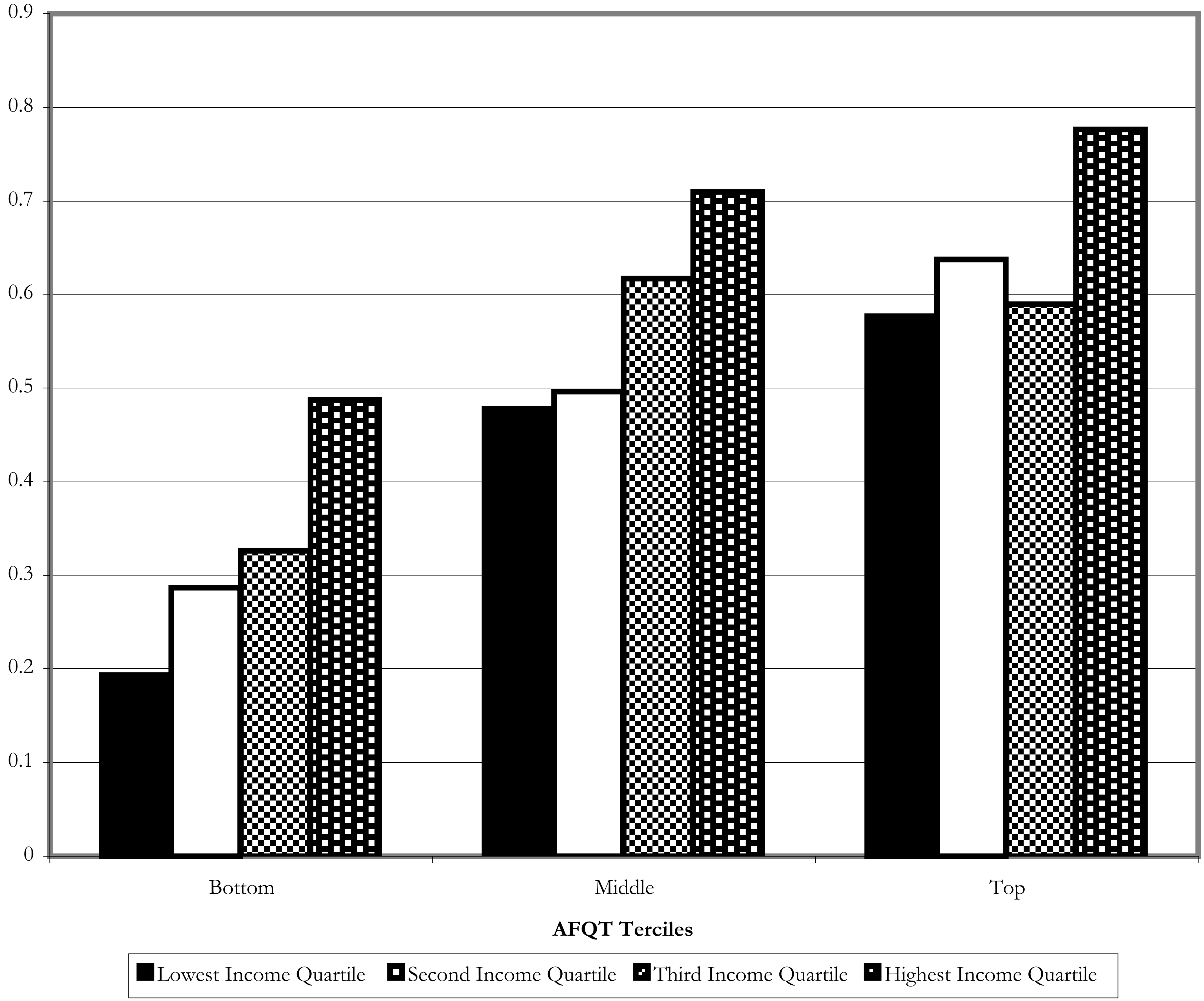
Source: These numbers were computed from the CPS P-20 School Reports and the October CPS.
*Dependent is living at parental home or supported by parental family while at college.

Figure 8

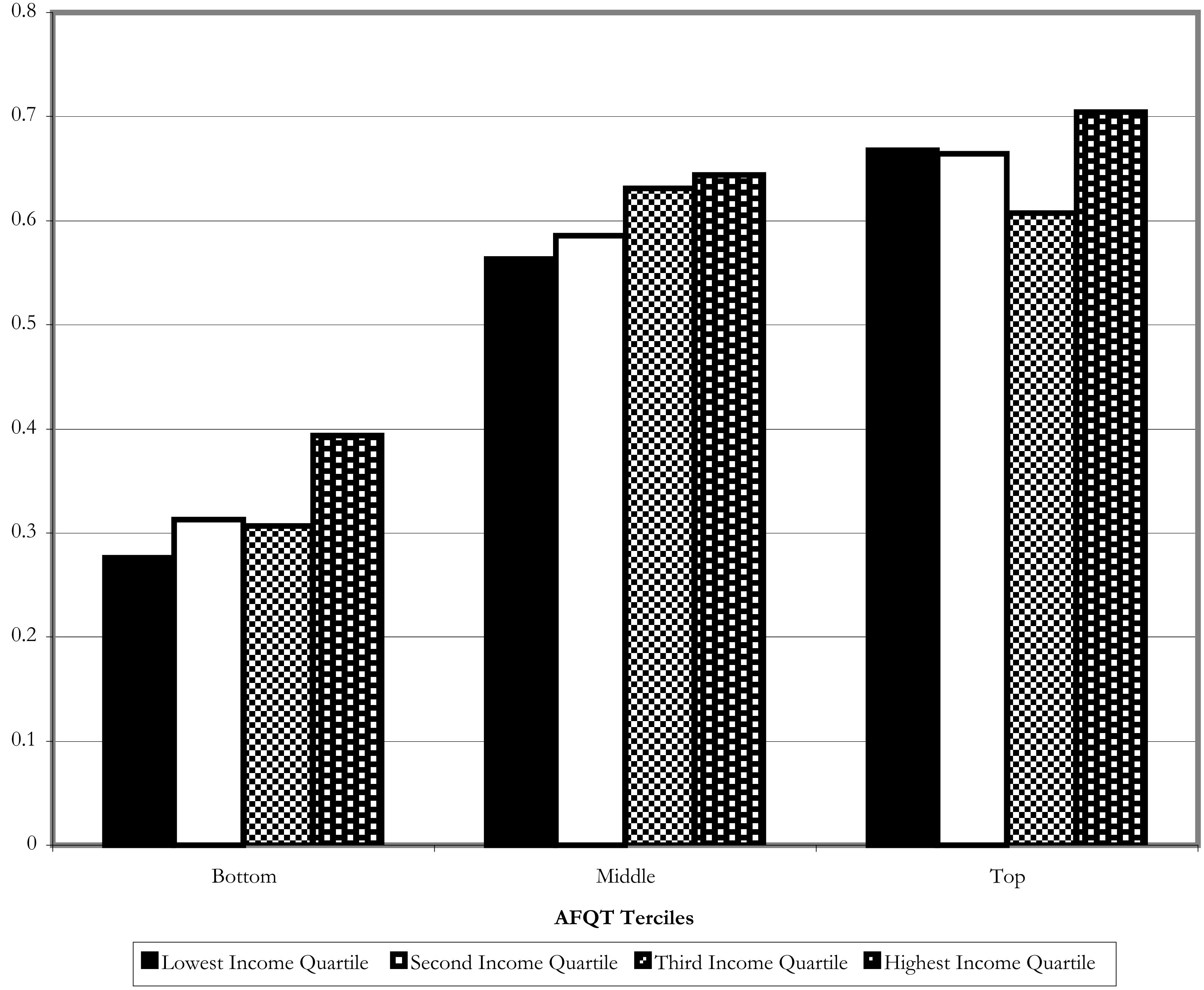
Enrollment, Completion and No Delay Rates by Family Income Quartiles and Age-Adjusted AFQT Terciles

White Males, NLSY79

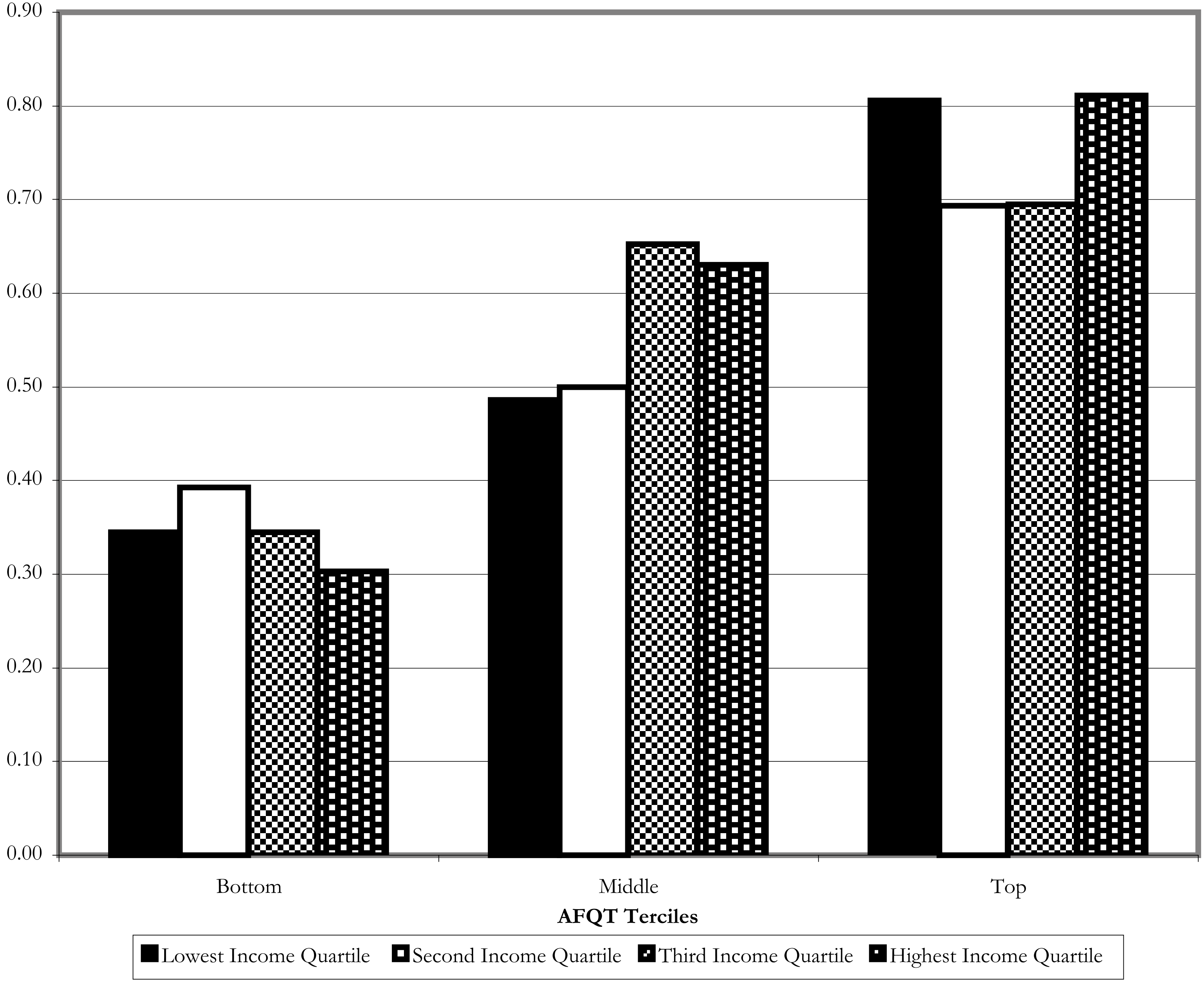
A. Percentage Enrolled in 2-Year and 4-Year Colleges

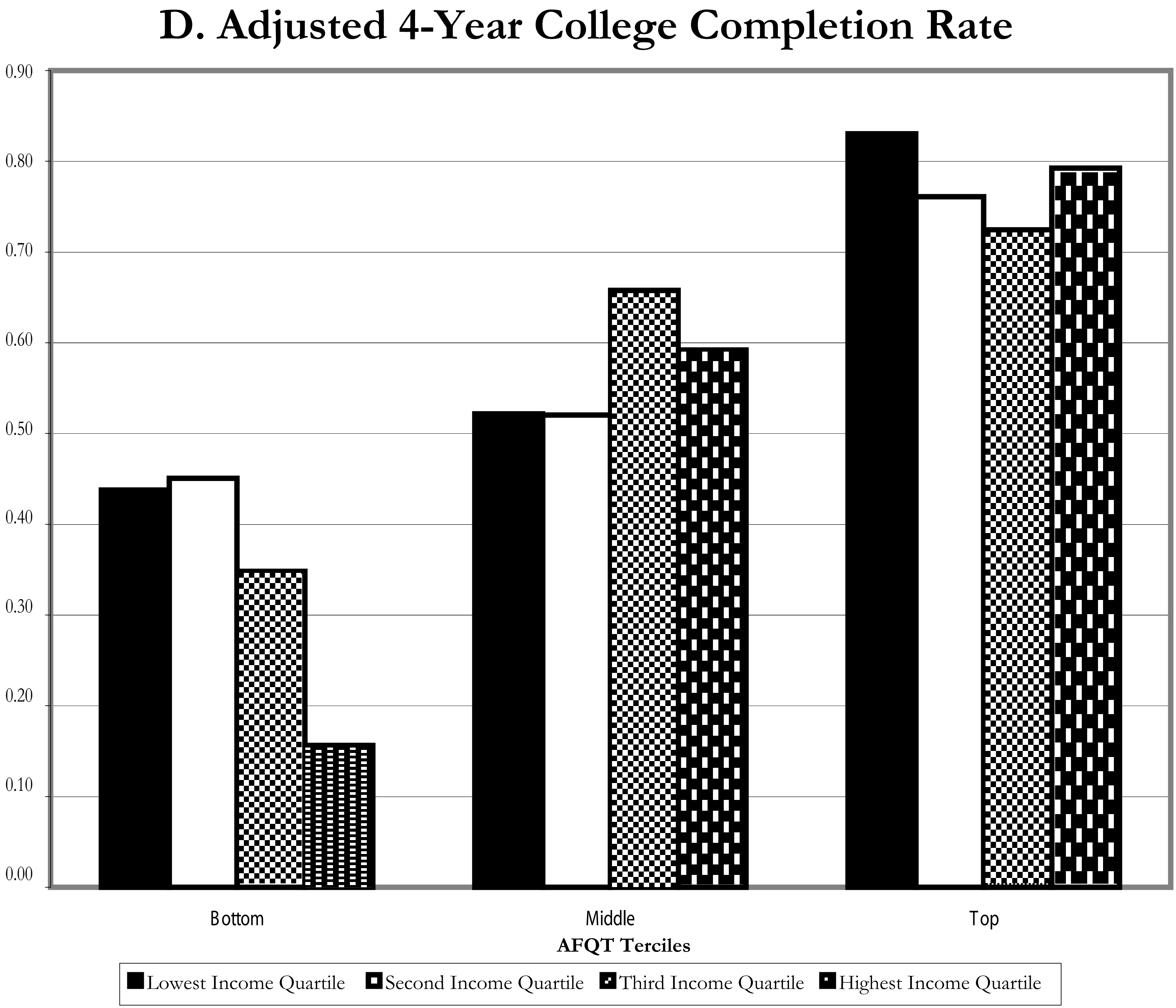


B. Adjusted Percentage Enrolled in 2-Year and 4-Year Colleges



C. 4-Year College Completion Rate




D. Adjusted 4-Year College Completion Rate
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Bottom
Middle
Top
AFQT Terciles
Lowest Income Quartile
Second Income Quartile
Third Income Quartile
Highest Income Quartile

- % credit constrained by family income at age 17 is at most 8% (Less for most groups).

- Controlling for ability, minorities are more likely to go to school and not drop out.

- Family income (permanent income) matters, but in the sense of providing lifetime constraints and resources.

- The real credit constraint is the inability of the child to buy a parent who will provide an enriched early environment.

Table 6a

Regression of College Enrollment on Various Measures of Family Income and PIAT Math at Age 12

	(1) College Enrollment	(2) College Enrollment	(3) College Enrollment	(4) College Enrollment
Permanent Family Income at Ages 0-18 (in 10K)	0.0839**	0.0747**	0.0902**	0.0779**
	(0.0121)	(0.0184)	(0.0185)	(0.0284)
PIAT Math at Age 12	0.0077**	0.0076**	0.0076**	0.0075**
	(0.0017)	(0.0018)	(0.0018)	(0.0018)
Permanent Family Income at Ages 0-5 (in 10K)	-	0.0158	-	0.0149
	-	(0.0238)	-	(0.0261)
Permanent Family Income at Ages 16-18 (in 10K)	-	-	-0.0069	-0.0023
	-	-	(0.0177)	(0.0194)
Constant	0.1447**	0.1404**	0.1410**	0.1380**
	(0.0264)	(0.0272)	(0.0268)	(0.0273)
Observations	863	863	861	861
R-squared	0.1	0.1	0.11	0.11

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Permanent family income is discounted to age 0 using a 5% rate.

Table 6b

Regression of College Enrollment
on Various Measures of Family Income

	(1) College Enrollment	(2) College Enrollment	(3) College Enrollment	(4) College Enrollment
Permanent Family Income at Ages 0-18 (in 10K)	0.0942**	0.0829**	0.1031**	0.0887**
	(0.0108)	(0.0170)	(0.0169)	(0.0270)
Permanent Family Income at Ages 0-5 (in 10K)	-	0.0259	-	0.0233
	-	(0.0220)	-	(0.0246)
Permanent Family Income at Ages 16-18 (in 10K)	-	-	-0.0108	-0.0048
	-	-	(0.0170)	(0.0188)
Constant	0.1367**	0.1179**	0.1329**	0.1158**
	(0.0243)	(0.0251)	(0.0246)	(0.0252)
Observations	1015	987	1013	985
R-squared	0.07	0.08	0.07	0.08

Standard errors in parentheses

* significant at 5%; ** significant at 1%

Permanent family income is discounted to age 0 using a 5% rate.

- Long Term Family Environments and Abilities are Major Predictors of Skill Attainment

- Family Environments are Deteriorating.

Trends in Home Environments

- Relatively more children are growing up in adverse environments, independent of how one measures adversity.
- Fewer children are living with two married parents.

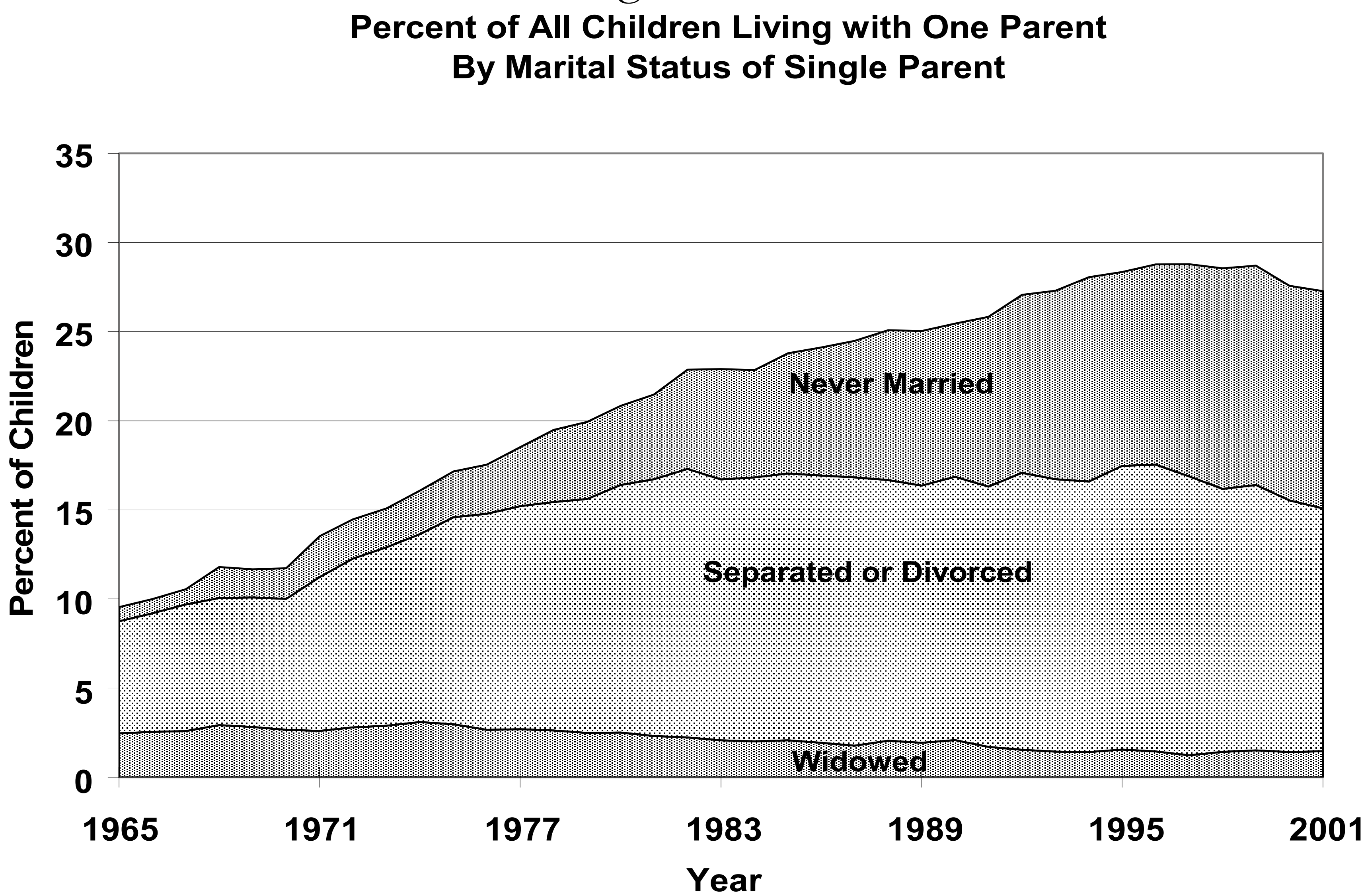
- Most of that increase has to do with non-marital childbearing rather than divorce.

- Single-parenthood and divorce are much more common for high school dropout mothers.

- Non-marital teen childbearing is relatively high.

- These family structures are associated with poor outcomes for kids.

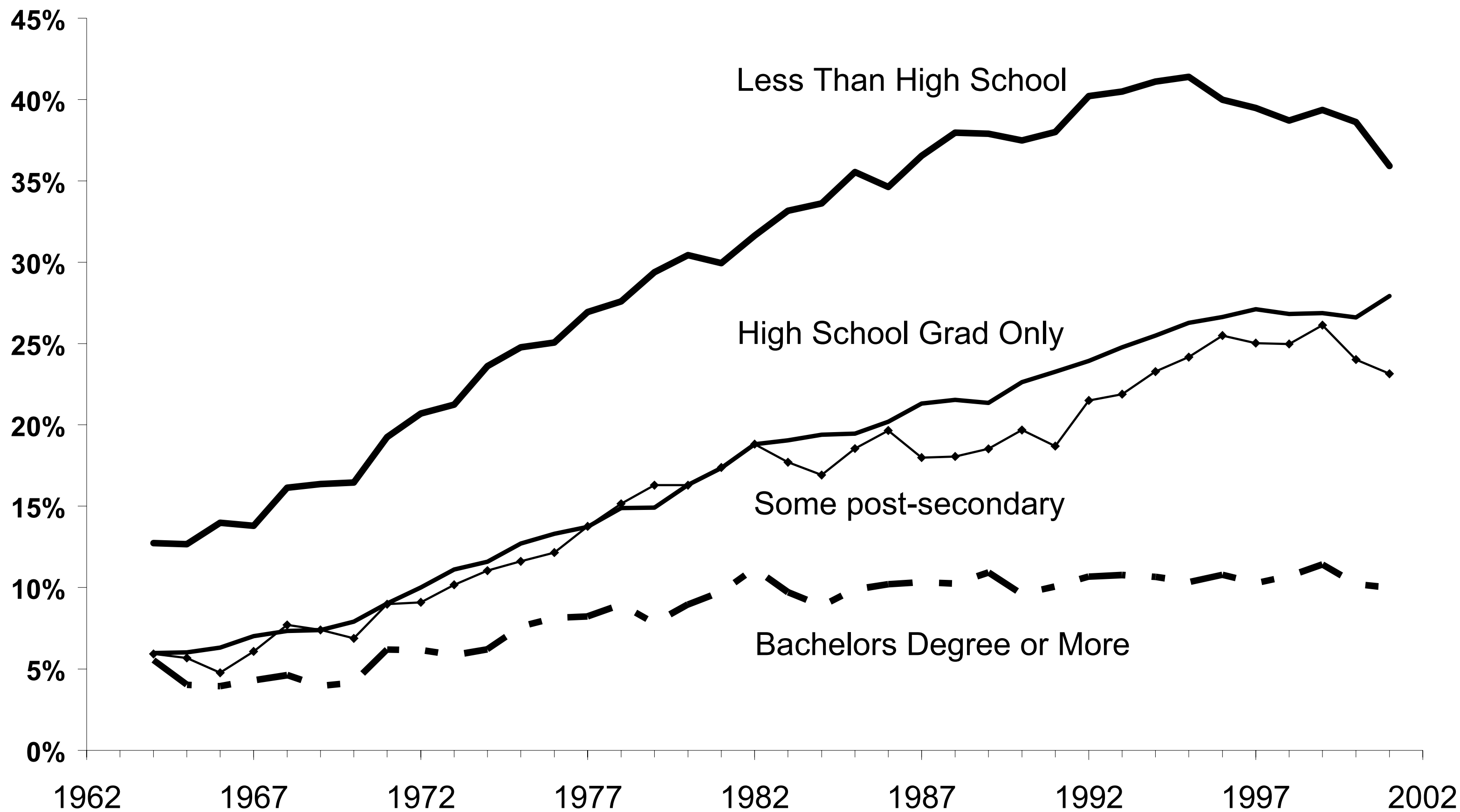
Figure 9a



Source: Jencks and Ellwood (2004), using March Current Population Survey.

Figure 9b

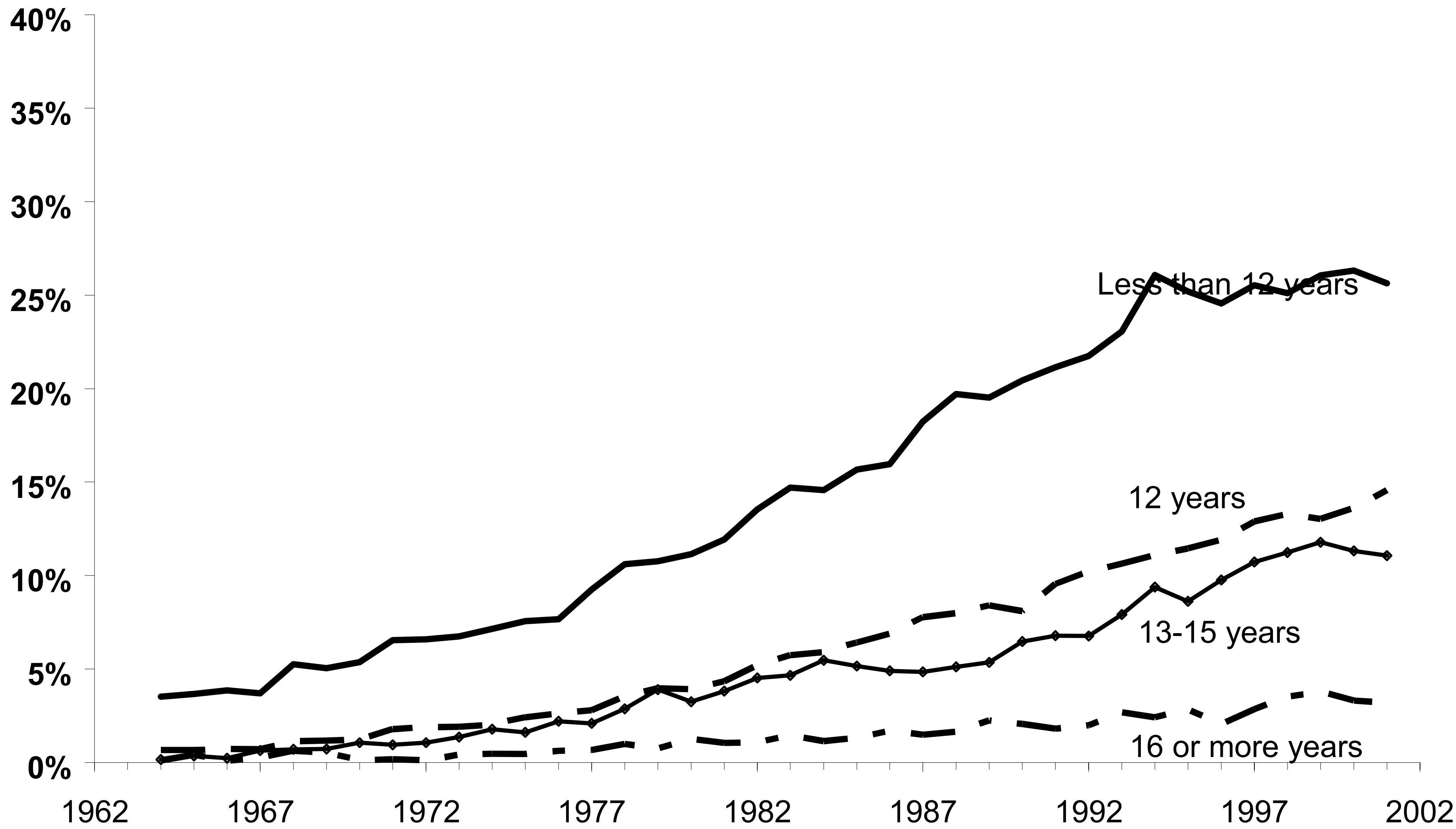
Percent of Children in Single Mother Homes By Education of the Mother



Source: Jencks and Ellwood (2004), using March Current Population Survey.

Figure 9c

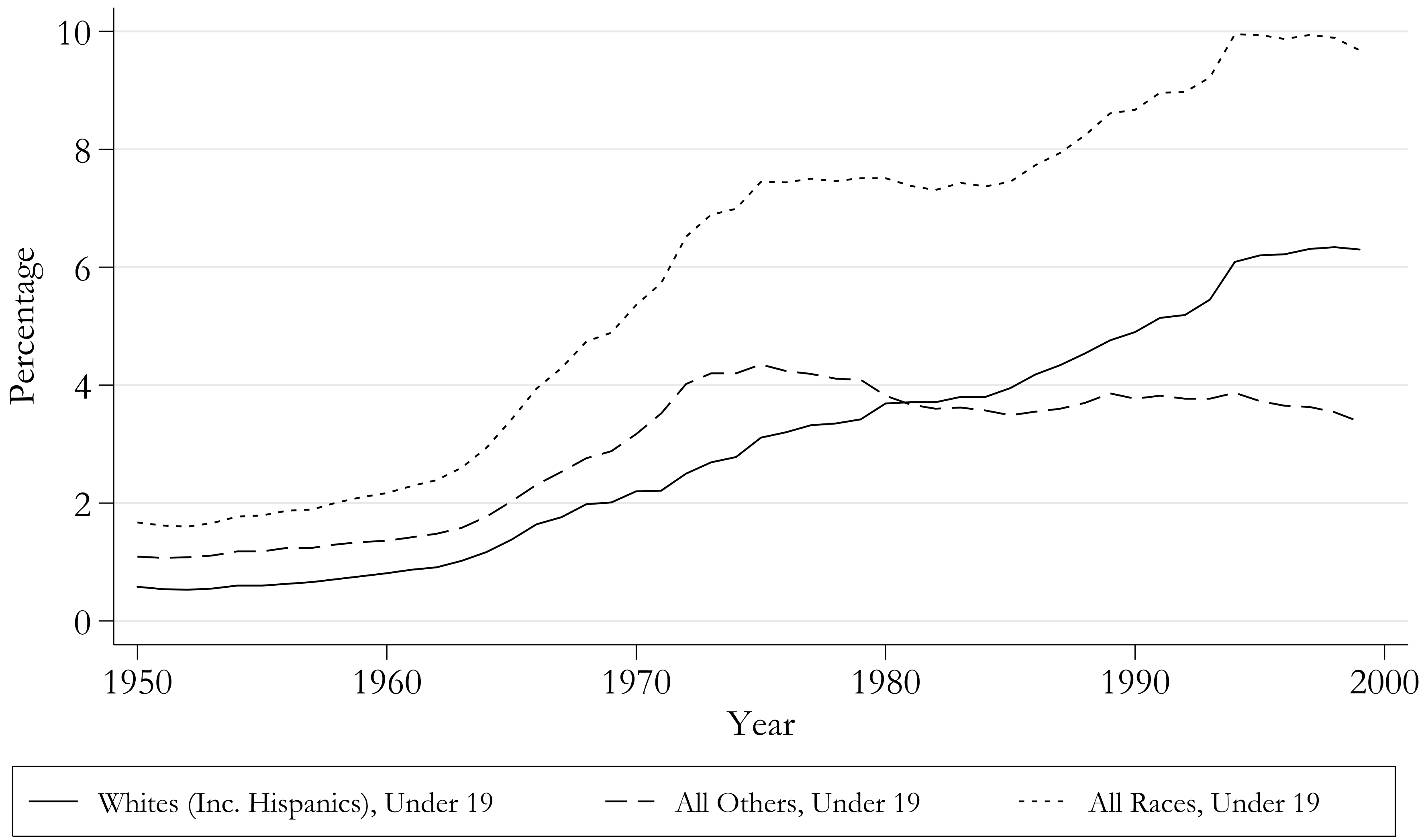
Percent of Women With Children Who Have Never Been Married
By Education of Mother



Source: Jencks and Ellwood (2004), using March Current Population Survey.

Figure 9d

Births to Unmarried Women Under Age 19 As a Percentage of Total Births in a Given Year By Race



Note: Data from Ventura and Bachrach (2000). Child's race is used to define race until 1980, and mother's race thereafter.

Cognitive and Emotional Stimulation

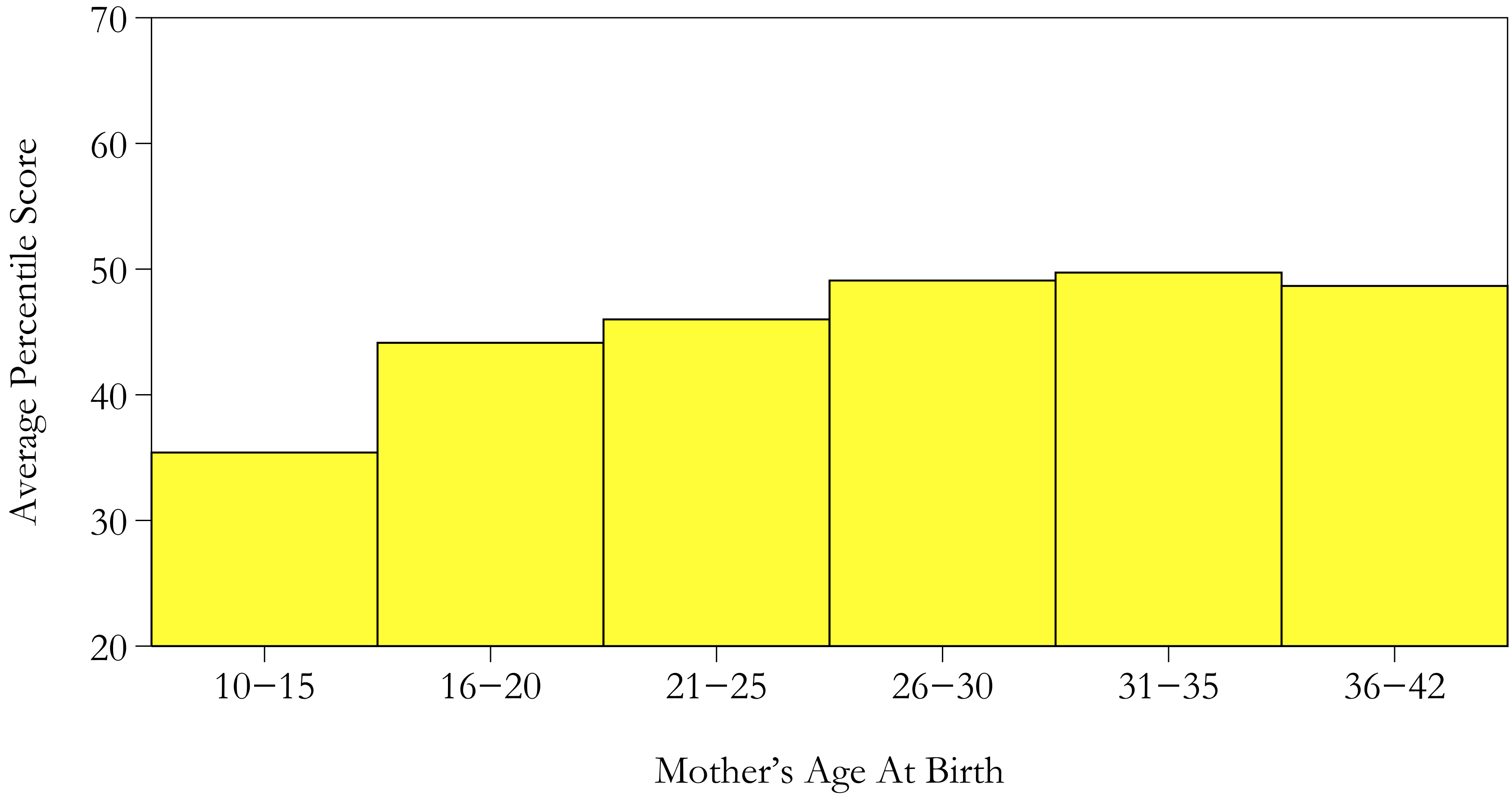
- Uneducated teenage mothers provide less cognitive and emotional stimulation than other mothers.

- Mothers with less schooling provide less cognitive and emotional stimulation.

- Mothers with less cognitive ability tend to have children earlier than other women.

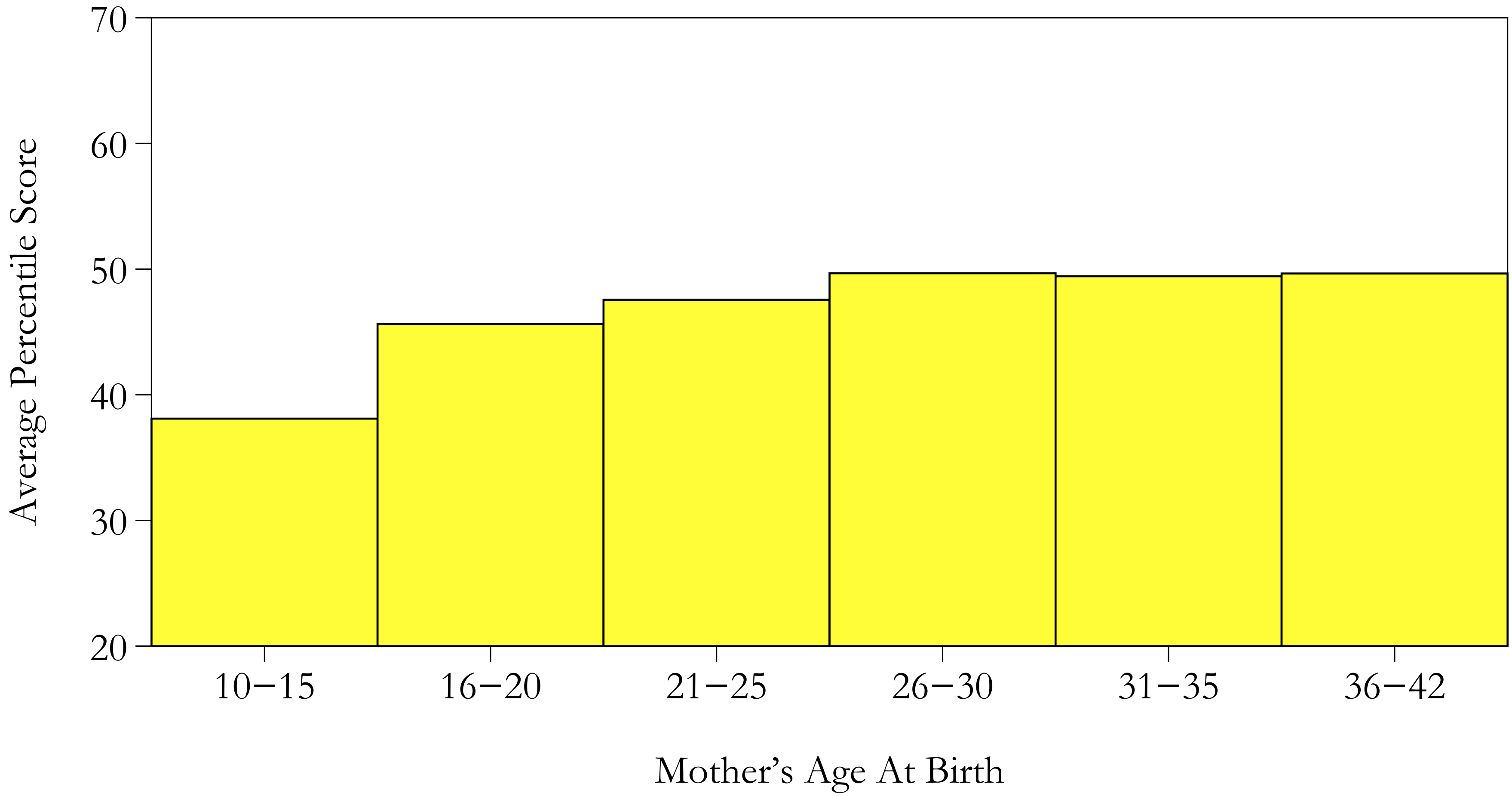
- Mothers with less cognitive ability provide less stimulation.

Figure 10a
Average Cognitive Stimulation Score By Mother's Age At Birth
Data From CNLSY79



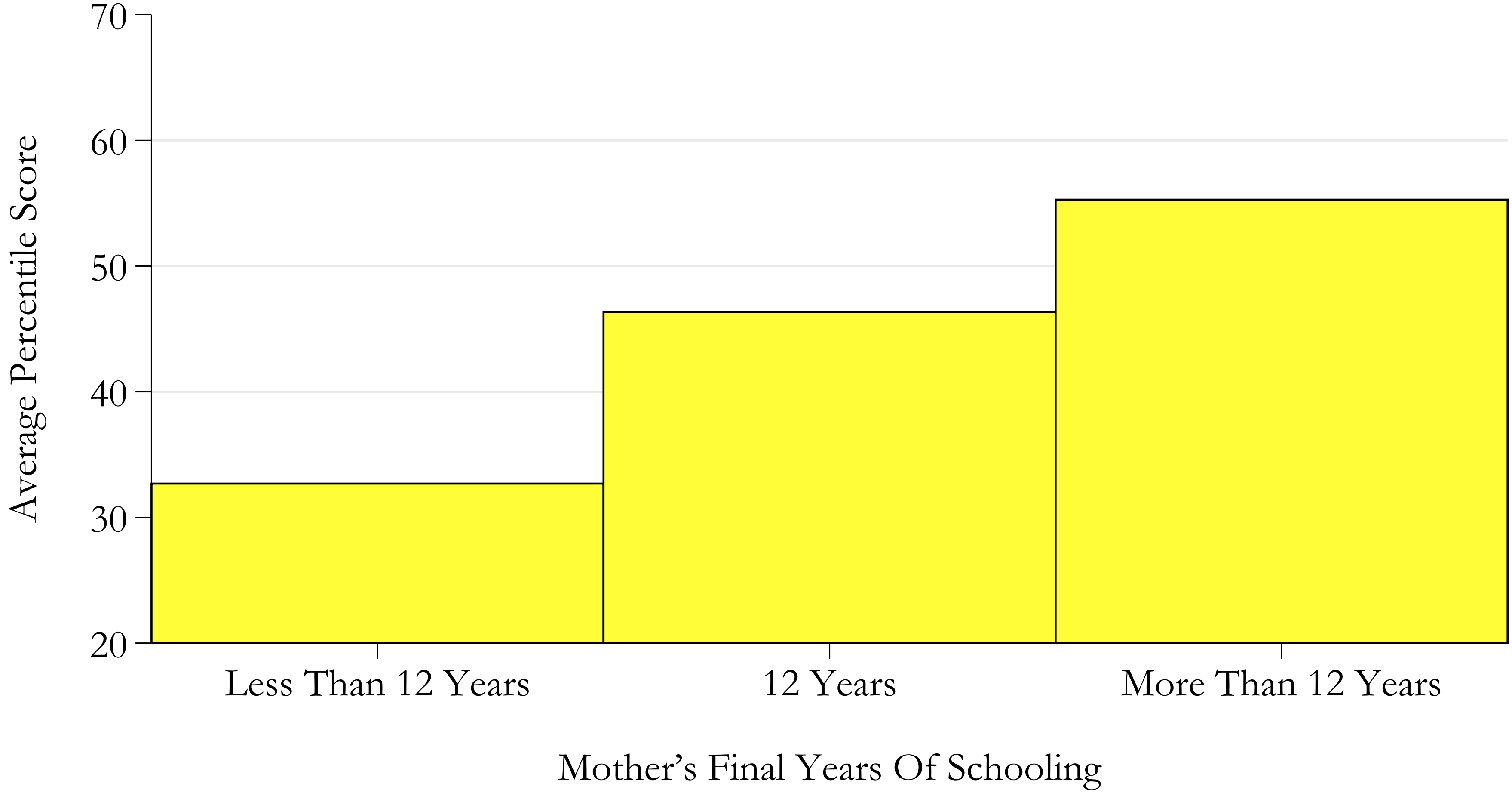
Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

Figure 10b
Average Emotional Stimulation Score By Mother's Age At Birth
Data From CNLSY79



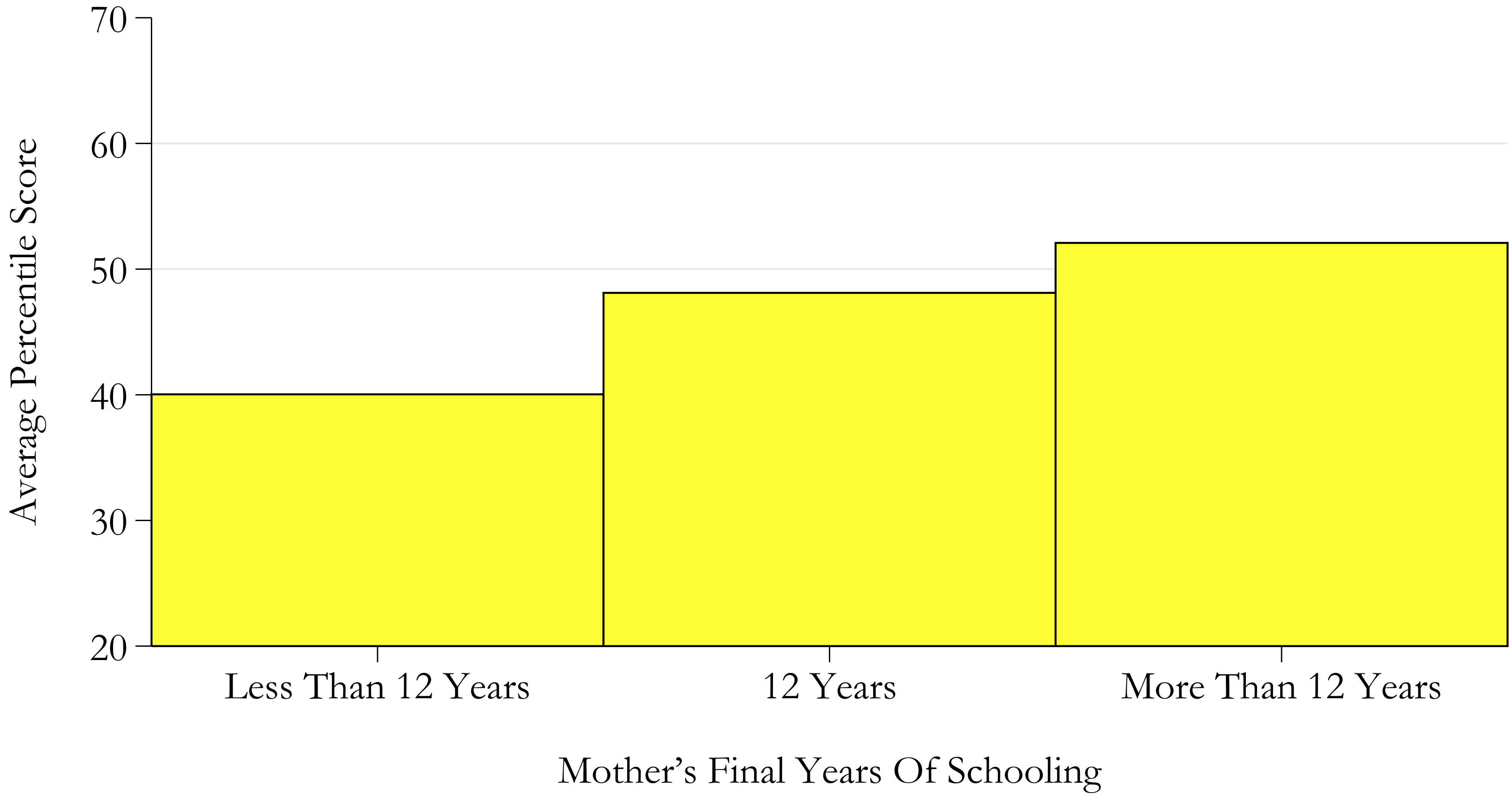
Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

Figure 10c
Average Cognitive Stimulation Score By Mother's Final Years Of Schooling
Data From CNLSY79

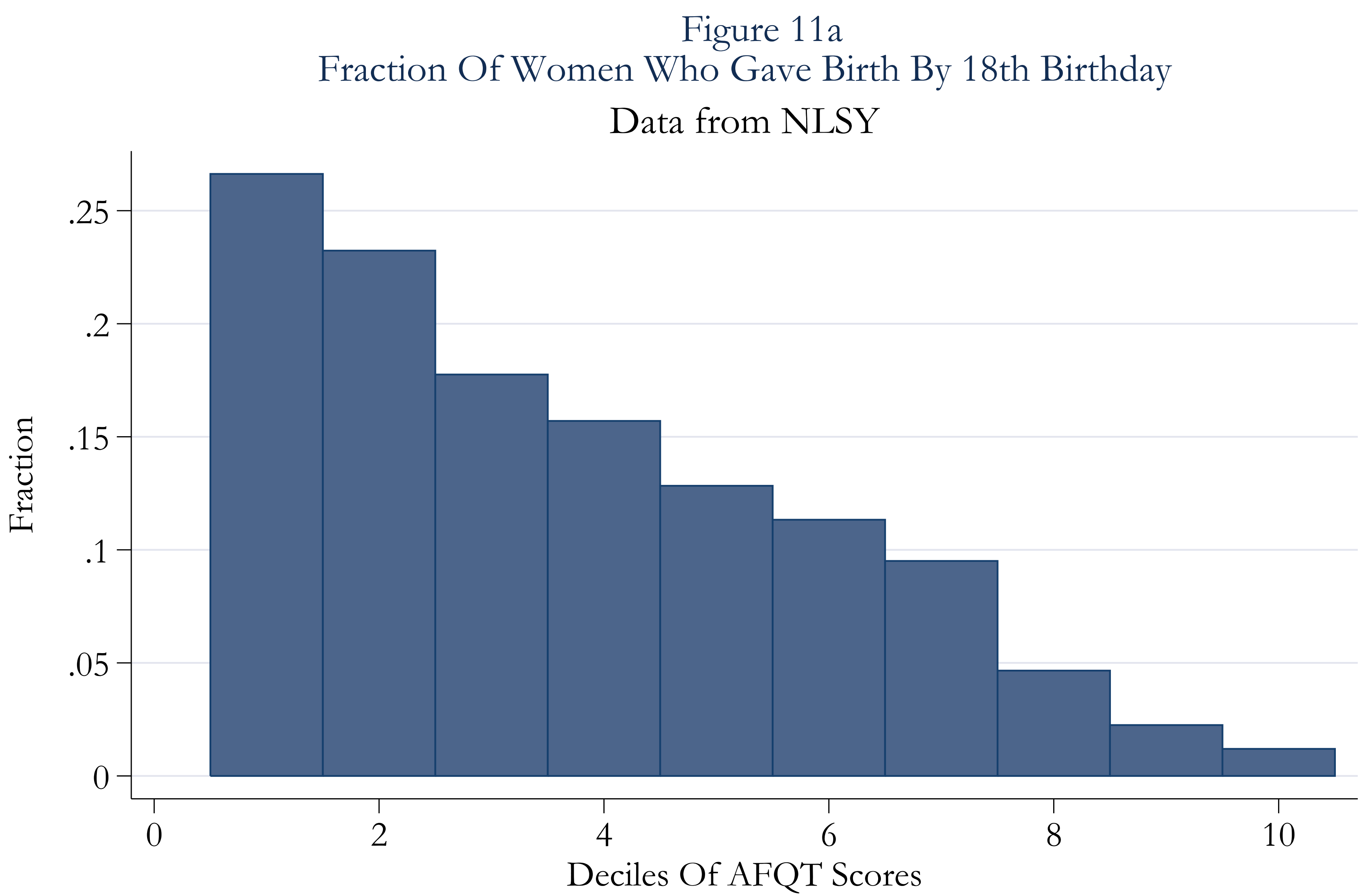


Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

Figure 10d
Average Emotional Stimulation Score By Mother's Final Years Of Schooling
Data From CNLSY79

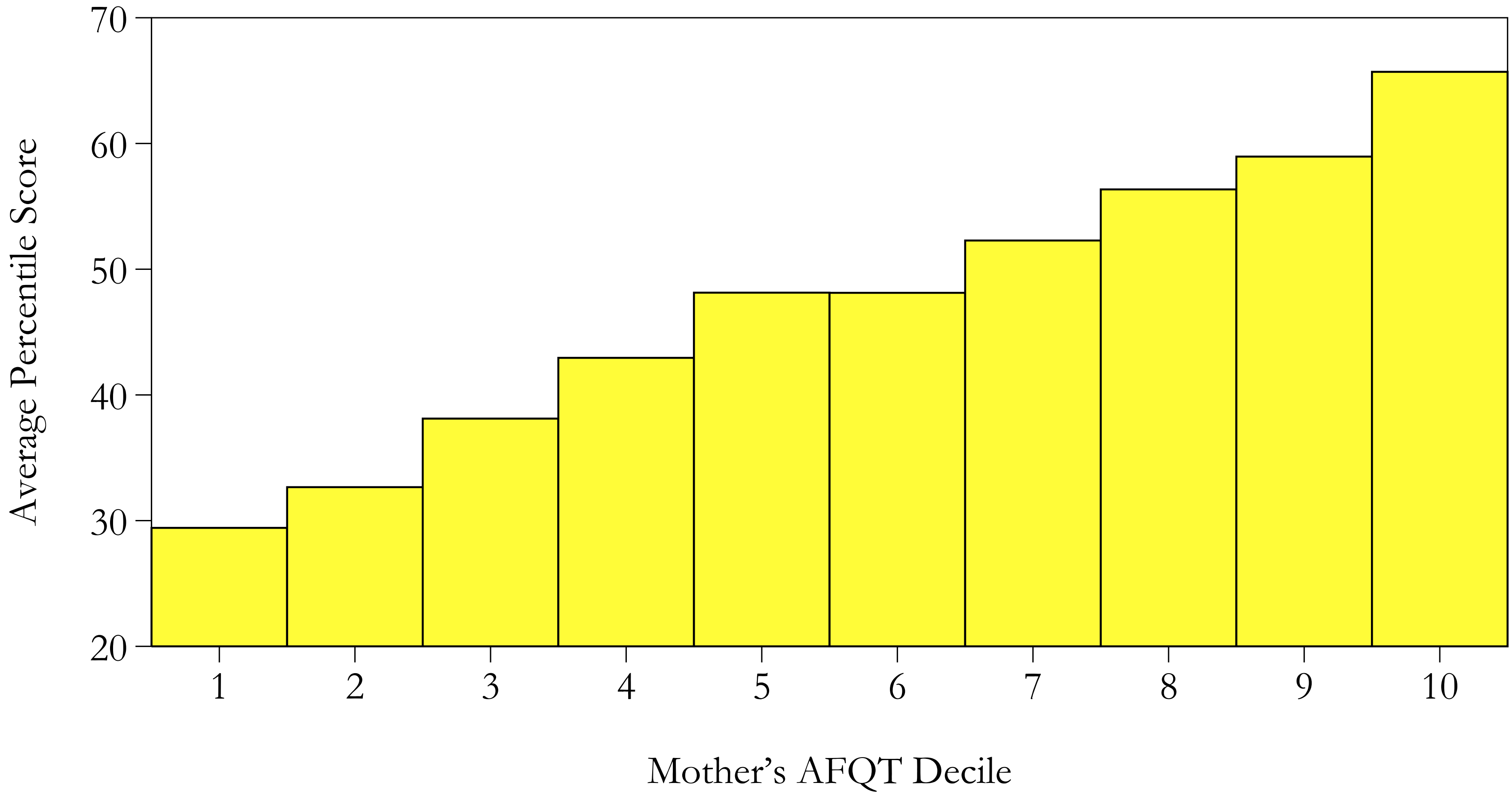


Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.



Note: Uses the AFQT calculation procedure as defined by the Department of Defense in 1989. Data used 1979Ĭ2000

Figure 11b
Average Cognitive Stimulation Score By Mother's AFQT Decile
Data From CNLSY79

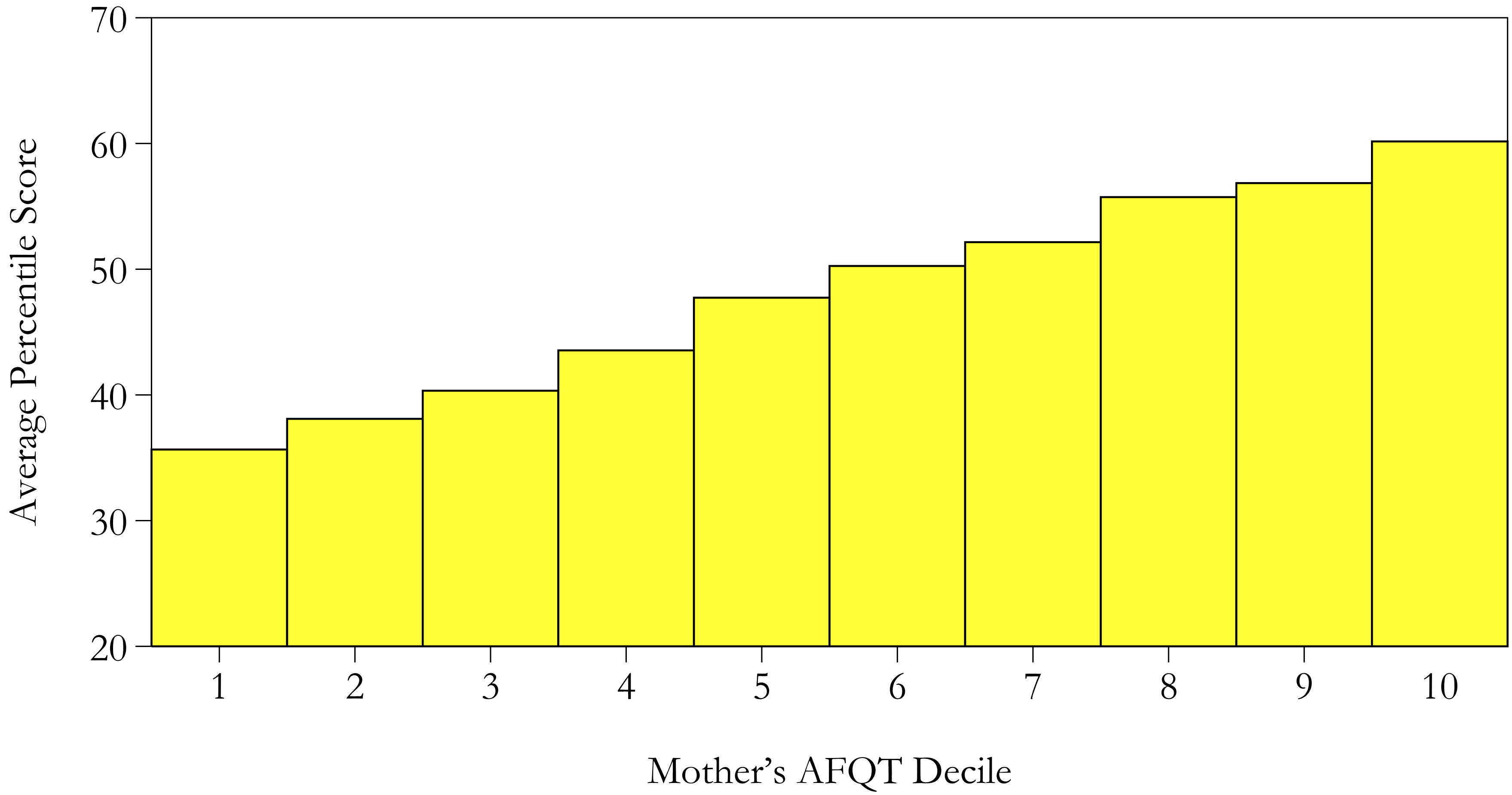


Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

Figure 11c

Average Emotional Stimulation Score By Mother's AFQT Decile

Data From CNLSY79



Note: Overall stimulation is a measure of the quality of the child's home environment. It comprises emotional and cognitive stimulation subscores. It is based on measures of resources, such as books, and on interactions with parents. The score is measured in percentiles.

Table 7a. College Enrollment and Completion By Type of Family

Survey	Outcome	Two-Parent Families	One-Parent Families
NLSY	Enrollment	59%	54%
	Completion	27%	20%
PSID	Enrollment	51%	48%
	Completion	21%	18%
HSB	Enrollment	57%	50%
	Completion	-	-
NSFH1	Enrollment	57%	48%
	Completion	23%	15%
NSFH2	Enrollment	61%	49%
	Completion	37%	17%

Note: Data from National Longitudinal Survey of Youth, Panel Study of Income Dynamics, High School and Beyond, National Survey of Families and Households (Cohorts 1-2). One parent families include step-families. All numbers are adjusted for race, sex, mother's education, father's education, number of siblings, and place of residence. The numbers represent the percentage of high school graduates who enrolled or completed college. All differences by family type are significant except for PSID.
Source: McLanahan and Sandefur (1994).

Table 7b. Percentage of Youths Who Are Not In School and Not Working By Type of Family and Sex

Sample	Survey	Two-Parent Families	One-Parent Families
Young Men	NLSY	12%	17%
	PSID	19%	29%
	HSB	9%	12%
Young Women	NLSY	16%	28%
	PSID	26%	41%
	HSB	18%	24%

Note: Data from National Longitudinal Survey of Youth, Panel Study of Income Dynamics, High School and Beyond, National Survey of Families and Households (Cohorts 1-2). One parent families include step-families. All numbers are adjusted for race, sex, mother's education, father's education, number of siblings, and place of residence. All differences by family type are significant.

Source: McLanahan and Sandefur (1994).

Table 7c . Teen Childbearing By Type of Family

Survey	Type of Birth	Two-Parent Families	One-Parent Families
NLSY	Marital	5%	14%
	Non-Marital	6%	13%
PSID	Marital	9%	18%
	Non-Marital	5%	13%
HSB	Marital	7%	9%
	Non-Marital	7%	10%
NSFH1	Marital	11%	15%
	Non-Marital	9%	15%
NSFH2	Marital	16%	26%
	Non-Marital	6%	8%

Note: Data from National Longitudinal Survey of Youth, Panel Study of Income Dynamics, High School and Beyond, National Survey of Families and Households (Cohorts 1-2). One parent families include step-families. All numbers are adjusted for race, sex, mother's education, father's education, number of siblings, and place of residence. The numbers represent the percentage of women who has a teen birth. All differences by family type are significant except for teen nonmarital births in NSFH2.

Source: McLanahan and Sandefur (1994).

Abilities and Outcomes

- Cognitive and noncognitive ability are important determinants of schooling and socioeconomic success.

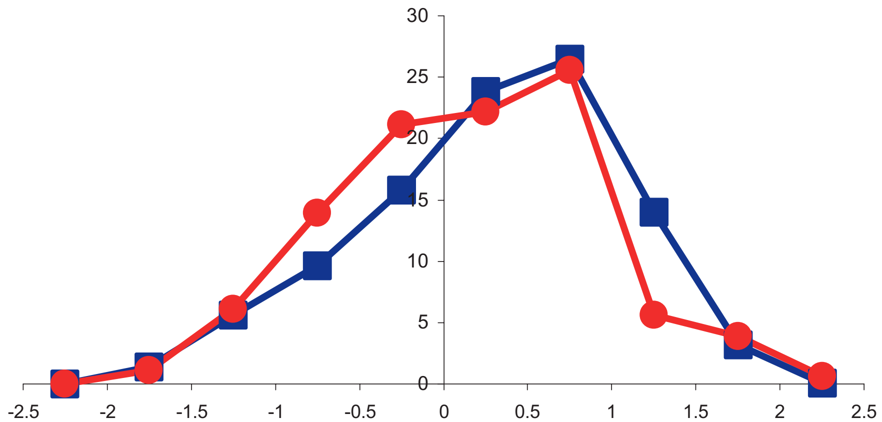
- Schooling gaps have more to do with ability deficits than family finances in the school-going years.

- Noncognitive abilities matter greatly.
- Their importance tends to be underrated in current policy discussions because they are not easily measured.

Figure 12

Density of age adjusted AFQT scores,
GED recipients and high school graduates with twelve years of schooling

(a) White males



(b) White females

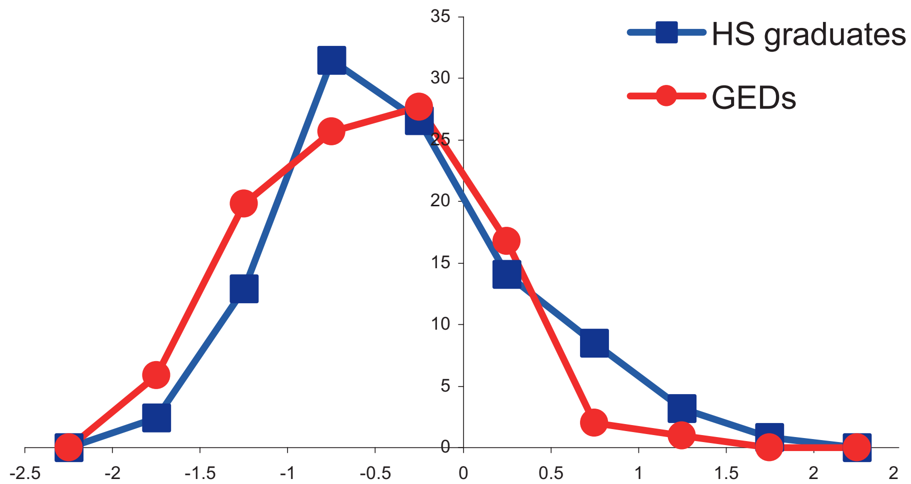
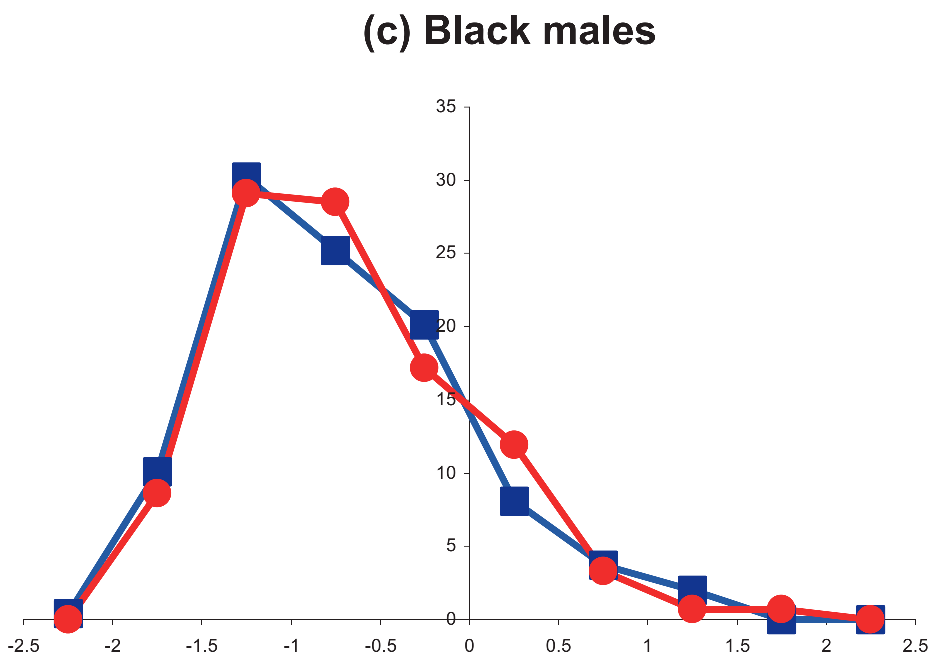
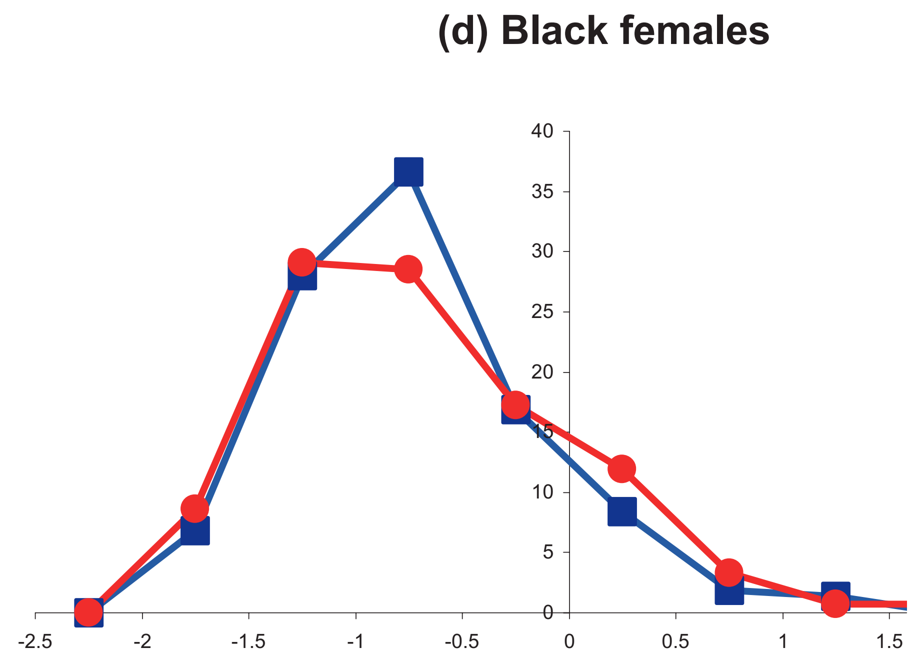


Figure 12b

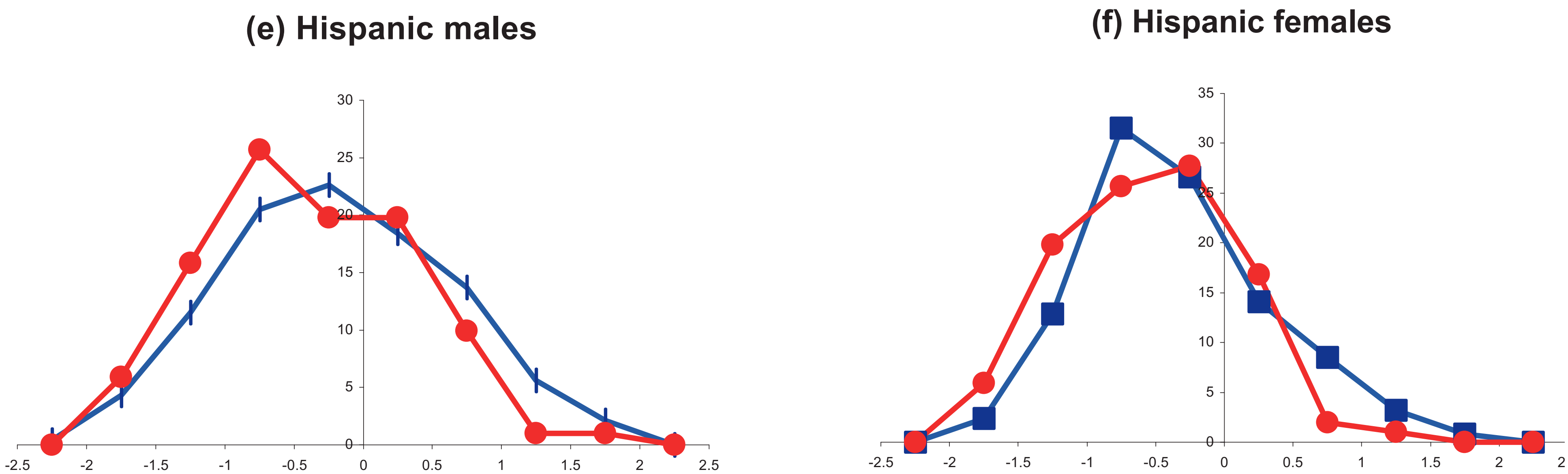


(c) Black males
35
30
25
20
15
10
5
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5



(d) Black females
40
35
30
25
20
15
10
5
0
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5

Figure 12c



Source: Heckman, Hsee and Rubinstein (2001).

Table 8

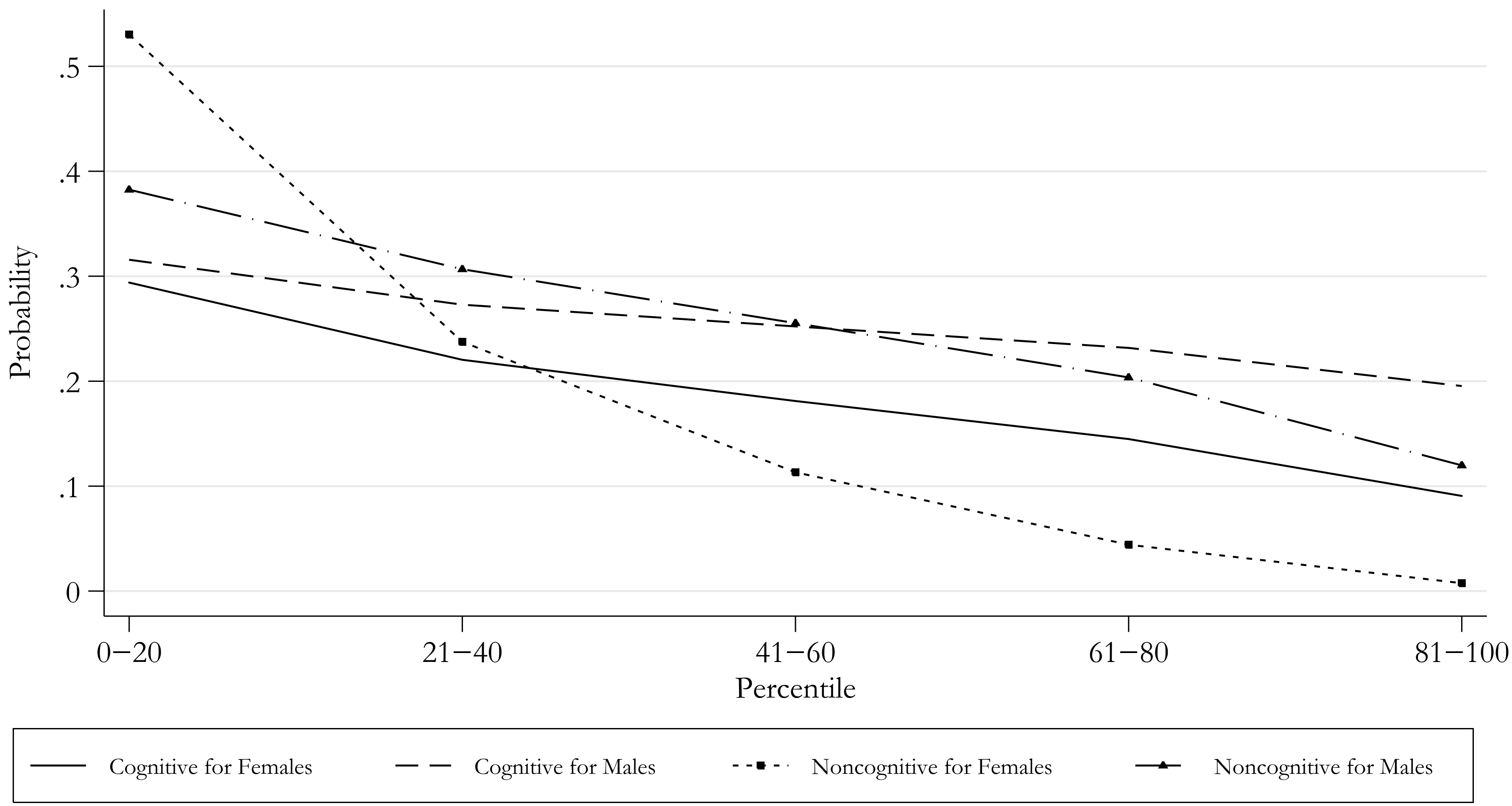
How Does the Labor Market Treat GED Recipients?

A First Glance at the Data
High School Dropouts, GED Recipients and High School Graduates

	OLS		
Variable	**(i)**	**(ii)**	**(iii)**
High school dropout	**-0.273**	**-0.193**	**-0.022**
	(0.024)	(0.026)	(0.033)
GED degree	**-0.181**	**-0.187**	**-0.107**
	(0.039)	(0.038)	(0.038)
Armed Forces Qualifying Test*		0.106	0.074
		(0.013)	(0.014)
Years of schooling			0.070
			(0.011)
Training			0.029
			(0.005)

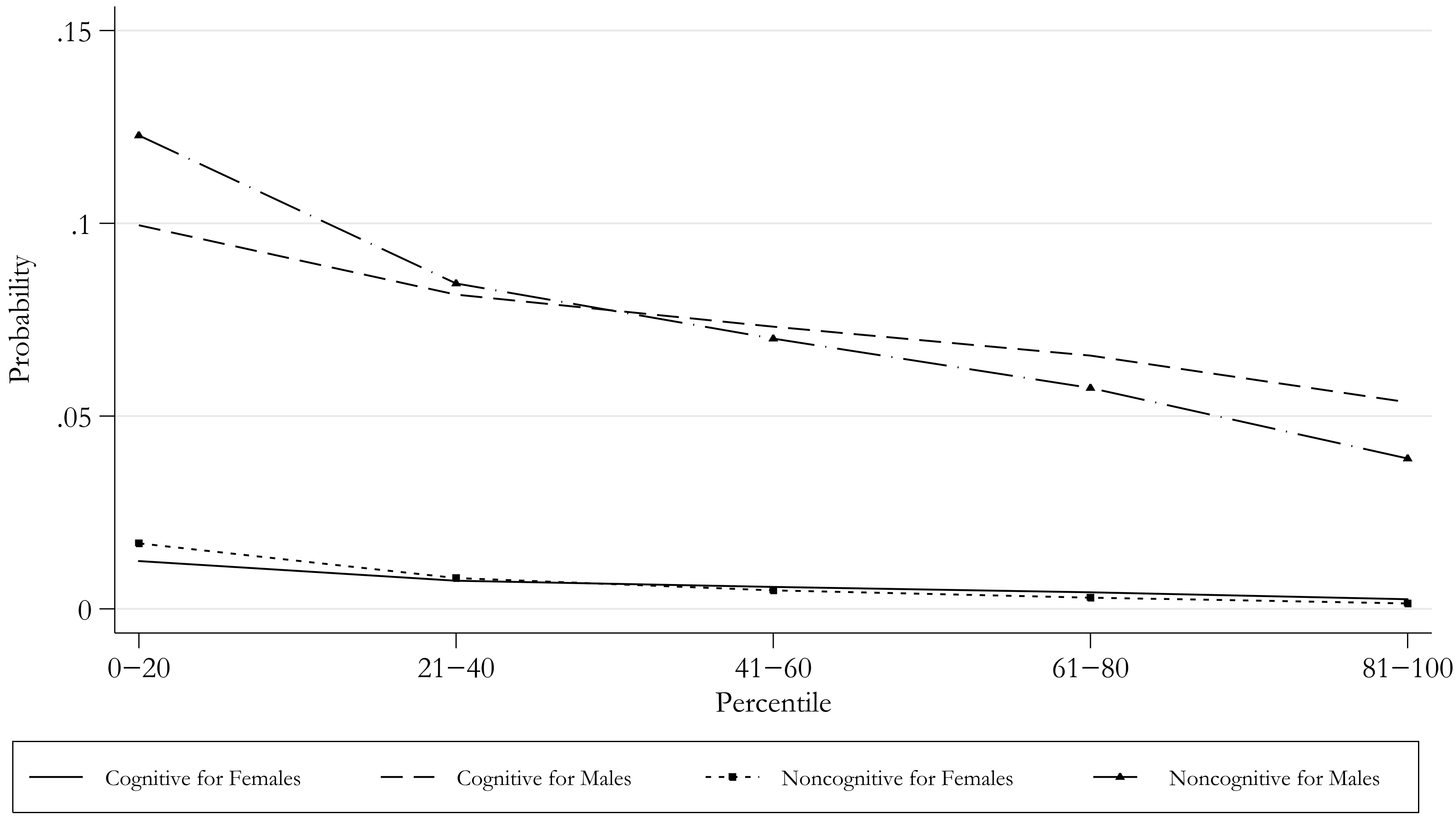
- Evidence that Both Cognitive and Noncognitive Skills are Important:

Figure 13a
Probability Of Being a High School Dropout And Increased Ability



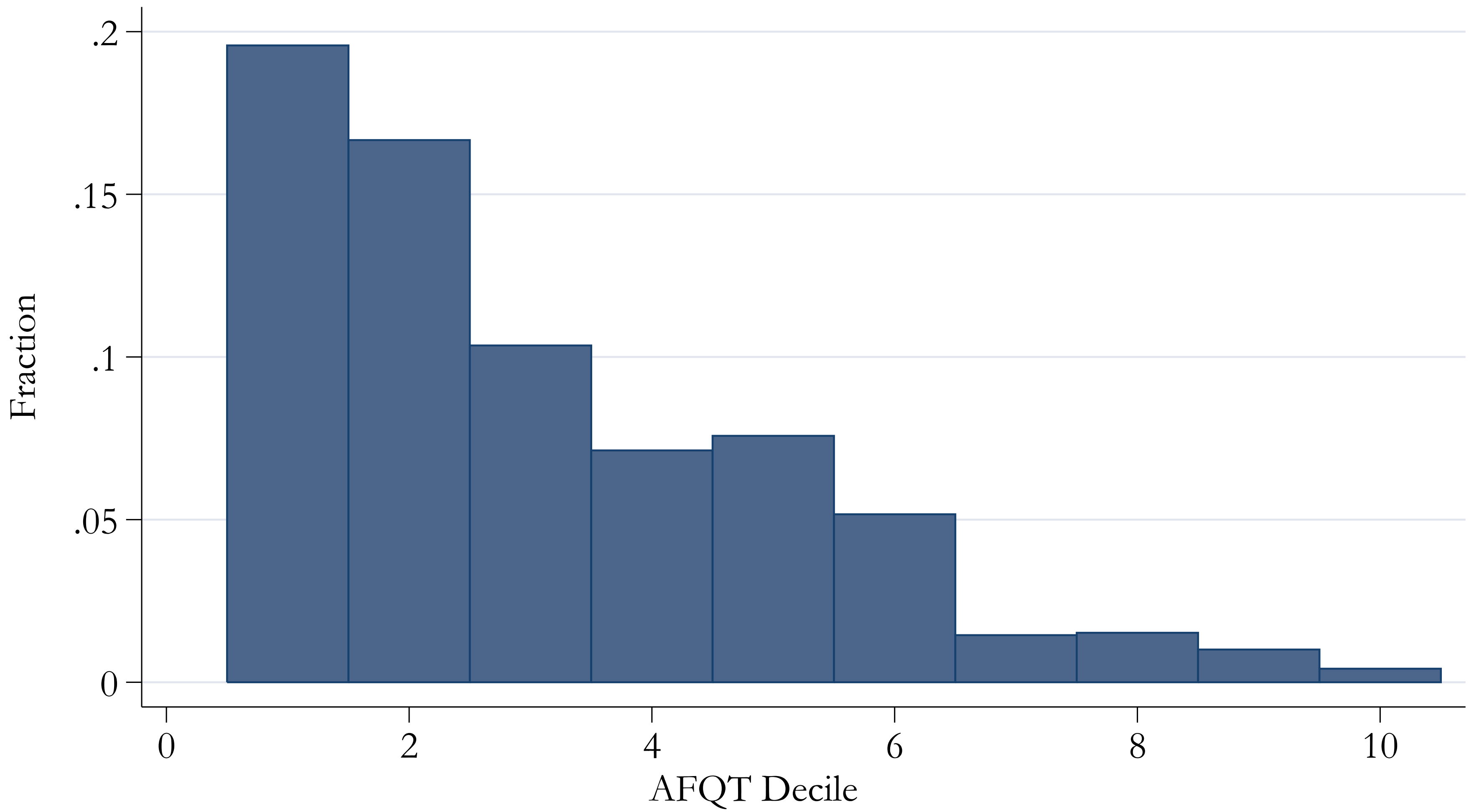
Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone with mean ability in the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability for someone with average cognitive ability. Source: Heckman, Stixrud, and Urzua (2004).

Figure 13b
Probability Of Spending Time In Jail By Age 30 And Increased Ability



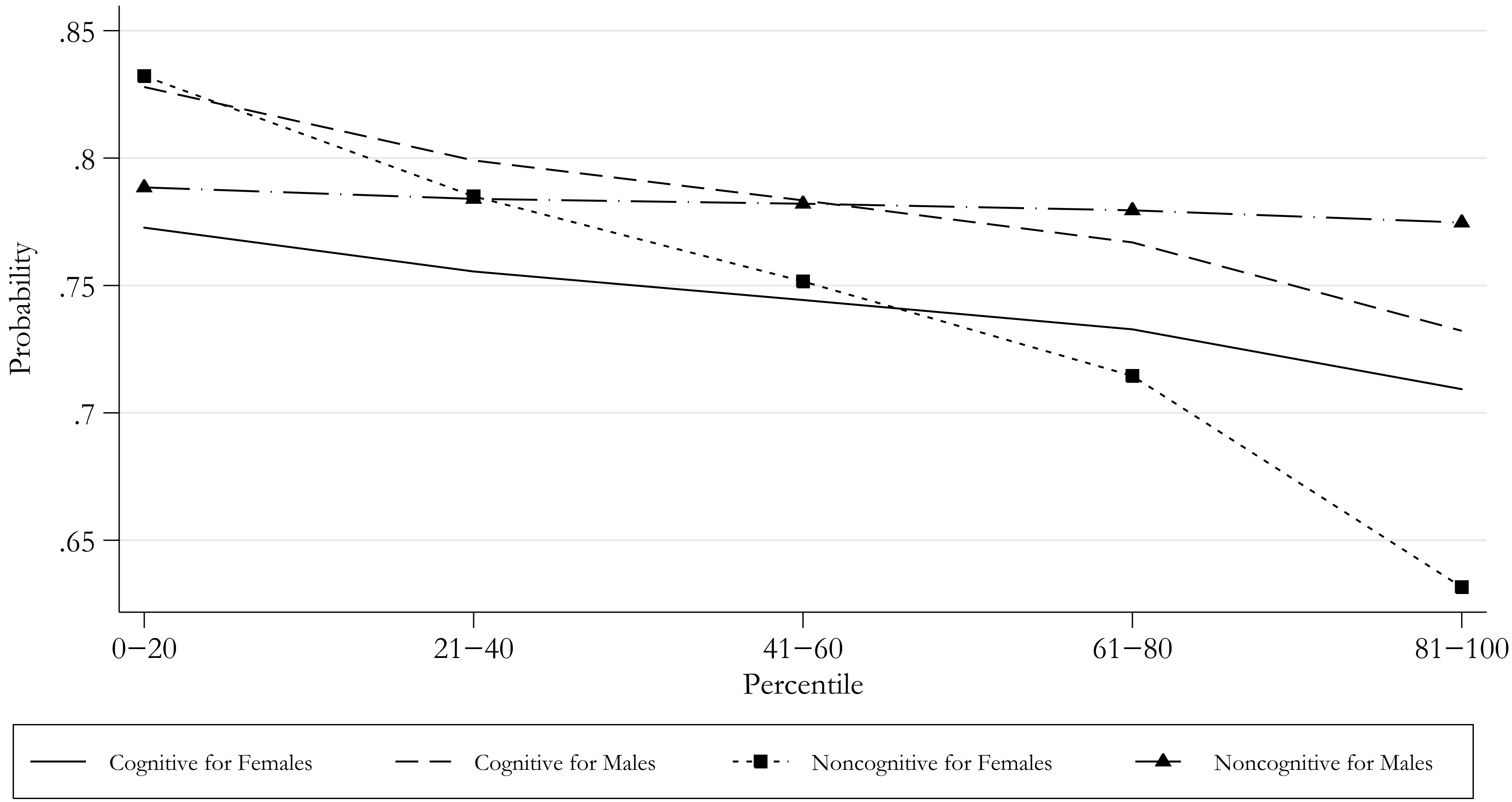
Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone with mean ability in the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability for someone with average cognitive ability. Source: Heckman, Stixrud, and Urzua (2004).

Figure13c
Fraction Of Male Respondents In Jail At Age 30 Or Below
Data from NLSY



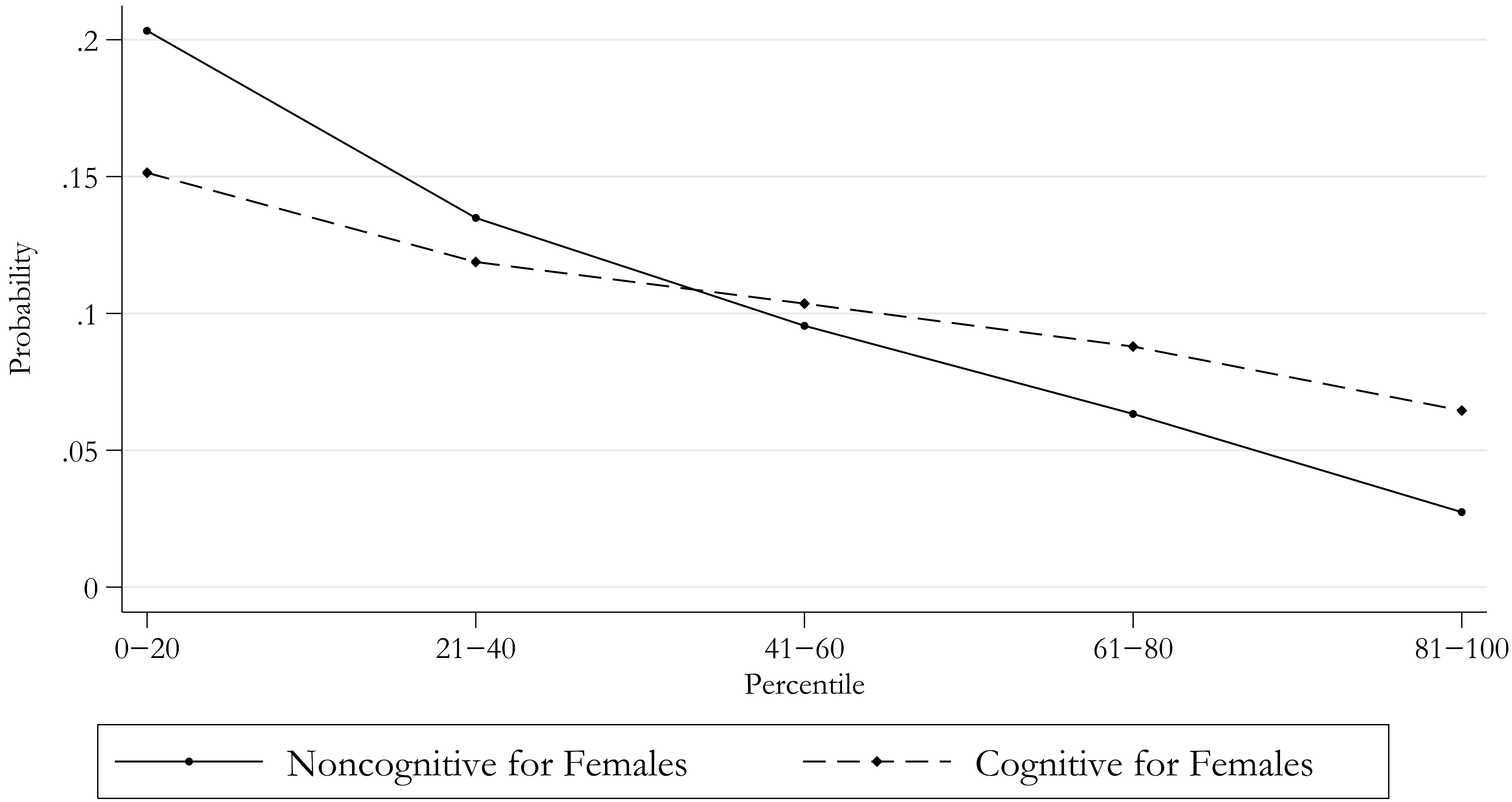
Note: Uses the AFQT calculation procedure as defined by the Department of Defense in 1989. Data used 1979Ĭ2000

Figure 13d
Probability Of Trying Smoking By Age 18 And Increased Ability



Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone with mean ability in the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability for someone with average cognitive ability. Source: Heckman, Stixrud, and Urzua (2004).

Figure 13e
Probability Of Being Single With Child And Increased Ability



Note: This figure plots the probability of a given behavior associated with moving up in one ability distribution for someone with mean ability in the other distribution. For example, the lines with markers show the effect of increasing noncognitive ability for someone with average cognitive ability. Source: Heckman, Stixrud, and Urzua (2004).

- Abilities affect returns to schooling.

Table 9

Return to one year of college for individuals
at different percentiles of the math test score distribution
White males from High School and Beyond

	5%	25%	50%	75%	95%
Average return in the population	0.1121	0.1374	0.1606	0.1831	0.2101
	(0.0400)	(0.0328)	(0.0357)	(0.0458)	(0.0622)
Return for those who attend college	0.1640	0.1893	0.2125	0.2350	0.2621
	(0.0503)	(0.0582)	(0.0676)	(0.0801)	(0.0962)
Return for those who do not attend college	0.0702	0.0954	0.1187	0.1411	0.1682
	(0.0536)	(0.0385)	(0.0298)	(0.0305)	(0.0425)
Return for those at the margin	0.1203	0.1456	0.1689	0.1913	0.2184
	(0.0364)	(0.0300)	(0.0345)	(0.0453)	(0.0631)

- Those with higher abilities are more likely to take post-school company job training.

Table 10

Average Marginal Effect on Participation in Company Training

Variables	Average Marginal Effect					
	White Males		Black Males		Hispanic Males	
	(1)	(2)	(1)	(2)	(1)	(2)
Age-Adjusted AFQT	0.0149		0.0182		0.0066	
	(0.0024)		(0.0033)		(0.0037)	
Family Income in 1979 (in $10,000)	-0.0021	-0.0005	-0.0047	-0.0019	0.0011	0.0015
	(0.0012)	(0.0011)	(.0024)	(0.0023)	(0.0024)	(0.0023)
Grade Completed	0.0382		0.0060		0.0036	
	(0.001)		(0.0014)		(0.0014)	
Father's Education	-0.0014	0.0007	0.0003	0.0010	0.0002	0.0008
	(0.0006)	(0.0005)	(0.0008)	(0 0008)	(0.0007)	(0.0007)

Notes: The panel data set was constructed using NLSY79 data from 1979-1994. Data on training in 1987 is combined with 1988 in the original dataset.

Company training consists of formal training run by employers and military training excluding basic training. Standard errors are reported in parentheses.

Specification (1) includes a constant, age, father's education, mother's education, number of siblings, southern residence at age 14 dummy, urban residence at age 14 dummy, and year dummies.

Specification (2) drops age-adjusted AFQT and grade completed. Average marginal effect is estimated using average derivatives from a probit regression.

Table 10 (continued)

Average Marginal Effect on Participation in Company Training

Variables	Average Marginal Effect					
	White Females		Black Females		Hispanic Females	
	(1)	(2)	(1)	(2)	(1)	(2)
Age-Adjusted AFQT	0.0076		0.0169		0.0159	
	(0.0025)		(0.0038)		(0.0045)	
Family Income in 1979 (in $10,000)	-0.0007	0.0001	-0.0006	0.0014	-0.0065	-0.0043
	(0.0011)	(0.0011)	(0.0024)	(0.0023)	(0.0031)	(0.0029)
Grade Completed	0.0027		0.0014		0.0013	
	(0.0010)		(0.0016)		(0.0016)	
Father's Education	0.0001	0.0009	0.0015	0.0021	-0.00001	0.0007
	(0.0006)	(0.0006)	(0.0008)	(0.0008)	(0.0009)	(0.0008)

Notes: The panel data set was constructed using NLSY79 data from 1979-1994. Data on training in 1987 is combined with 1988 in the original dataset.

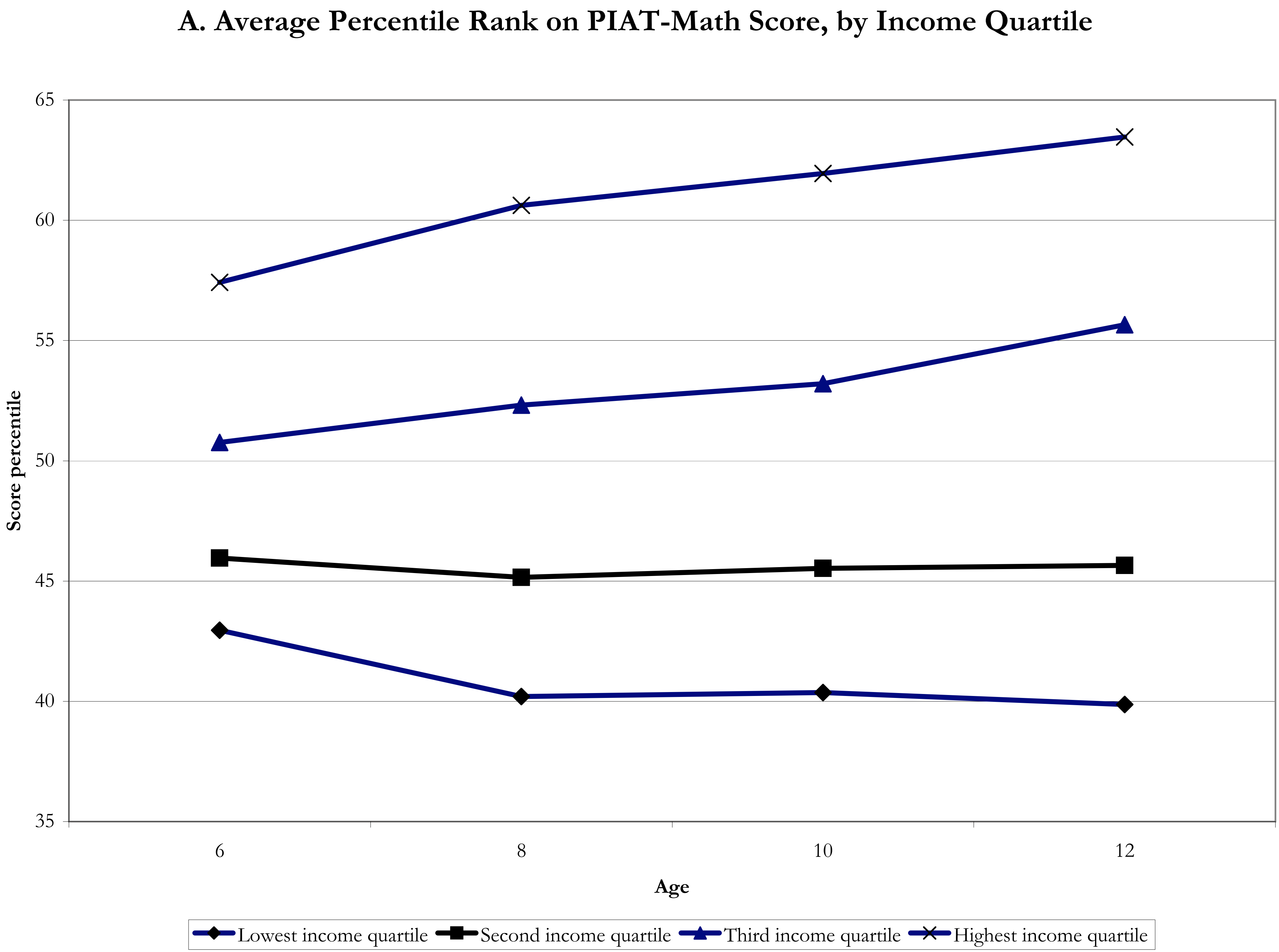
Company training consists of formal training run by employers and military training excluding basic training. Standard errors are reported in parentheses.

Specification (1) includes a constant, age, father's education, mother's education, number of siblings, southern residence at age 14 dummy, urban residence at age 14 dummy, and year dummies.

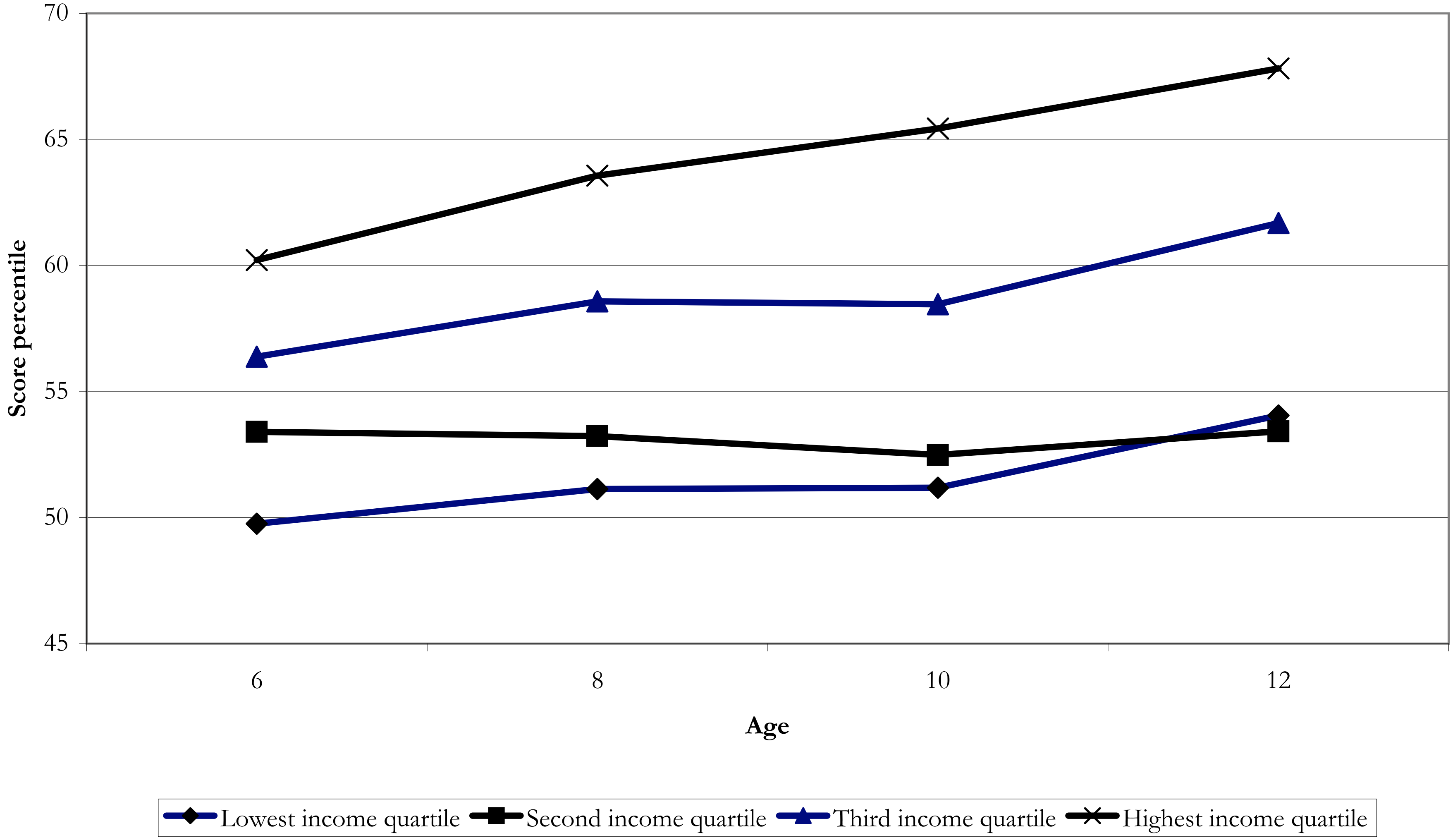
Specification (2) drops age-adjusted AFQT and grade completed. Average marginal effect is estimated using average derivatives from a probit regression.

- Abilities Explaining Skill Attainment Open Up Early.
- Can be Substantially Eliminated by Adjusting for Long-Term Family Environmental Factors.

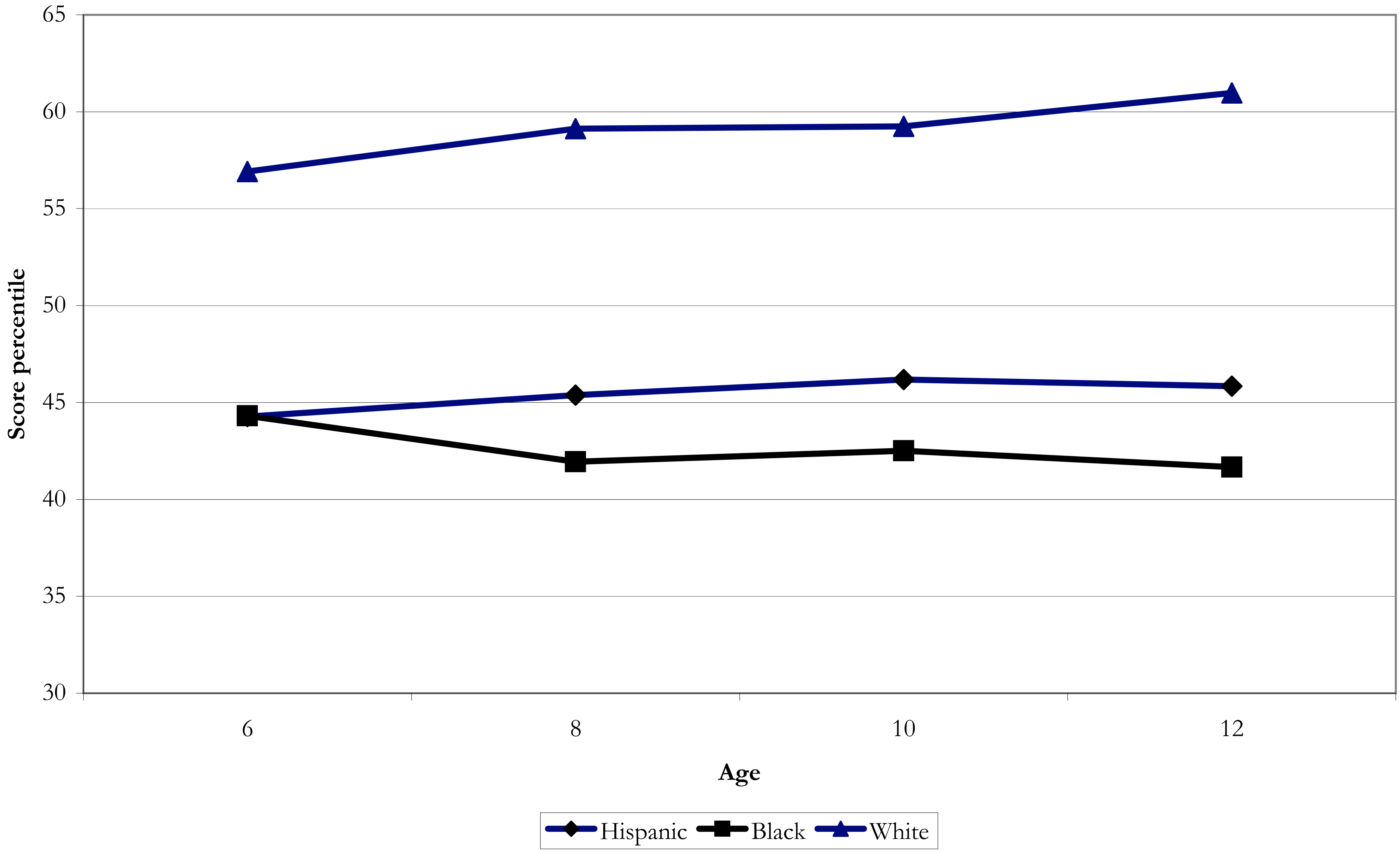
Figure 14
Cognitive and Noncognitive Scores and Family Environment


A. Average Percentile Rank on PIAT-Math Score, by Income Quartile
65
60
55
50
45
40
35
Score percentile
6
8
10
12
Age
Lowest income quartile
Second income quartile
Third income quartile
Highest income quartile

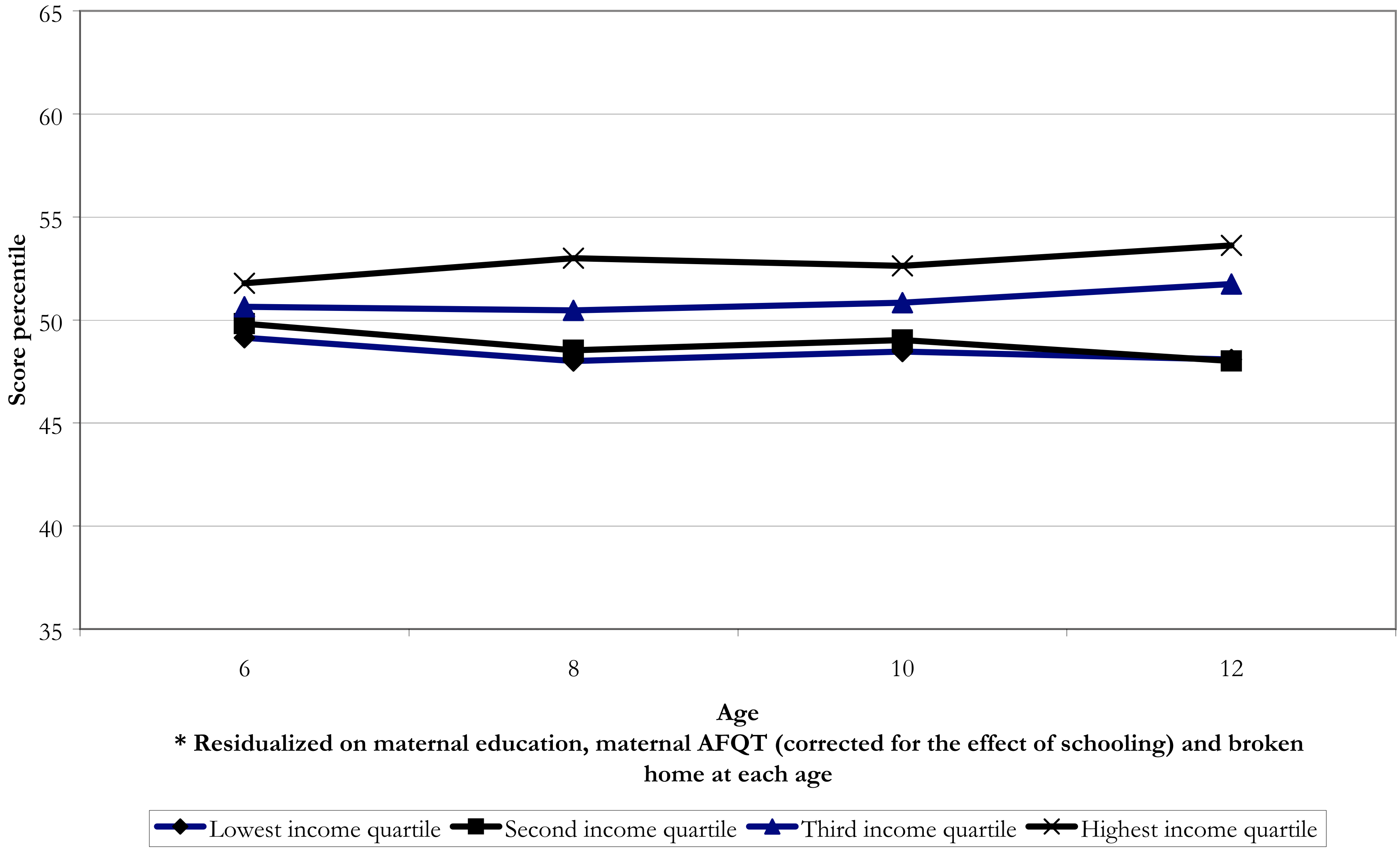
B. Average Percentile Rank on PIAT-Math Score, by Income Quartile
Whites Only



C. Average Percentile Rank on PIAT-Math Score, by Race

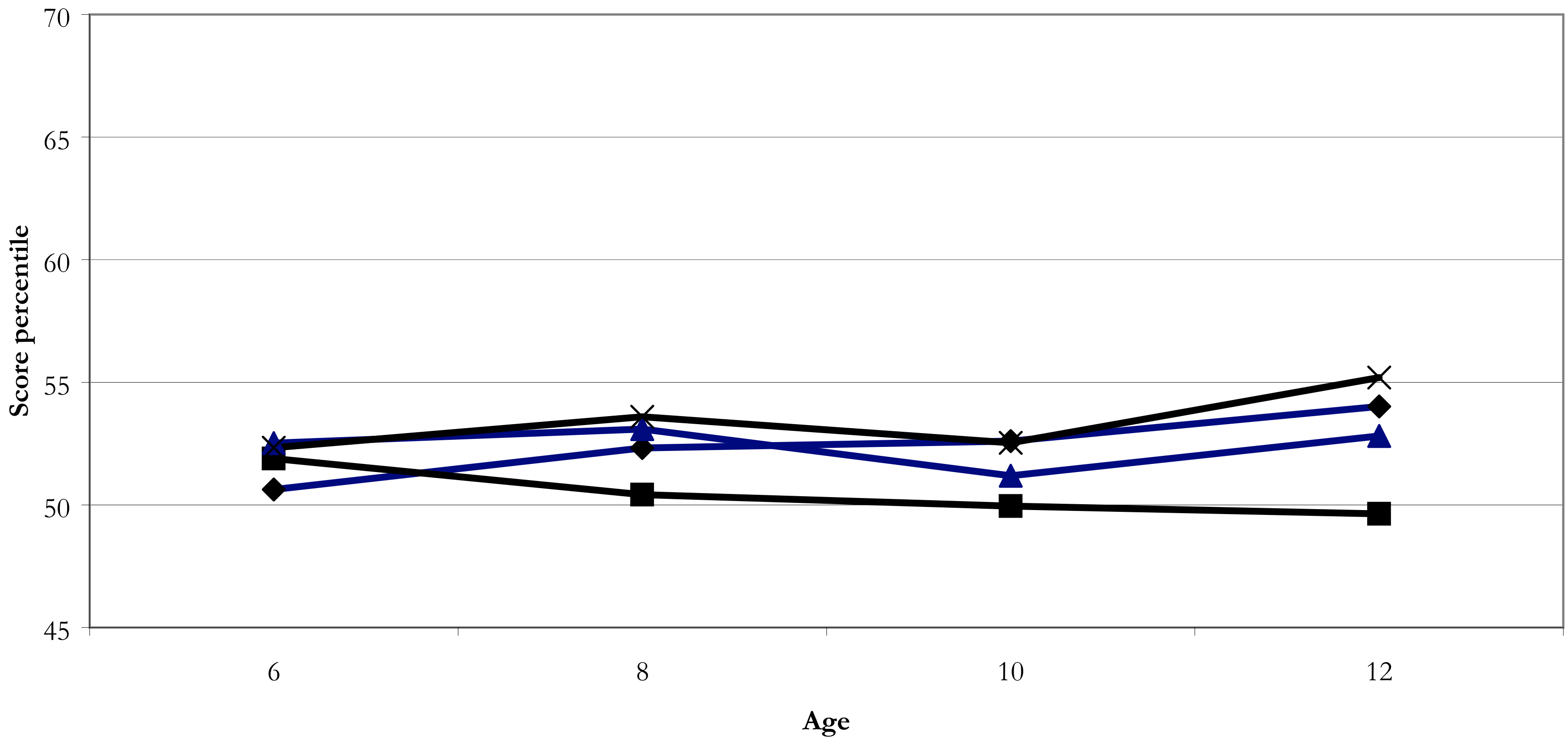


D. Residualized Average PIAT-Math Score Percentiles by Income Quartile*



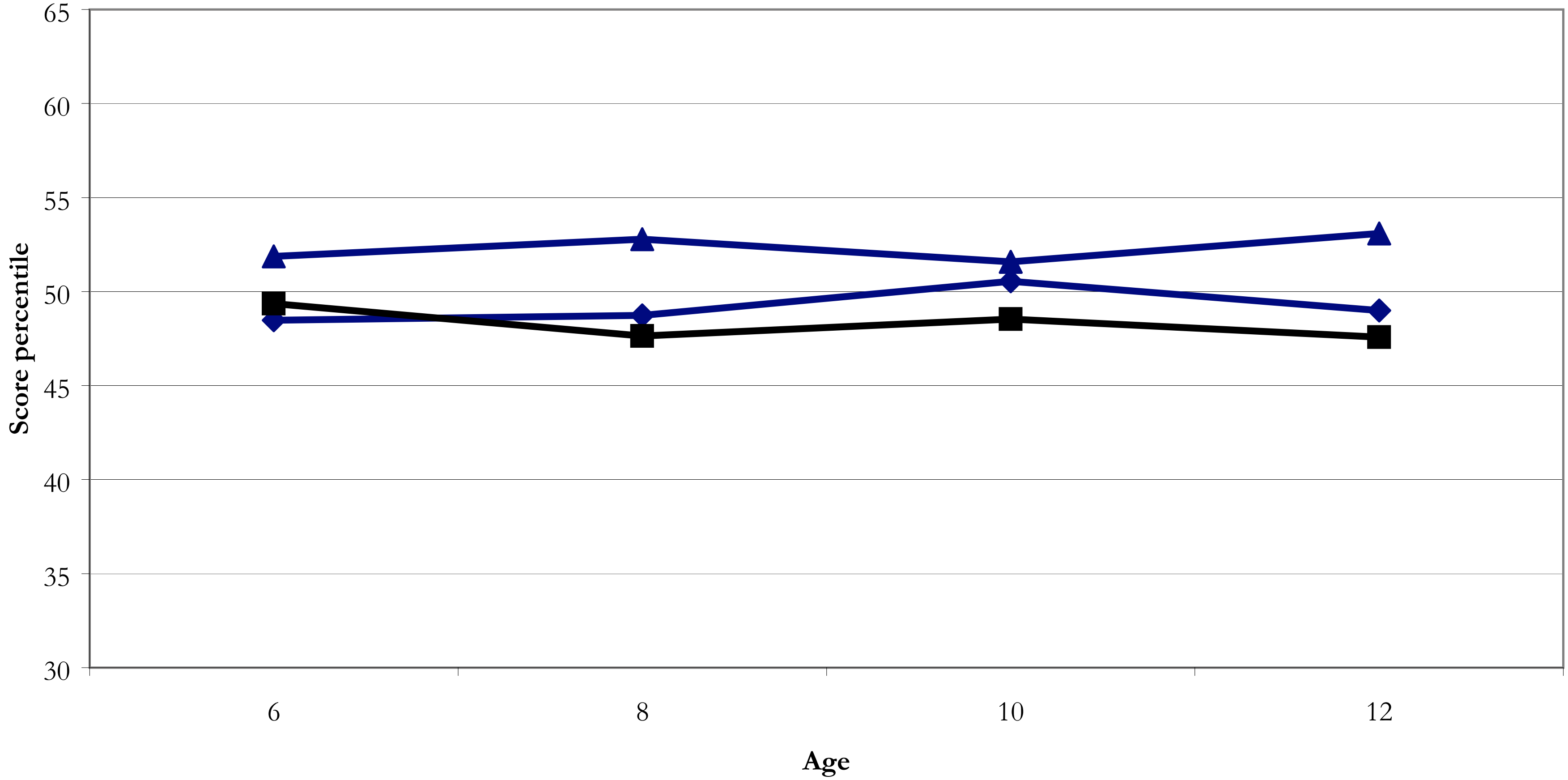
*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

E. Residualized Average PIATM Score Percentiles by Income Quartile*
Whites Only



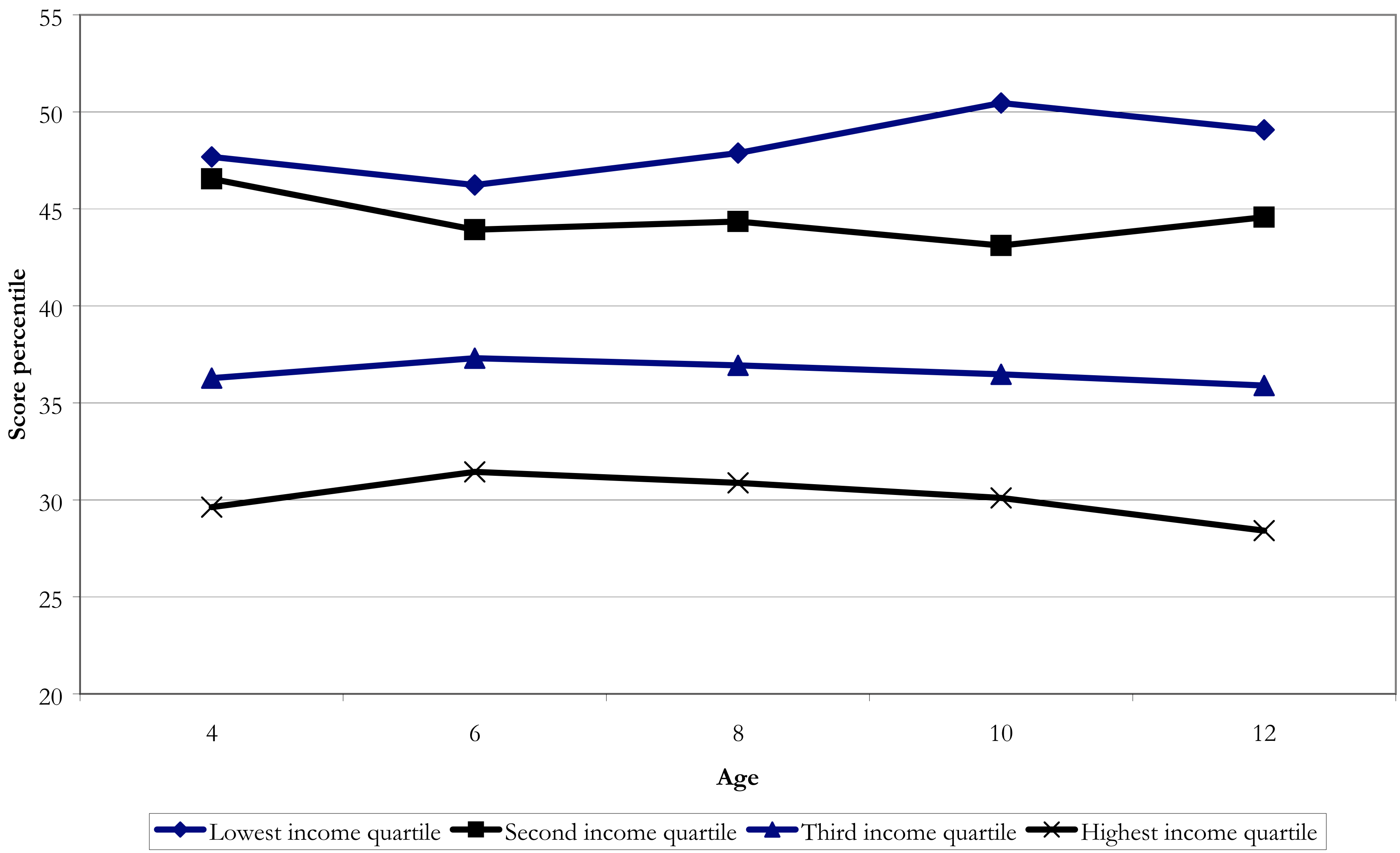
*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

F. Residualized Average PIATM Score Percentile by Race*

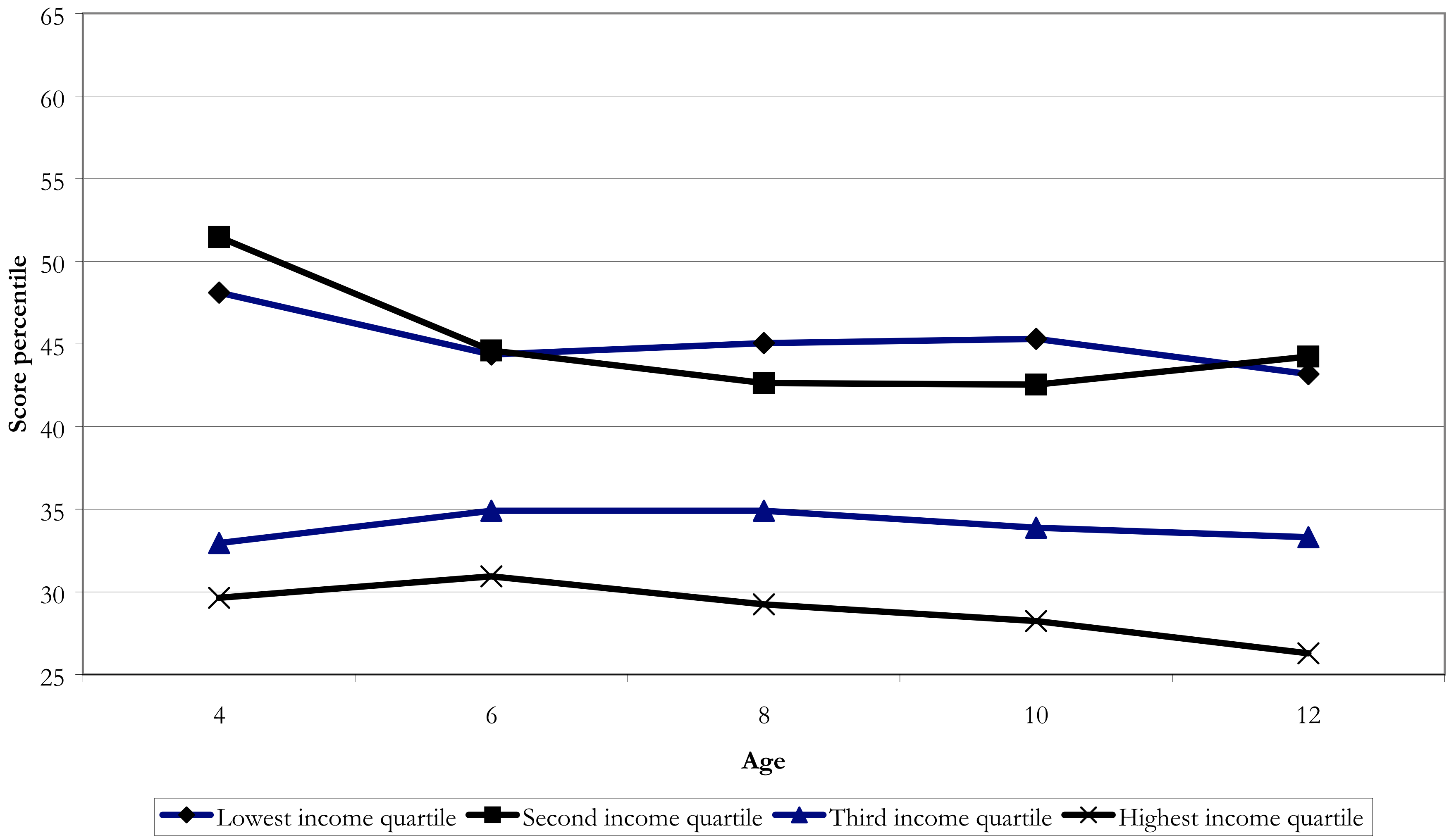


*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

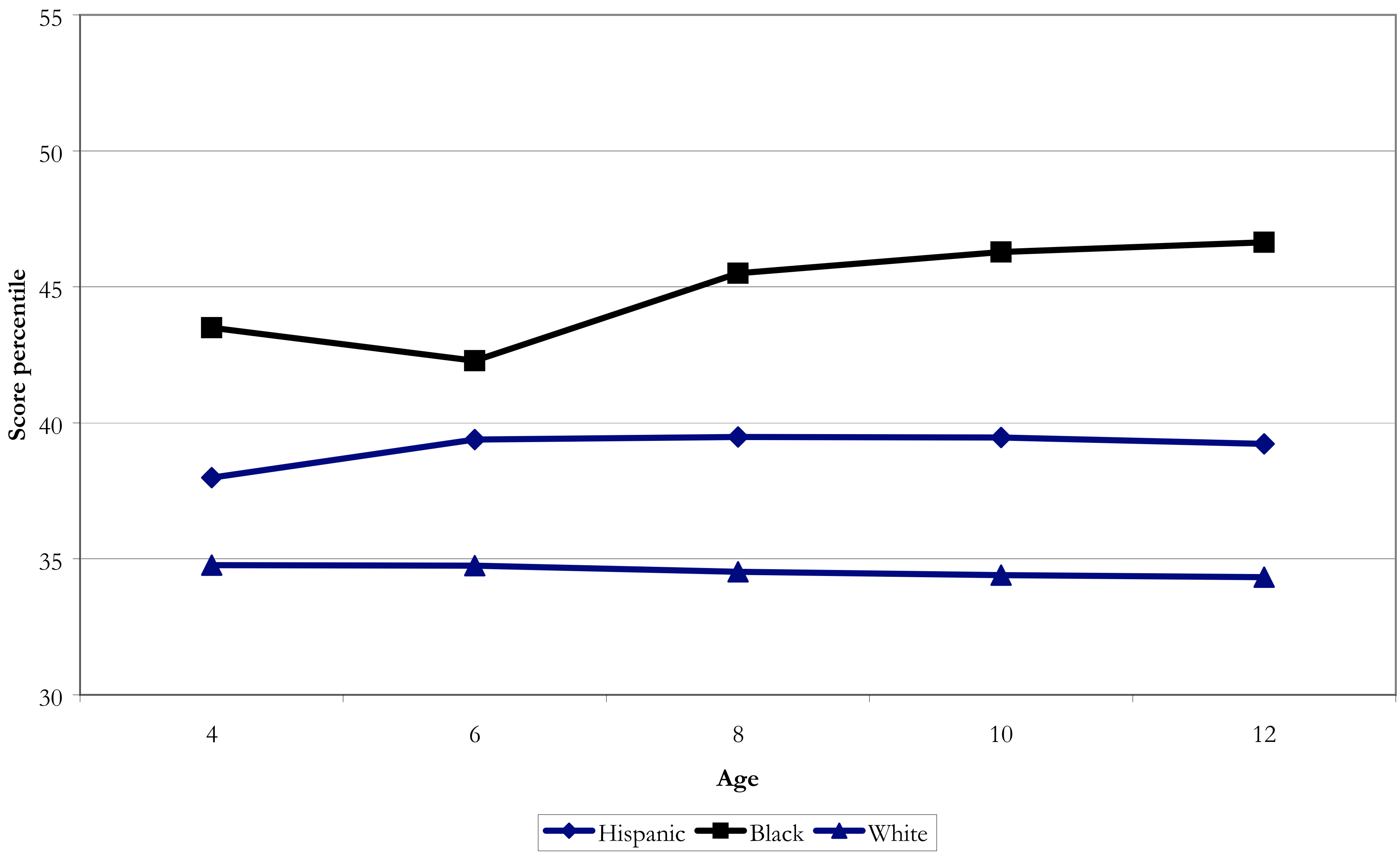
G. Average Percentile Rank on Anti-Social Score, by Income Quartile*



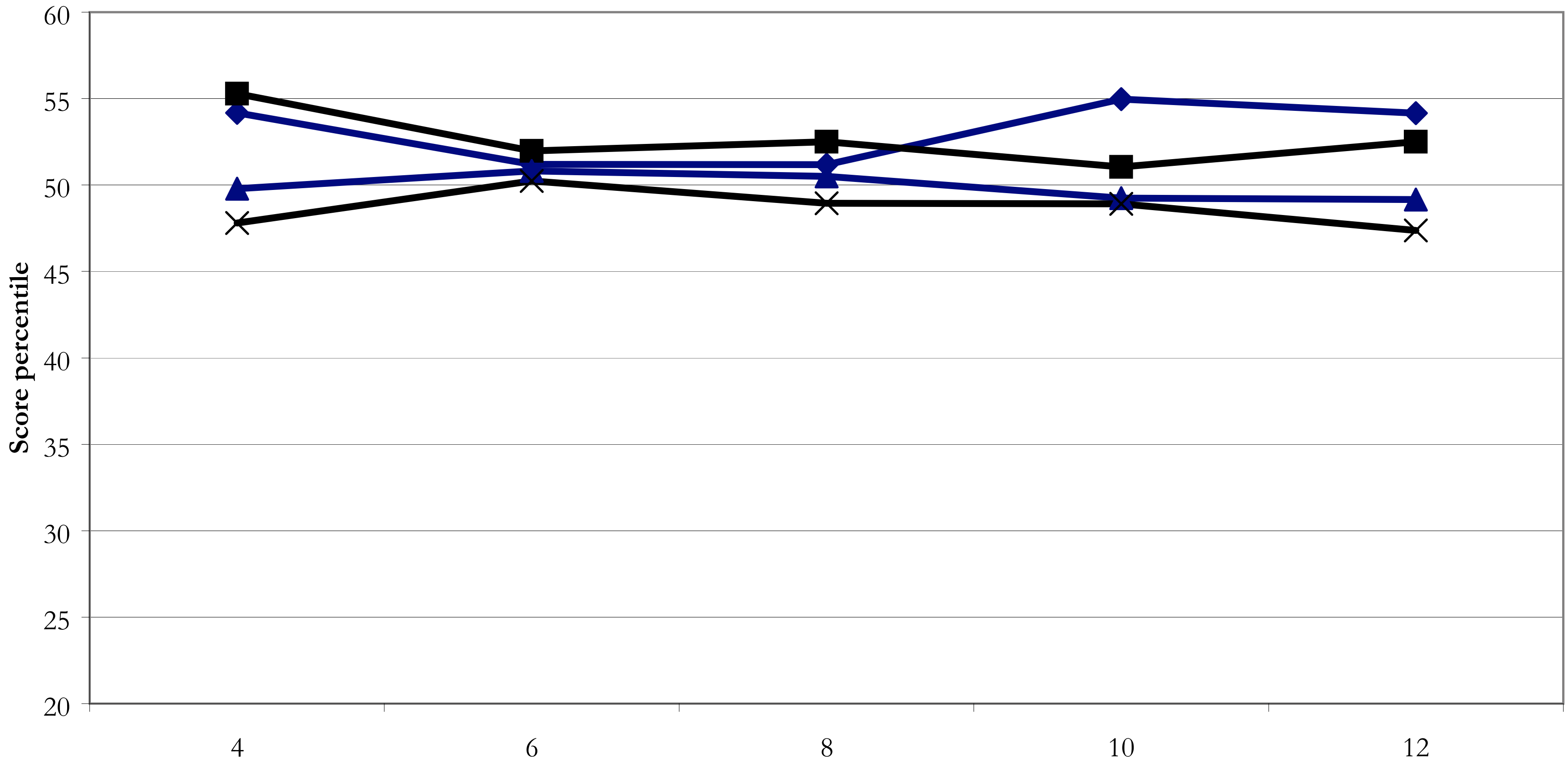
H. Average Percentile Rank on Anti-Social Score, by Income Quartile*
Whites Only



I. Average Percentile Rank on Anti-Social Score, by Race

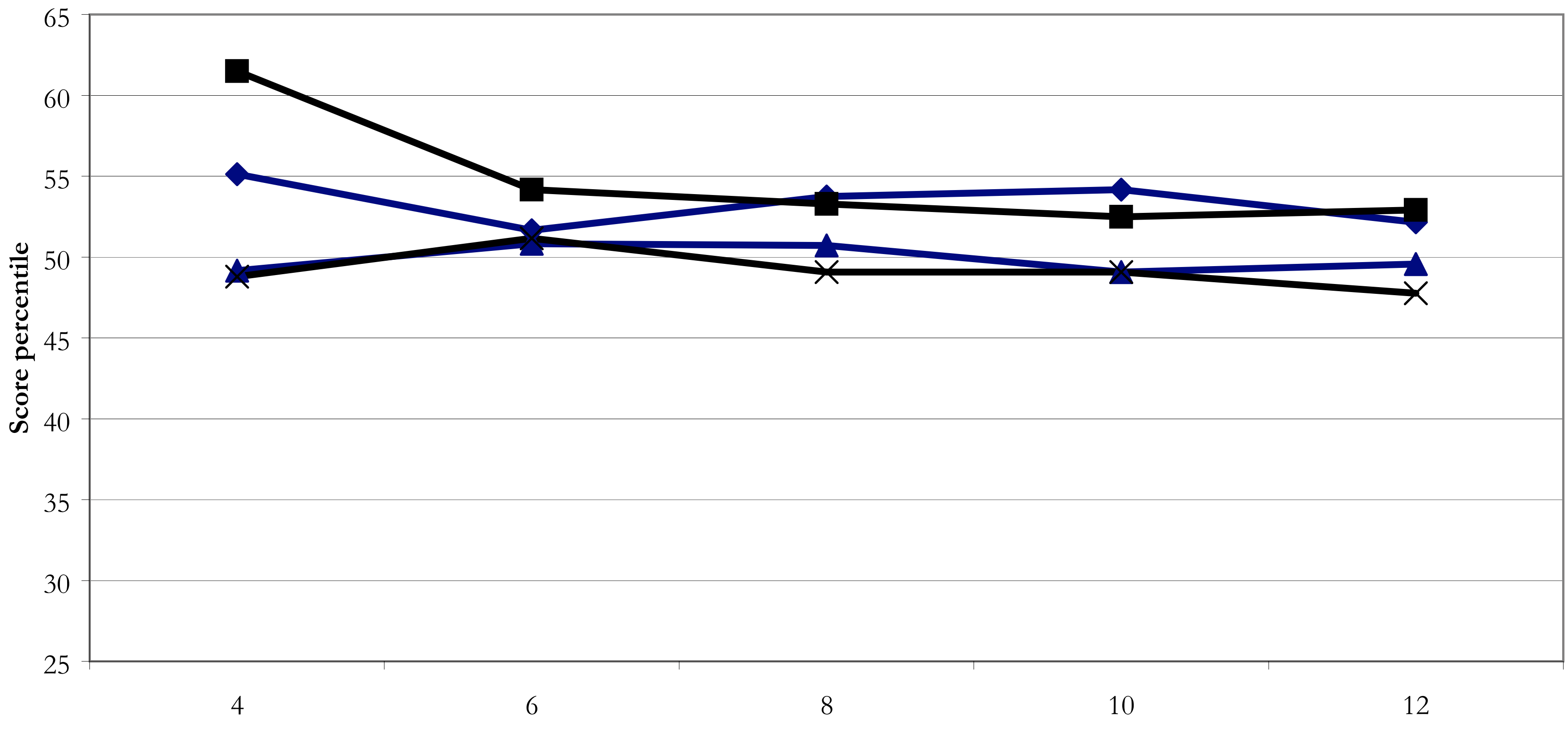


J. Residualized Average Anti-Social Score Percentile by Income Quartile*



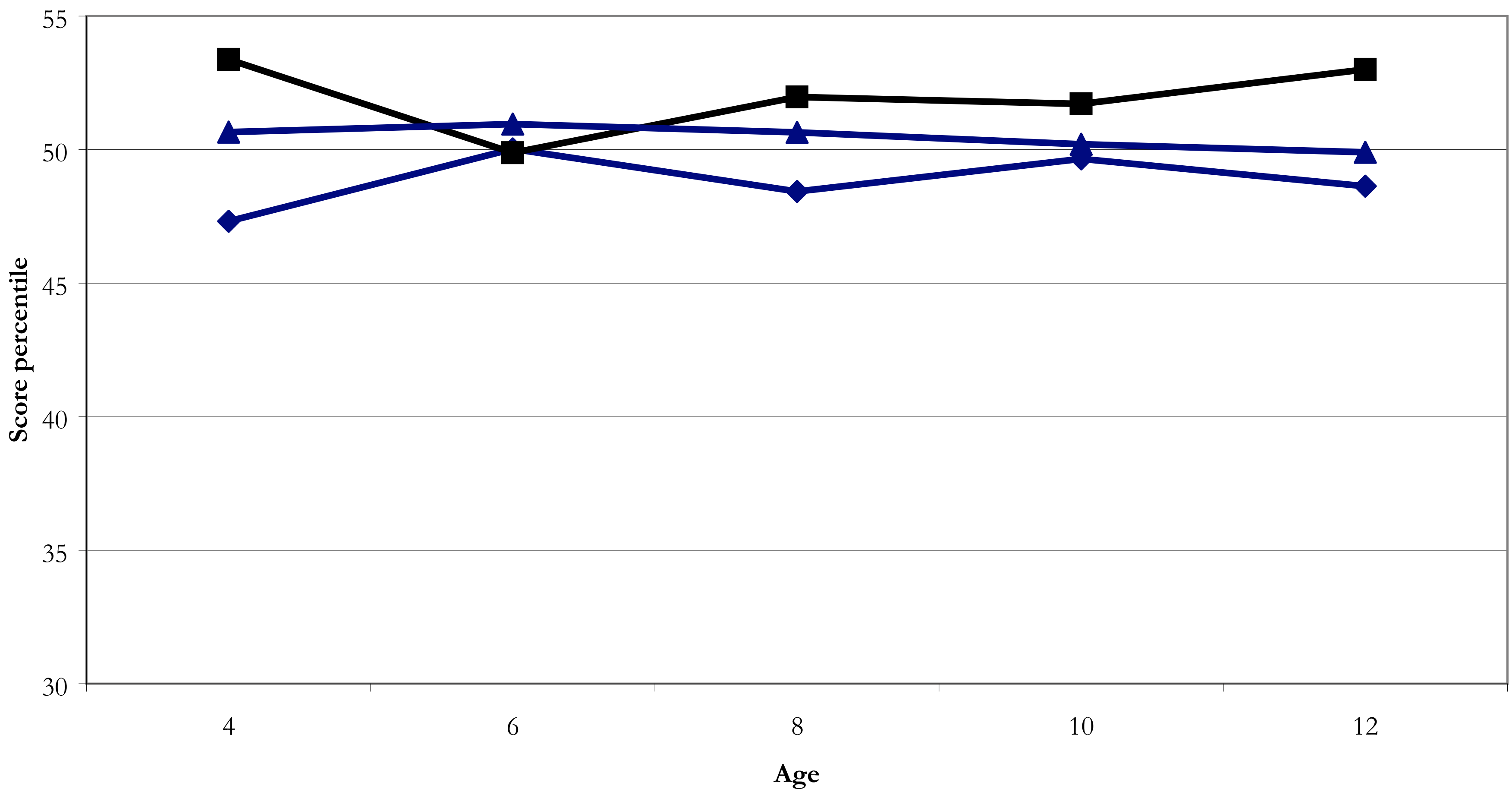
* Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age

K. Residualized Average Anti-Social Score Percentile by Income Quartile*
Whites Only



*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

L. Residualized Average Anti-Social Score Percentile by Race*



*** Residualized on maternal education, maternal AFQT (corrected for the effect of schooling) and broken home at each age**

- Later Interventions Less Effective at Current Levels of Expenditure

Table 11

Evaluating School Quality Policies

Discounted Net Returns to Decreasing Pupil-Teacher Ratio by 5 Pupils per Teacher for People with 12 Years of Schooling in 1990

	Productivity growth rate	Includes 50% social cost of funds	Annual rate of return to earnings from school quality change 1%	2%
7% discount rate	0%	Yes	-9056	-8092
	0%	No	-5716	-4752
	1%	Yes	-8878	-7736
	1%	No	-5538	-4396
5% discount rate	0%	Yes	-9255	-7537
	0%	No	-5597	-3880
	1%	Yes	-8887	-6802
	1%	No	-5230	-3145
3% discount rate	0%	Yes	-8840	-5591
	0%	No	-4810	-1562
	1%	Yes	-8036	-3984
	1%	No	-4007	45

Note: All values, in 1990 dollars, are given as net present values at age 6 of an individual; costs of schooling improvements are incurred between ages 6 and 18 and benefits from increased earnings occur between ages 19 and 65. Data for costs are from NCES 1993. Costs of adding new teachers include salaries and capital, administrative, and maintenance expenditures. Estimates of increases in earnings resulting from a decrease in the pupil-teacher ratio by 5 pupils per teacher come from Card and Kruger (1992), table 3, which produces a range of estimated earnings increases from about 1 to 4 percent, whereas most of the estimates are in the 1 to 2 percent range, which we use in this paper. To capture the benefits of smaller class sizes, students must attend twelve years of higher-quality schooling. We calculate the costs for one year of improvements and then calculate the present value of the costs over the twelve years of school attendance.

- GED certification and second chance programs are not effective on average: help only a few.
- Job training is not effective except for a few.

Table 12
Lessons from the Evaluation Literature

Programmes	Appears to help	Appears not to help	General observations on effectiveness
Formal classroom training	Women re-entrants	Prime-age men and older workers with low initial education	Important that courses have strong labour market relevance, or signal "high" quality to employers. Should lead to a qualification that is recognised and valued by employers. Keep programmes relatively small in scale.
On-the-job training	Women re-entrants; single mothers	Prime-age men (?)	Must directly meet labour market needs. Hence, need to establish strong links with local employers, but this increases the risk of displacement.
Job-search assistance (job clubs, individual counselling, etc.)	Most unemployed but in particular, women and sole parents		Must be combined with increased monitoring of the job-search behaviour of the unemployed and enforcement of work tests.
Of which:			
re-employment bonuses	Most adult unemployed		Requires careful monitoring and controls on both recipients and their former employers.

Table 12 (cont.)
Lessons from the Evaluation Literature

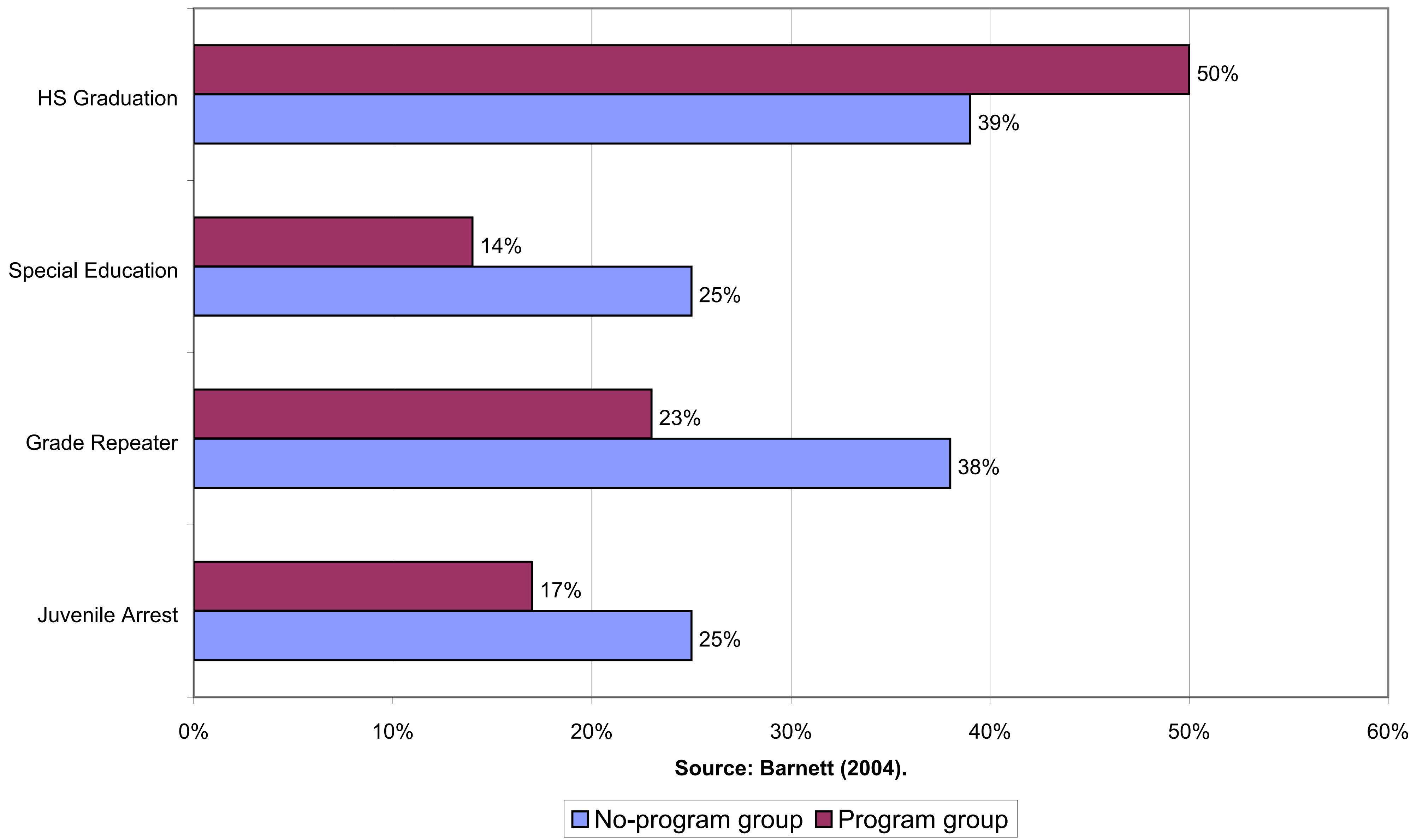
Special youth measures (training, employment subsidies, direct job creation measures)		Disadvantaged youths	Effective programmes need to combine an appropriate and integrated mix of education, occupational skills, work-based learning and supportive services to young people and their families. *Early* and *sustained* interventions are likely to be most effective. Need to deal with inappropriate attitudes to work on the part of youths. Adult mentors can help.
Subsidies to employment	Long-term unemployed; women re-entrants		Require careful targeting and adequate controls to maximise net employment gains, but there is a trade-off with employer take-up.
Of which:			
Aid to unemployed starting enterprises	Men (below 40, relatively better educated)		Only works for a small subset of the population.
Direct job creation		Most adult and youth unemployed	Typically provides few long-run benefits and principle of additionality usually implies low marginal-product jobs.

Source: Martin and Grubb, 2001

- Evidence from Early Interventions with Long Term Follow-up.

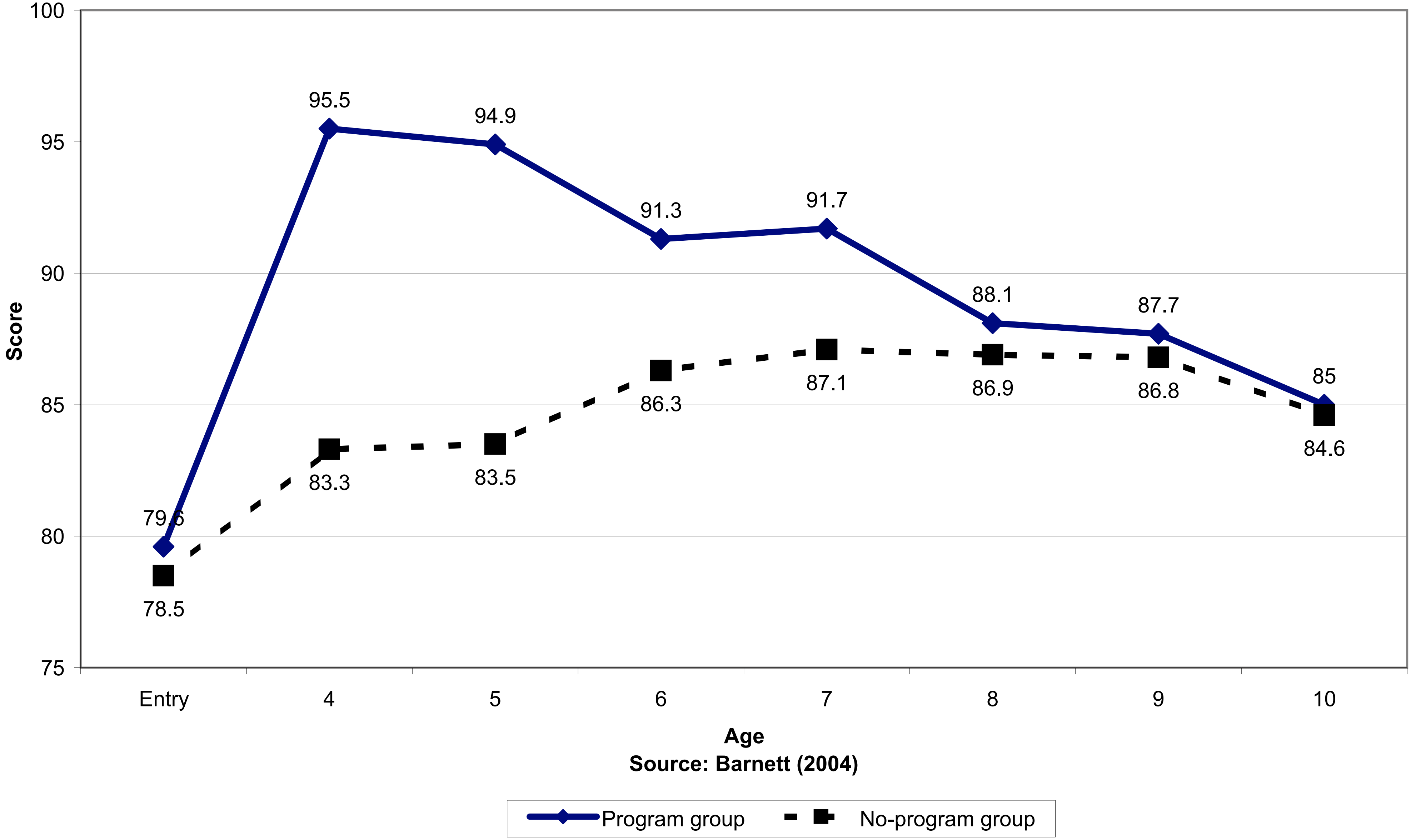
Figure 15

Academic and Social Benefits at School Exit For CPC Participants



Source: Barnett (2004).

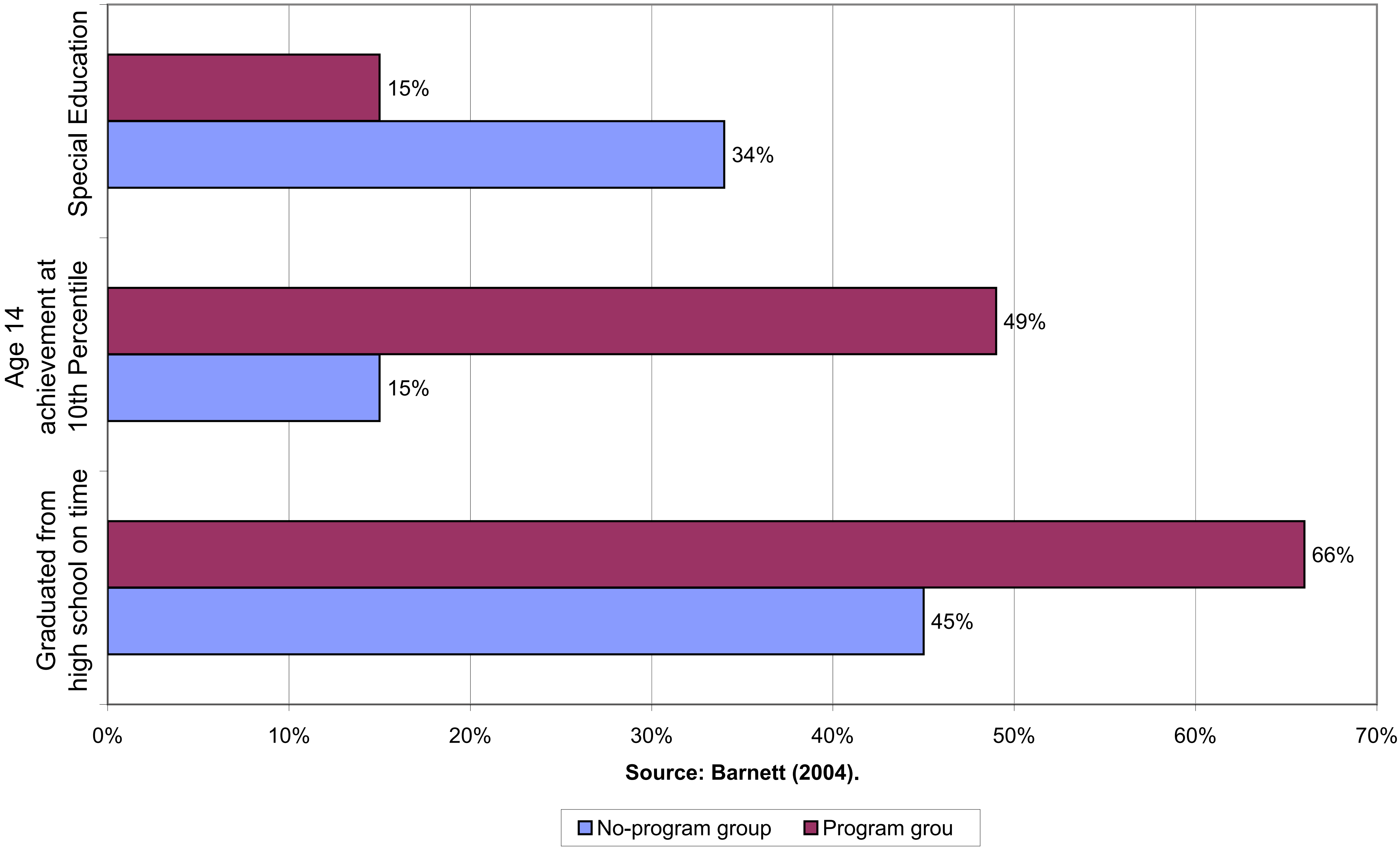
Figure 16a
Perry Preschool IQ Over Time



Source: Barnett (2004)

Figure 16b

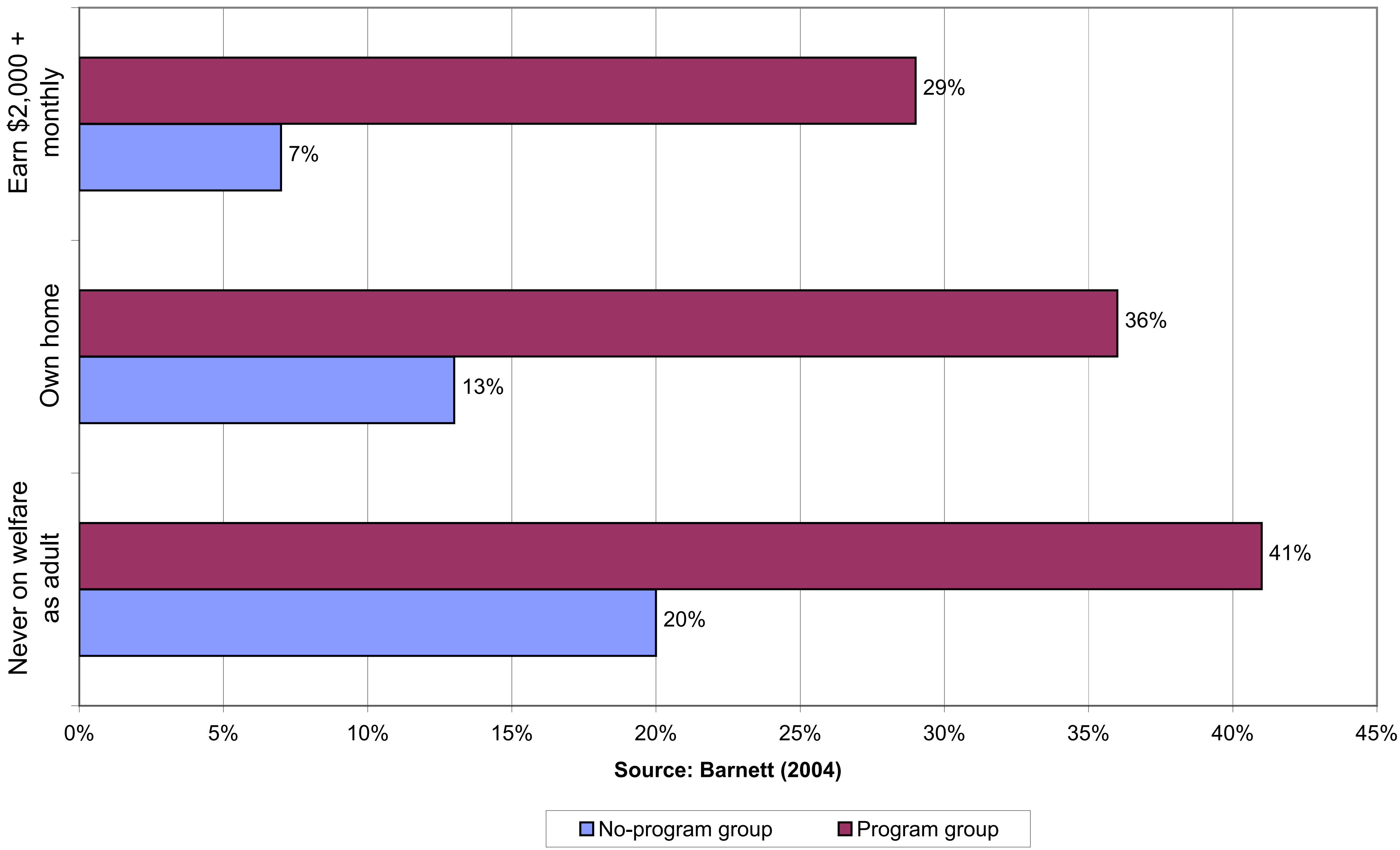
Perry Preschool: Educational Effects



Source: Barnett (2004).

Figure 16c

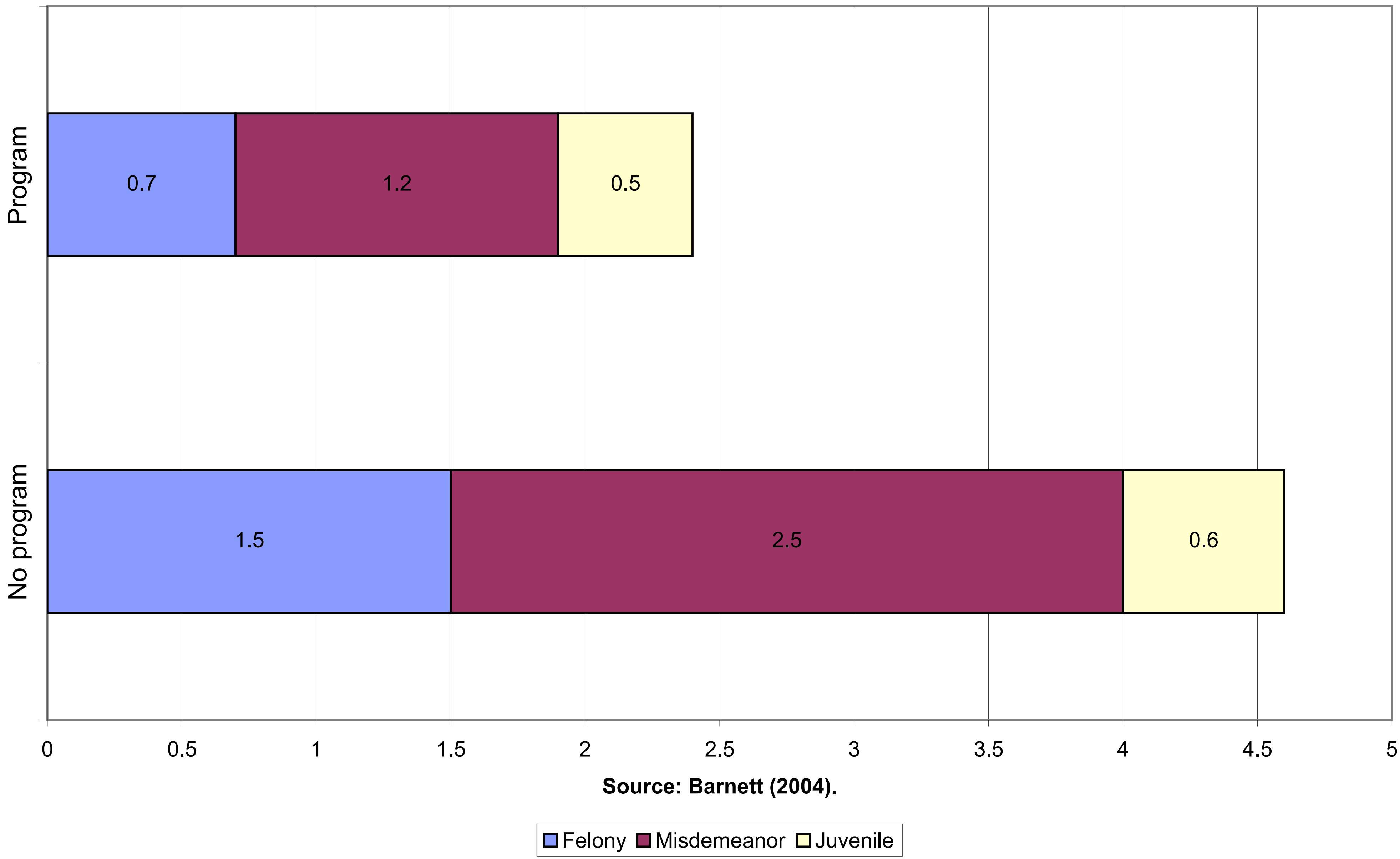
Perry Preschool: Economic Outcomes



Source: Barnett (2004)

Figure 16d

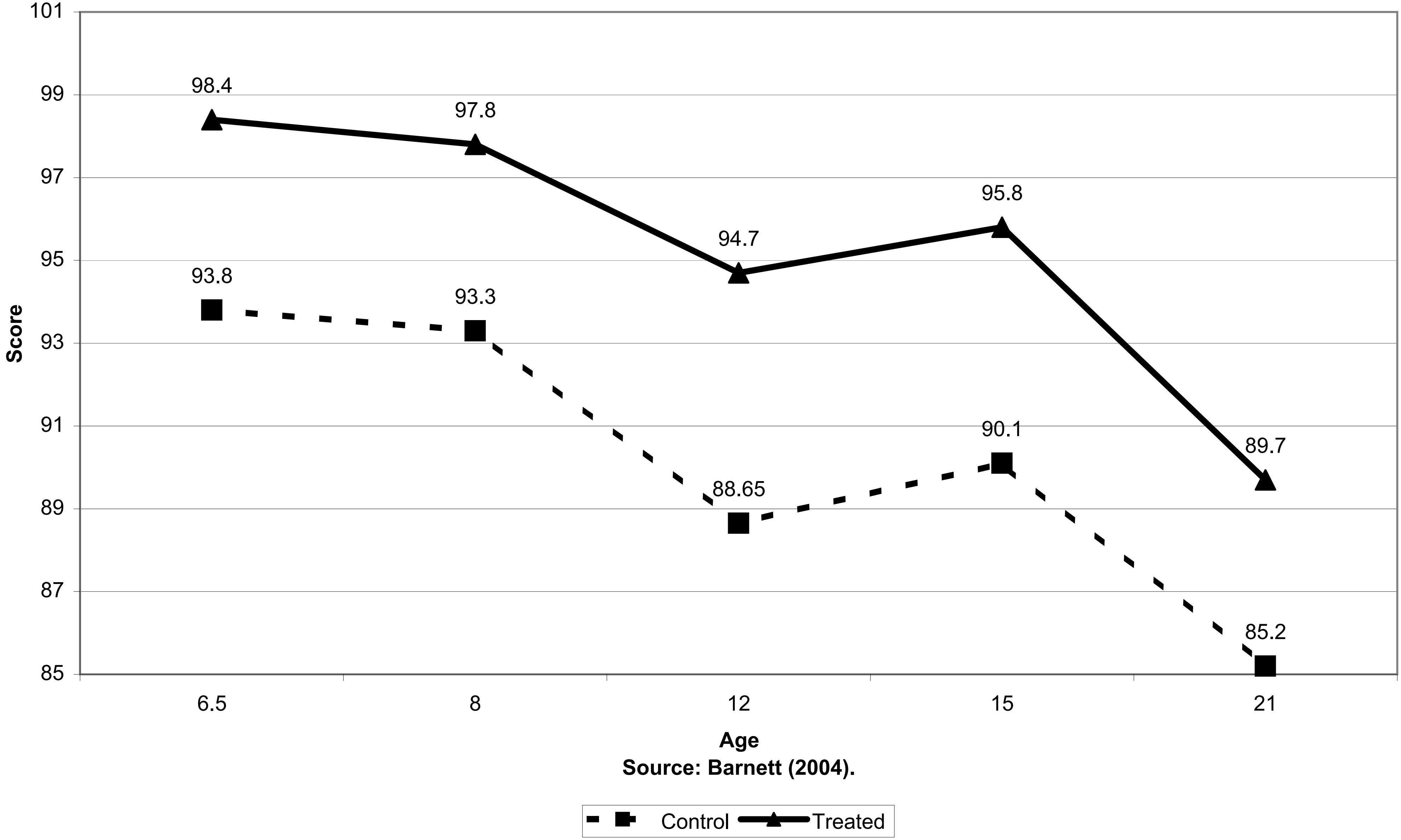
Perry Preschool: Arrests Per Person by Age 27



Source: Barnett (2004).

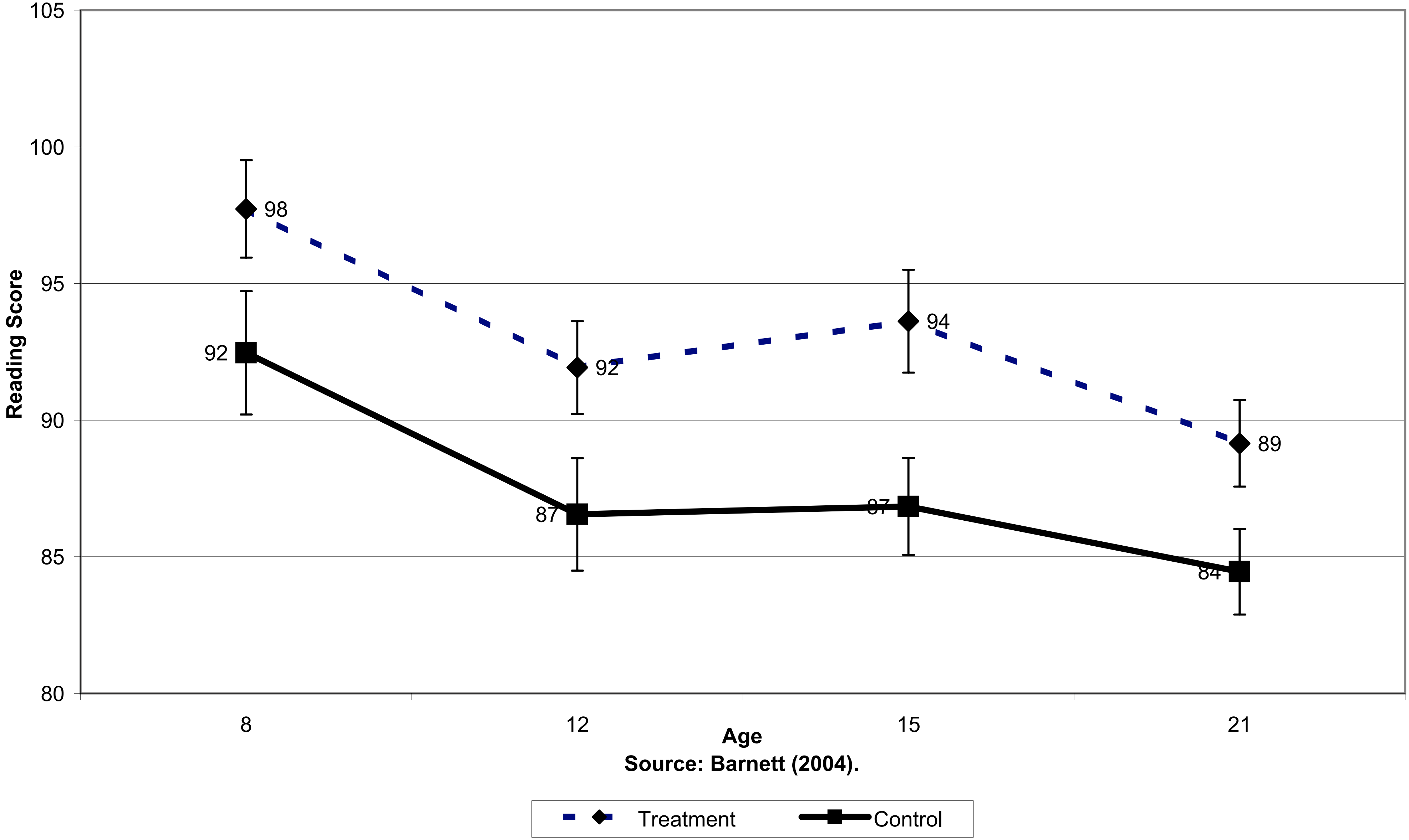
Figure 17a

Abecedarian IQ Scores Over Time



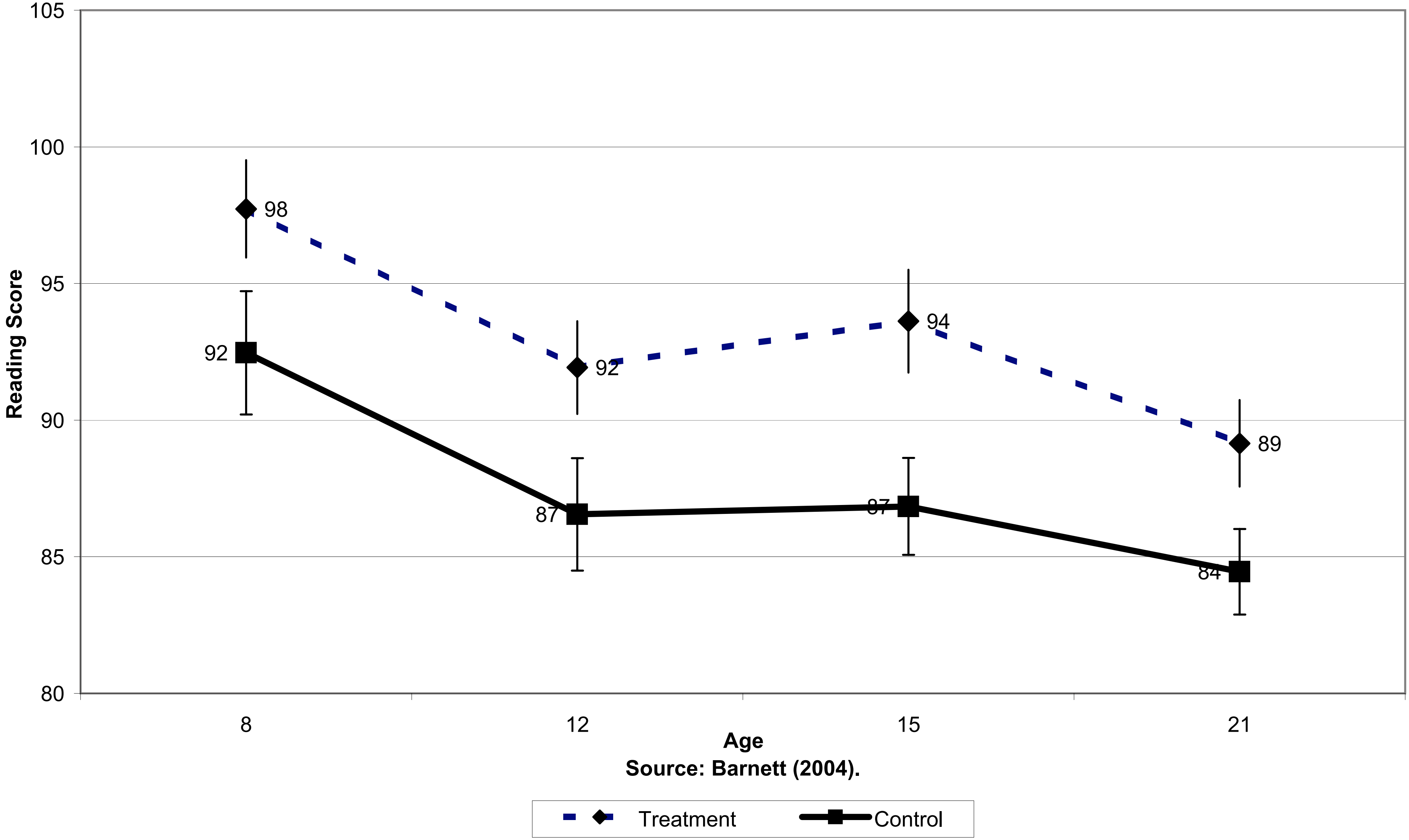
Source: Barnett (2004).

Figure 17b
Abecedarian Reading Achievement Over Time



Source: Barnett (2004).

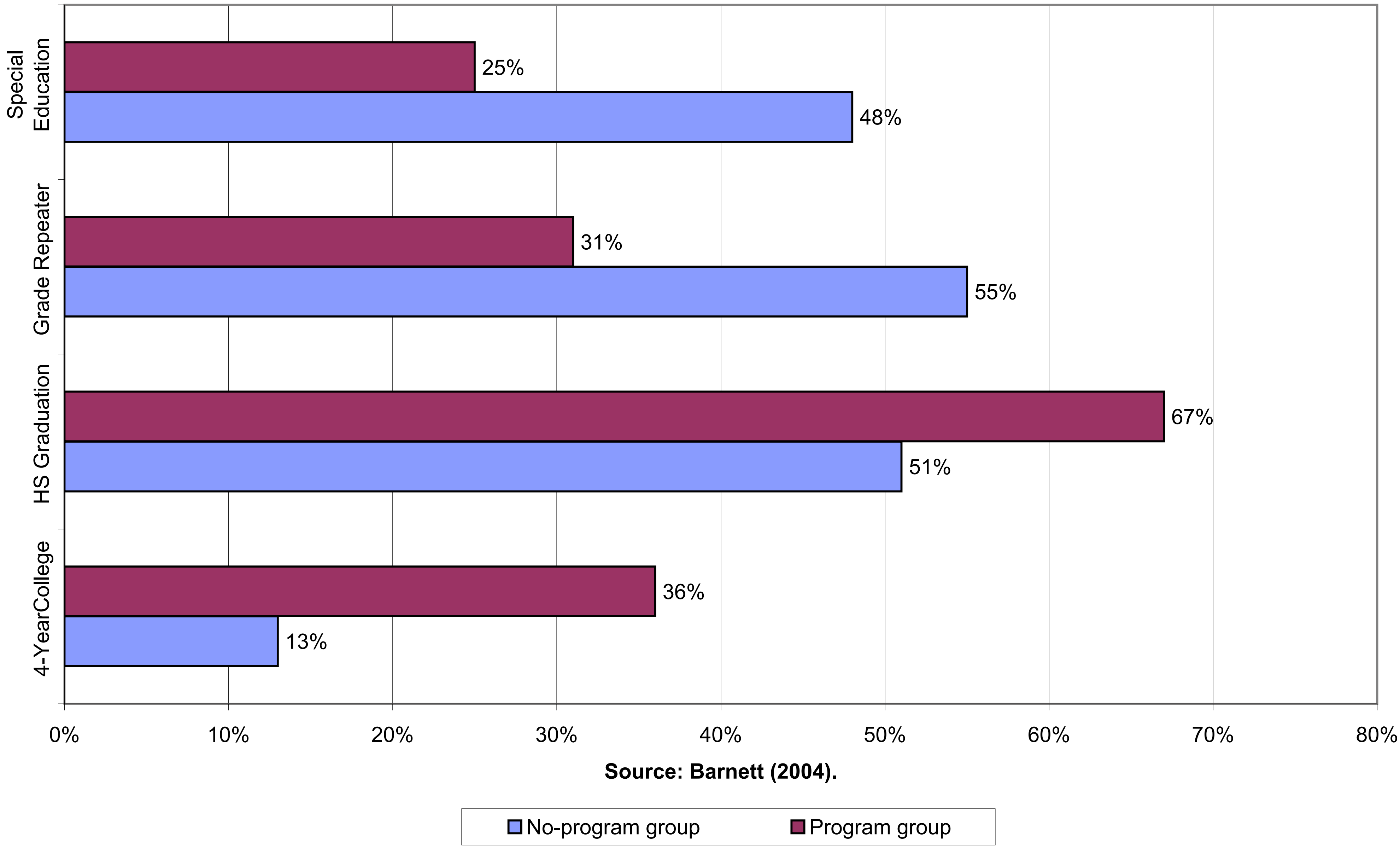
Figure 17c
Abecedarian Math Achievement Over Time



Source: Barnett (2004).

Figure 17d

Abecedarian Academic Outcomes



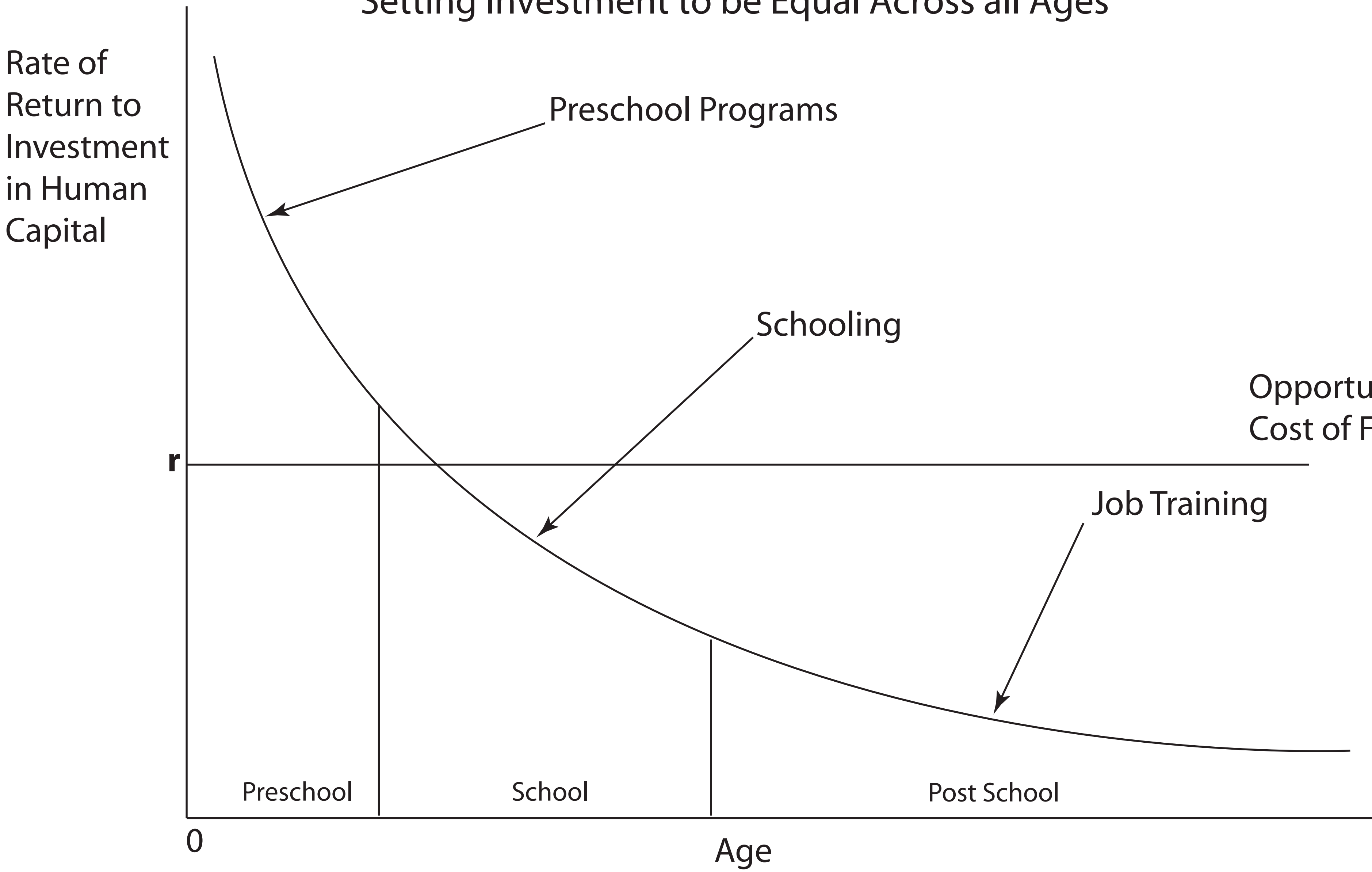
Source: Barnett (2004).

On Both Theoretical and Empirical Grounds, the Gains to Early Childhood Investments Greater than to Older Investments.

A. Younger People Have Longer Horizon.

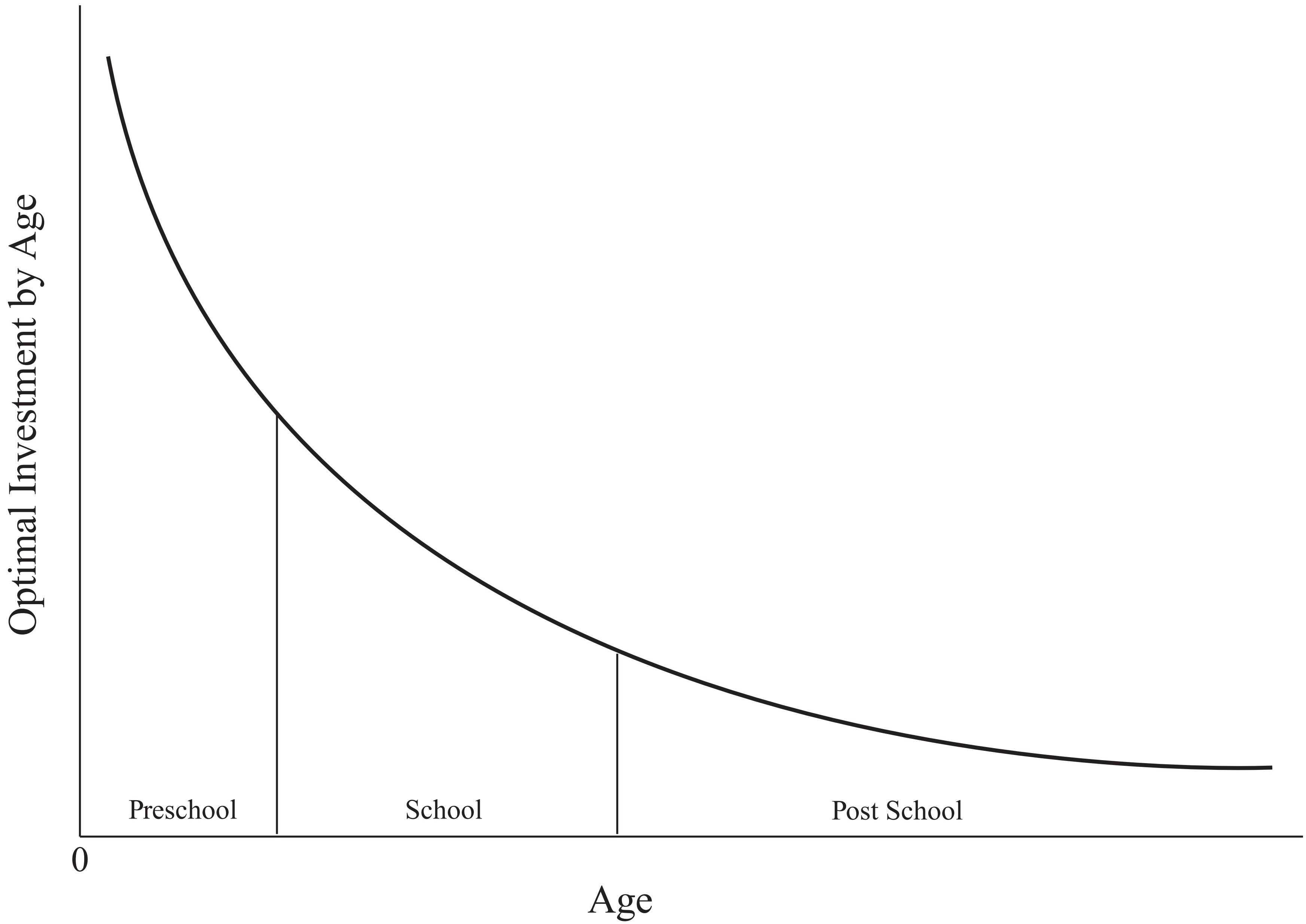
B. Skill Begets Skill.

Figure 18-1
Rates of Return to Human Capital Investment Initially
Setting Investment to be Equal Across all Ages



Rates of Return to Human Capital Investment Initially Setting Investment to be Equal Across all Ages

Figure 18-2
Optimal Investment Levels



Using More Economic Theory to Interpret the Evidence and Evaluate Social Policies

3 An Intuitive Introduction

- Two periods in a child's life: "0" and "1"
- H level of human capital as the child starts adulthood.
- Investment in "0" is I_0. Investment in "1" is I_1.
- We postulate: $H = f(I_0, I_1; \theta)$.
- f is concave and twice differentiable.

- Two children: A and B
- Maximize $H^A + H^B$, given $I_0^A = \bar{I}_0^A$, $I_0^B = \bar{I}_0^B$.
- Assume $\theta_A = \theta_B = \theta$.
- If I_0, I_1 are perfect substitutes
  $(f(I_0 + \gamma I_1; \theta) = H,\ \gamma > 0)$
- Fixed budget M
- Maximize

$$f(\bar{I}_0^A + \gamma I_1^A; \theta) + f(\bar{I}_0^B + \gamma I_1^B; \theta)$$

  subject to

$$I_1^A + I_1^B \leq M, \qquad I_1^A \geq 0, \qquad I_1^B \geq 0.$$

We obtain

$$\begin{aligned}\left(\gamma f'(\bar{I}_0^A + \gamma I_1^A;\theta) - \lambda\right) I_1^A &= 0\\ \left(\gamma f'(\bar{I}_0^B + \gamma I_1^B;\theta) - \lambda\right) I_1^B &= 0\end{aligned}$$

If solutions are interior, investment is fully equalizing.

If, however, I_0 and I_1 perfect complements (Leontief technology)

$$\bar{I}_0^A < \bar{I}_0^B \Rightarrow I_1^A < I_1^B$$

We find, empirically, something closer to the Leontief case.

Some Important Lessons

A. In all but perfect substitute case, timing matters.

B. No conflict between equity and efficiency in early investments.

C. Real conflict possible for late investments.

4 Lessons from the Technology of Skill Formation

Investment should be redirected toward the young and able:

1) Longer periods to collect the returns of the investment.

2) The Self-Productivity and Complementarity of Early and Late Investments in Human Capital.

- The productivity of late investments increases with the amount of early investments. Remediation of poor early investments is costly and very difficult because there is no solid base on which remediating investments can build on.

- Conversely, the productivity of early investments is low if these are not followed by later investments.

The Technology of Skill Formation

- x is the early investment in human capital
- z is the late investment in human capital
- h is adult human capital

$$h = \left\{ \gamma_x x^{\phi_0} + (1 - \gamma_x) \left[\gamma_z x^{\phi_1} + (1 - \gamma_z) z^{\phi_1} \right]^{\frac{\phi_0}{\phi_1}} \right\}^{\frac{\rho}{\phi_0}}$$

- Human Capital is index of skills developed over lifecycle

Self-productivity

- Early skills are inputs in the production of late skills

Complementarity

- Early skills are combined with late skills to produce HC
- No equity-efficiency tradeoff for early investments
- A tradeoff for late investments

4.1 Self-Productivity and Complementarity

Assume $\phi_0 = \phi_1 = \phi$

$$h = \left[\left(\gamma_x + (1 - \gamma_x) \gamma_z \right) x^{\phi} + (1 - \gamma_x) \gamma_z z^{\phi} \right]^{\frac{\rho}{\phi}}$$

Define $\gamma = \gamma_x + (1 - \gamma_x) \gamma_z$

$$h = \left[\gamma x^{\phi} + (1 - \gamma) z^{\phi} \right]^{\frac{\rho}{\phi}}$$

γ captures the self-productivity of HC formation.

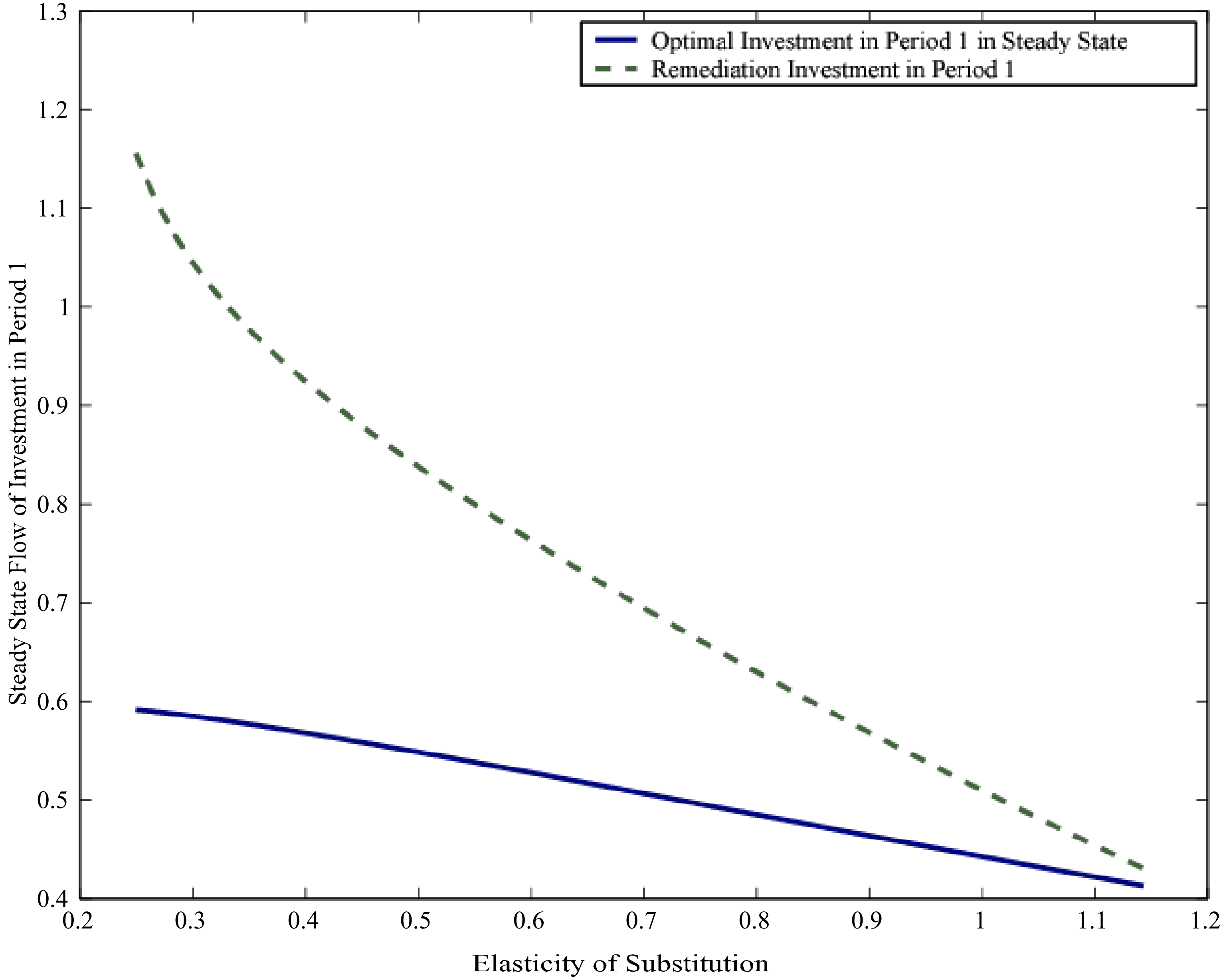
ϕ captures the complementarity between skills.

5 Main Idea

When parents are subject to lifetime liquidity constraints, they will cut back on investments on the children's human capital along the whole path of investments. Deficiencies in human capital formation accumulate as a consequence of the dynamics. If policy is directed toward the financing of late investments, it is certainly inefficient and may not attain the goal of correcting the existing market failure.

This is not considered in the literature that collapses childhood in one period. This literature shapes policies, however. The single period of childhood model puts tuition, childcare, and school quality on equal footing.

Figure 19: The Flow of Investment Necessary To O;set Low Investment in Period 0 To Restore The Steady State Stock of Human Capital To The Optimal Steady State Investment in Period 1



6 Baseline Economy– OLG with Complete Markets

6.1 Generational Structure

- OLG economy with infinite periods $t \in \{0, 1, 2, ...\}$
- Each agent lives for 4 periods: child, adolescent, young parent, old parent
- The size of each cohort is normalized to 1.
- There is no population growth.

Table 13
The Generational Structure

Generation Born At Period	**Periods**				
	t = 0	t = 1	t = 2	t = 3	t = 4
-3	Old Adult				
-2	Young Adult	Old Adult			
-1	Adolescent	Young Adult	Old Adult		
0	Child	Adolescent	Young Adult	Old Adult	
1		Child	Adolescent	Young Adult	Old Adult
2			Child	Adolescent	Young Adult
3				Child	Adolescent
4					Child

6.2 Budget Constraint of the Young Parent

$$c_y + x + \frac{s}{(1+r)} = h\varepsilon + b(\varepsilon)$$

- c_y consumption of the young parent
- x early investments in human capital of the child
- s savings (or loans) of the young parents
- h parental human capital
- ε idiosyncratic permanent shock with distribution F_ε
- $b(\varepsilon)$ bequests the young parents inherit conditional on ε

6.3 Budget Constraint of the Old Parent

$$c_o + z + \int q\left(\varepsilon' \middle| \varepsilon\right) b'\left(\varepsilon' \middle| \varepsilon\right) d\varepsilon' = h\varepsilon + s$$

- c_o consumption of the young parent
- z late investments in human capital of the child
- $q\left(\varepsilon' \middle| \varepsilon\right)$ price of an AD security
- $b'\left(\varepsilon' \middle| \varepsilon\right)$ amount of AD securities bought by parent for bequest

6.4 The Problem of the Parent:

$$V(h,b,\varepsilon) = \max \left\{ u(c_y) + \beta u(c_o) + \beta^2 \theta E\left[V(h',b',\varepsilon') \middle| \varepsilon \right] \right\}$$

subject to:

$$c_y + x + \frac{s}{(1+r)} = h\varepsilon + b(\varepsilon)$$

$$c_o + z + \int q(\varepsilon' | \varepsilon)\, b'(\varepsilon' | \varepsilon)\, d\varepsilon' = h\varepsilon + s$$

$$h' = \left[\gamma x^{\phi} + (1-\gamma) z^{\phi} \right]^{\frac{\rho}{\phi}}$$

6.5 Firms

Two inputs in the production function of goods Y:

- K physical capital
- L labor, measured in efficiency units.

The aggregate production function F is a CRS technology:

$$Y = F(\mathbf{K}, \mathbf{L})$$

The problem of the firm in the goods production sector is:

$$\pi_Y = \max \{F(\mathbf{K}, \mathbf{L}) - w\mathbf{L} - (r + \delta)\mathbf{K}\}$$

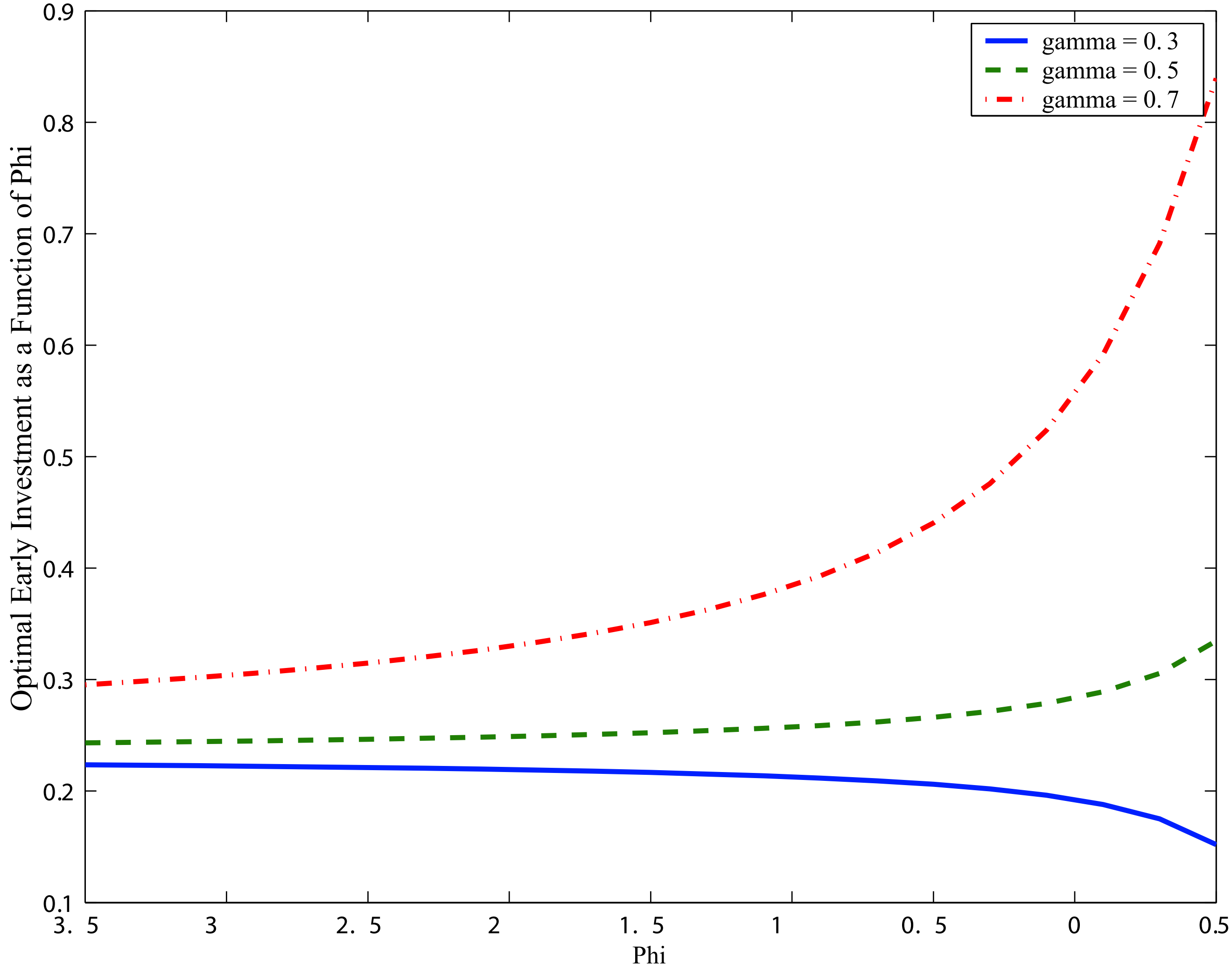
6.6 Feasibility

$$\mathbf{C}^{y}+\mathbf{C}^{o}+\mathbf{I}+\mathbf{X}+\mathbf{Z}=\mathbf{Y}$$

$$\mathbf{B}+\mathbf{S}=\mathbf{K}$$

$$\mathbf{K}'=\mathbf{I}+(1-\delta)\,\mathbf{K}$$

Figure 20
The Optimal Profile of Early Investment as a Function of Phi
for Different Values of Gamma



The figure above is produced in the following way. First we solve the agent's problem:

$$V(h, b, \varepsilon) = \max \{u(c_y) + \beta u(c_o) + \beta^2 \theta E[V(h', b', \varepsilon')|\varepsilon\}$$

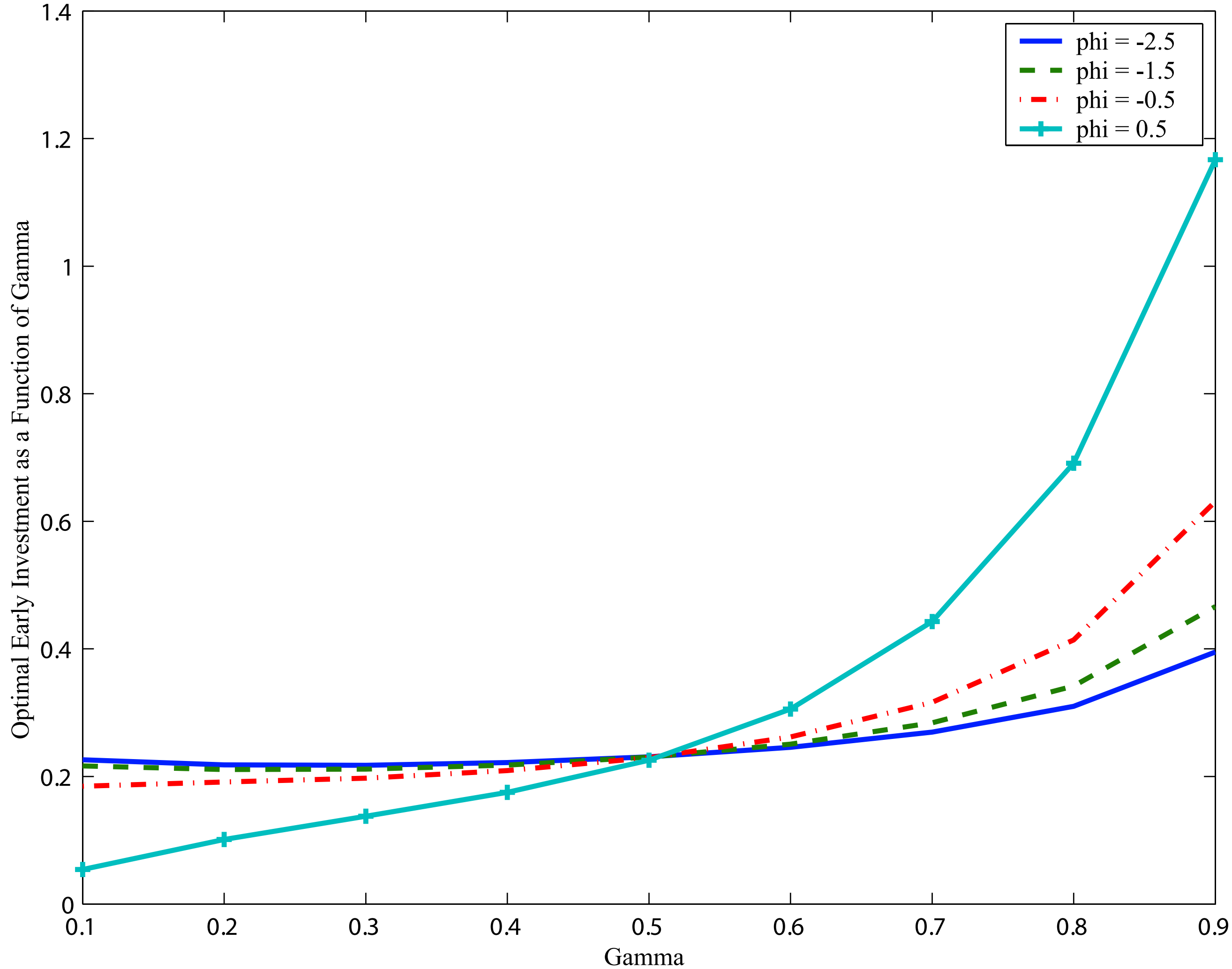
$$\text{subject to:} \quad c_y + x + s/(1+r) = h + b$$

$$c_o + z + b' = h + s$$

$$h' = [\gamma x^{\phi} + (1-\gamma) z^{\phi}]^{\rho/\phi}$$

The solution to the problem is a policy function $x(\phi, \gamma, h, b)$. Here, we plot $x(\phi, \gamma, h^*, b^*)$ against ϕ for three different values of γ, where h^* and b^* are the steady state stocks of human capital and bequests.

Figure 21
The Optimal Profile of Early Investment as a Function of Gamma
for Different Values of Phi



The figure above is produced in the following way. First we solve the agent's problem:

$$V(h, b, \varepsilon) = \max \{u(c_y) + \beta u(c_o) + \beta^2 \theta E[V(h', b', \varepsilon')|\varepsilon\}$$

$$\text{subject to:} \quad c_y + x + s/(1+r) = h + b$$

$$c_o + z + b' = h + s$$

$$h' = [\gamma x^\phi + (1-\gamma) z^\phi]^{\rho/\phi}$$

The solution to the problem is a policy function $x(\phi, \gamma, h, b)$. Here, we plot $x(\phi, \gamma, h^*, b^*)$ against γ for three different values of ϕ, where h^* and b^* are the steady state stocks of human capital and bequests.

7 Identification of the Technology

Let f denote the technology of skill formation.

We want to estimate the following model:

$$h = D\left(f\left(X, Z\right), \varepsilon\right)$$

The random term ε has distribution F_{ε} and is independent of X, Z.

X, Z have continuous density $f_{X,Z}$.

Assumption 1: The function f is strictly increasing and homogenous of degree ρ.

Assumption 2: There exists (x^*, z^*) and $\alpha \in \mathbb{R}_+$ such that $f(x^*) = \alpha$.

Assumption 3: The function D is continuous and strictly increasing in both arguments.

Assumption 4: The distribution of the error term ε, F_ε, is strictly increasing.

Assumption 5: There exists $(x_0, z_0) \in \mathbf{X}$ such that

$$D\left(f\left(x_0, z_0\right), \varepsilon\right) = \varepsilon.$$

Proposition 1 *Assume assumptions 1-5 hold and that f is homogenous of degree ρ. Then, f and F_ε are nonparametrically identified (Matzkin, 2003).*

Example The Parametric Case:

$$h = f(x, z) = \left[\gamma x^{\phi} + (1-\gamma) z^{\phi}\right]^{\frac{\rho}{\phi}}.$$

Note that for this choice f is homogenous of degree ρ.

Note that if $x^* = z^* = 1$ it follows that $f(1,1) = 1$.

Also, $D(f(x,z), \varepsilon) = f(x,z)\,\varepsilon_s$.

Assumption 5 is satisfied using $x_0 = z_0 = 1$.

8 Some Results on Parametric Estimation

Assume that

$$h_{i,t}^{k} = e^{\alpha}\left[\gamma\left(h_{i,t-1}^{k}\right)^{\phi} + (1-\gamma)\, x_{it}^{\phi}\right]^{\frac{\rho}{\phi}} e^{\varepsilon_{it}^{k}}$$

where $h_{i,t}^{k}$ is some measure of scores of child $i, i = 1, ..., N$, at age t, $t = 6, ..., 14$, in test k, $k =$ math, reading comprehension, reading recognition.

$x_{i,t}$ is the cognitive section of the HOME-SF score of Children of NLSY/1979.

Taking logs:

$$\log h_{i,t}^{k} = \alpha + \frac{\rho}{\phi} \log \left[\gamma \left(h_{i,t-1}^{k} \right)^{\phi} + (1-\gamma)\, x_{it}^{\phi} \right] + \varepsilon_{i,t}^{k}$$

Table 14
Maximum Likelihood Estimation of the Technology of Skill Formation
White Males, Children of the NLSY

Parameter	Maximum Likelihood Estimator Normal[1]	Likelihood Estimator Mixture of Normals[2]	Maximum Likelihood Fixed Effects Normal[3]	Maximum Likelihood Fixed Effect Mixture of Normals[4]	Maximum Likelihood Estimator Normal[5]
ψ	0.7390	0.7198	0.4599	0.4215	0.7012
	0.0639	0.0666	0.0265	0.0277	0.0158
ν	0.8218	0.8001	0.6048	0.6566	0.8649
	0.0271	0.0322	0.0037	0.0023	0.0219
λ	-0.5453	-0.4683	-1.3156	-1.6636	-0.4108
	0.0767	0.0727	0.0071	0.0040	0.1209

9 The Aiygari/Laitner Economy

$$V(h,b,\varepsilon) = \max\left\{u(c_y) + \beta u(c_o) + \beta^2 \theta E\left[V(h',b',\varepsilon')|\,\varepsilon\right]\right\}$$

subject to:

$$c_y + x + \frac{s}{(1+r)} = h\varepsilon + b$$

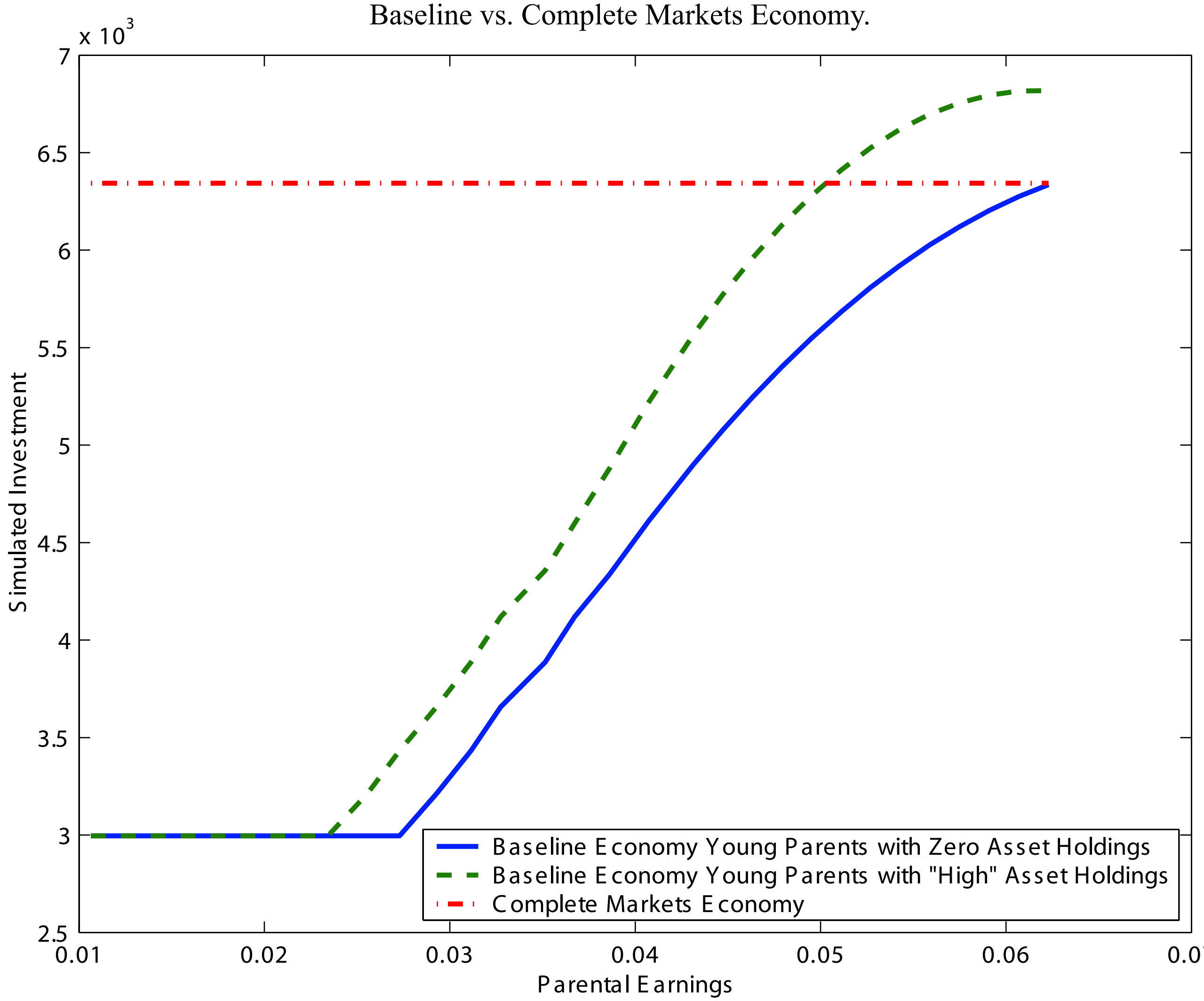
$$s \geq -\frac{h\varepsilon_{\min}}{(1+r)}$$

$$c_o + z + \frac{b'}{1+r} = h\varepsilon + s$$

$$h' = \left[\gamma x^{\phi} + (1-\gamma) z^{\phi}\right]^{\frac{\rho}{\phi}}$$

$$b' \geq 0$$

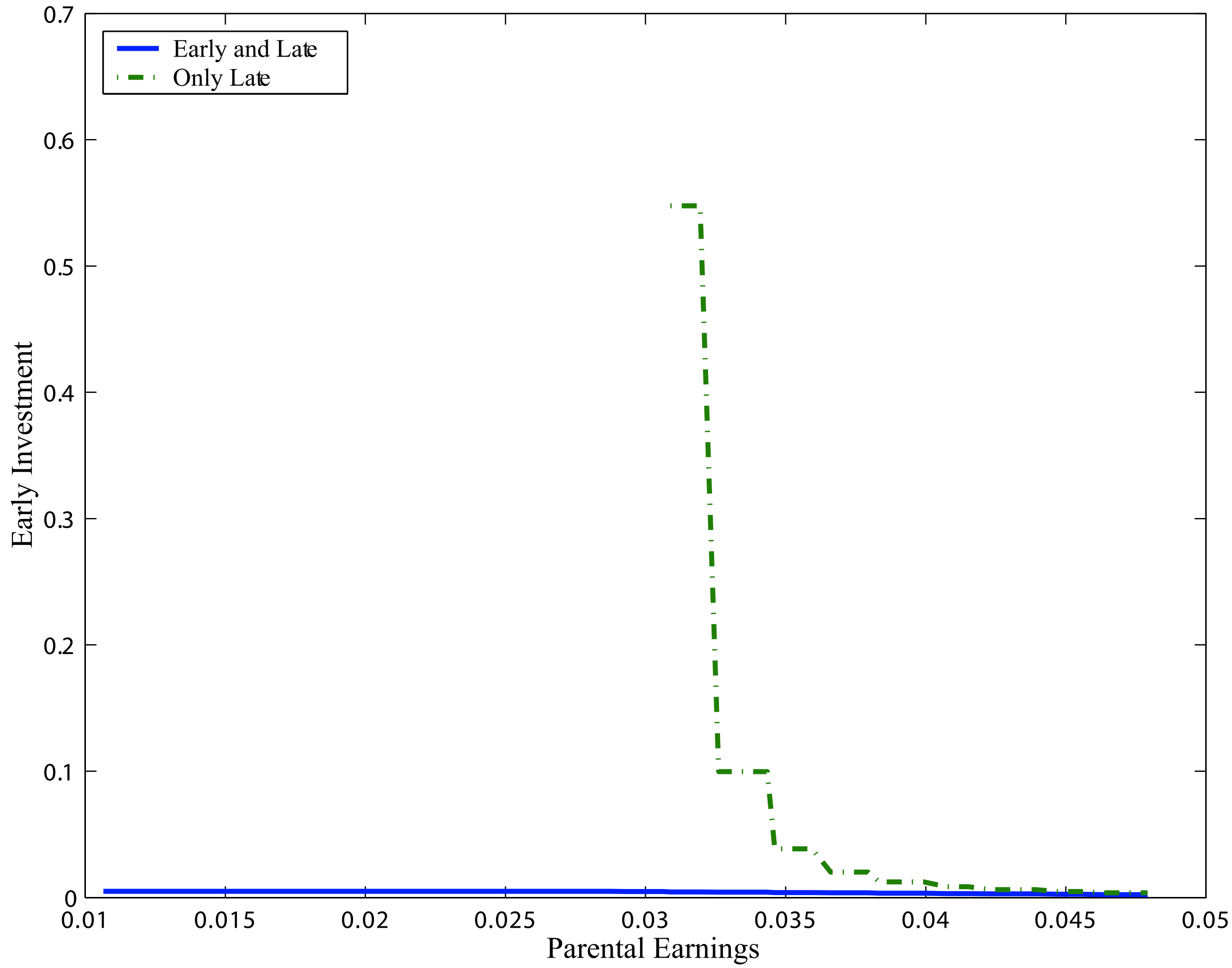
Figure 22
The Policy Function for Early Investment
Baseline vs. Complete Markets Economy.



By baseline economy we mean an Aiyagari/Laitner type of economy in which parents are subject to uninsurable idiosyncratic shocks in income, and are unable to borrow against their children's future earnings to finance investments in human capital. By Complete Markets Economy we mean an economy with Arrow-Debreu securities that is sufficiently rich to provide full insurance.
In this graph we plot the policy function of early investment in a complete markets economy (the flat curve) against those generated by the baseline economy. Note that in the baseline economy, the optimal early investment is a function of parental earnings and parental asset holdings as well. Therefore, for the baseline economy, we show the early investment policy function for parents that have zero asset holdings and for parents that have "high" asset holdings. By "high" asset holdings we mean the expected value of the asset holdings stationary distribution in a complete markets economy.

Figure 23

The Costs of Remediation
Late vs. Early and Late Remediation
Agents that Receive Zero Bequests



Let y denote parental earnings. Let x*, z* denote the early and late investments in the complete markets economy. Let x(y), z(y) denote the early and late investments in the Aiyagari/Laitner economy for agents with zero bequests. The early and late remediation are values $\Delta x(y)$ and $\Delta z(y)$ where $\Delta x(y) = x^* - x(y)$, and $\Delta z(y) = z^* - z(y)$. The cost of the early remediation is $C_1 = \Delta x(y) + \Delta z(y)/(1+r)$, where r is the steady state equilibrium interest rate of the Aiyagari/Laitner economy. Let h* denote the steady state stock of human capital in the complete markets economy. The late remediation is the value δ that solves $g(\delta) = h^* - (\gamma x(y)^{\phi} + (1-\gamma)*\delta^{\phi})$. The cost of the late remediation is $C_2 = \delta/(1+r)$.

Summary

1a - Holding the elasticity of substitution fixed, the greater the self-productivity parameter, the less effective policies that focus on late investments are because late investments have weak impact in producing human capital.

1b - Holding the self-productivity parameter fixed, the lower the elasticity of substitution, the less effective late interventions are because it takes a lot of late intervention to make up for the low initial investment.

2 - Now, we put them together. If there is little substitution, late policies are expensive because it is costly to remediate. If there is a lot of substitution, then the self-productivity parameter matters a lot. The higher γ, the more expensive it is to make up for low investments.

3 - When parents are subject to lifetime liquidity constraints, they will cut back on investments on the children's human capital along the whole path of investments. Deficiencies in human capital formation accumulate as a consequence of the dynamics. If policy is directed toward the financing of late investments, it is certainly inefficient and may not attain the goal of correcting the existing market failure.

4 - The policy implication: investments should be directed toward the young and able.

Appendix: The Importance of Parental Resources

Table A1
OLS Full Sample
Test Scores Against Per Capita Permanent Income of Family from ages 0-18 of the Child

	Standardized PIAT Reading Recognition Score at Age 6	Standardized PIAT Reading Recognition Score at Age 7	Standardized PIAT Reading Recognition Score at Age 8	Standardized PIAT Reading Recognition Score at Age 9	Standardized PIAT Reading Recognition Score at Age 10	Standardized PIAT Reading Recognition Score at Age 11	Standardized PIAT Reading Recognition Score at Age 12	Standardized PIAT Reading Recognition Score at Age 13	Standardized PIAT Reading Recognition Score at Age 14
Mother Completed High School	0.2630	0.1390	0.1840	0.3060	0.1290	0.2930	0.0700	0.3450	0.1800
	(3.65)**	(2.02)*	(2.53)*	(4.19)**	(1.6900)	(3.77)**	(0.9000)	(4.08)**	(2.14)*
Mother Completed Some College	0.3120	0.2950	0.2920	0.3920	0.3450	0.4970	0.3200	0.4470	0.4330
	(4.31)**	(3.67)**	(3.72)**	(4.88)**	(4.32)**	(5.85)**	(3.89)**	(4.88)**	(4.91)**
Mother Completed College or More	0.5170	0.5010	0.4250	0.6110	0.3530	0.6510	0.3190	0.6530	0.3790
	(5.09)**	(4.25)**	(3.52)**	(5.64)**	(3.11)**	(5.79)**	(2.84)**	(5.35)**	(3.27)**
Residualized Mother's AFQT Score****	0.1060	0.1520	0.1860	0.1960	0.1880	0.2190	0.2050	0.2070	0.2160
	(3.15)**	(4.83)**	(5.96)**	(6.41)**	(5.98)**	(7.17)**	(6.32)**	(6.37)**	(6.62)**
Child is Black	0.1220	-0.0260	-0.0880	-0.1900	-0.2170	-0.2610	-0.2190	-0.3000	-0.2820
	(1.7600)	(0.3800)	(1.2800)	(2.75)**	(3.10)**	(3.78)**	(2.91)**	(4.02)**	(3.66)**
Child is Hispanic	-0.2570	-0.0540	-0.2390	-0.1760	-0.3270	-0.2170	-0.2220	-0.0840	-0.1510
	(3.78)**	(0.7100)	(3.47)**	(2.53)*	(4.94)**	(3.03)**	(3.11)**	(1.0900)	(2.01)*
Child is Female	0.0400	0.0750	0.1540	0.2230	0.1300	0.1000	0.1410	0.1590	0.1750
	(0.7600)	(1.3500)	(2.88)**	(4.29)**	(2.41)*	(1.9200)	(2.51)*	(2.86)**	(3.01)**
Mother's Age At Child's Birth	-0.0370	-0.0260	-0.0340	-0.0080	-0.0150	-0.0110	-0.0190	0.0050	-0.0300
	(3.36)**	(2.38)*	(2.90)**	(0.6800)	(1.2200)	(0.9700)	(1.5400)	(0.4200)	(2.26)*
Teen Mother	-0.2460	-0.2020	-0.3100	-0.2020	-0.1470	-0.1830	-0.1850	-0.0520	-0.2470
	(3.29)**	(2.56)*	(3.91)**	(2.82)**	(1.9000)	(2.52)*	(2.18)*	(0.6600)	(3.01)**
Permanent Income ages 0 - 18 of the child***	0.0080	0.0100	0.0070	0.0080	0.0110	0.0080	0.0130	0.0070	0.0130
	(2.55)*	(2.33)*	(1.9000)	(3.12)**	(3.44)**	(1.9200)	(3.34)**	(2.18)*	(3.65)**
Constant	0.5760	0.3680	0.6470	-0.1010	0.1550	0.1180	0.3120	-0.3650	0.5530
	(2.00)*	(1.2900)	(2.15)*	(0.3600)	(0.5000)	(0.4100)	(0.9700)	(1.1700)	(1.6700)
Observations	1090	1147	1113	1184	1114	1191	1040	1079	946
R-squared	0.1000	0.0900	0.1300	0.1700	0.1600	0.2000	0.1700	0.1800	0.2000

Robust t statistics in parentheses
* significant at 5%; ** significant at 1%

*** Per Capita Net Family Income (in thousands of dollars) from ages 0-18 of the child is calculated as follows. First, we obtain the total net family income and family size from NLSY. We then deflate the reportedincome values using the CPI with 2000 as the base year. Next, we divide the deflated dollar figures by the number of people in the family. Therefore, for each year of the survey we have the per capita deflated total net income of the family. Using the year of birth of the child, we transform it into per capita total net family income by age of the child. We then compute the average earnings over the period 0 to 18 (not considering missing values). We discard families that have income missing for more than 10 periods. Using the average per capita income, we calculate the present value of per capita income, and therefore, the constant stream of income that has the same present value. This constant flow of per capita income is our measure of per capita permanent income. For other ages, the calculation proceeds similarly.

****Residualized Mother's AFQT score is calculated in the following manner. First, we obtain the raw AFQT score from NLSY survey. Second, we standardize the raw AFQT score. Then, we regress the standardize raw AFQT scores against a constant, a dummy for south residence at age 14, a dummy for urban residence at age 14, a dummy for broken home, number of siblings, mother's mother and mother's father highest grade completed, family income in 1979, the age of the mother at test date in 1980 and the mother's schooling at test date. We then obtain the residual of this regression. The standardized residual is our measure of Residualized Mother's AFQT Test Score.

Table A2
OLS Full Sample
Test Scores Against Per Capita Permanent Income of Family from ages 0-18 of the Child

	Standardized PIAT Reading Comprehension Score at Age 6	Standardized PIAT Reading Comprehension Score at Age 7	Standardized PIAT Reading Comprehension Score at Age 8	Standardized PIAT Reading Comprehension Score at Age 9	Standardized PIAT Reading Comprehension Score at Age 10	Standardized PIAT Reading Comprehension Score at Age 11	Standardized PIAT Reading Comprehension Score at Age 12	Standardized PIAT Reading Comprehension Score at Age 13	Standardized PIAT Reading Comprehension Score at Age 14
Mother Completed High School	0.2050	0.1620	0.1640	0.3640	0.2130	0.3670	0.1190	0.2600	0.1210
	(2.59)**	(2.20)*	(1.98)*	(4.59)**	(2.65)**	(4.78)**	(1.4800)	(3.60)**	(1.5400)
Mother Completed Some College	0.2650	0.3330	0.3060	0.4800	0.3220	0.5540	0.3580	0.3900	0.4370
	(3.23)**	(3.97)**	(3.48)**	(5.57)**	(3.84)**	(6.72)**	(4.41)**	(4.86)**	(5.06)**
Mother Completed College or More	0.4710	0.4370	0.3220	0.6700	0.4680	0.7510	0.4240	0.7810	0.5210
	(4.40)**	(3.66)**	(2.66)**	(5.76)**	(3.80)**	(6.87)**	(3.75)**	(6.50)**	(4.51)**
Residualized Mother's AFQT Score****	0.1160	0.1530	0.1880	0.1720	0.1820	0.2040	0.2200	0.1830	0.2270
	(2.88)**	(4.60)**	(5.77)**	(5.32)**	(5.72)**	(6.42)**	(6.87)**	(5.81)**	(7.23)**
Child is Black	0.2010	0.0320	-0.1140	-0.3170	-0.2310	-0.2620	-0.3300	-0.4700	-0.4580
	(2.55)*	(0.4300)	(1.5300)	(4.34)**	(3.24)**	(3.83)**	(4.47)**	(6.50)**	(6.06)**
Child is Hispanic	-0.2200	-0.0290	-0.2140	-0.2160	-0.2850	-0.1670	-0.1870	-0.2310	-0.2380
	(2.97)**	(0.3500)	(2.69)**	(2.86)**	(3.98)**	(2.32)*	(2.62)**	(3.14)**	(3.28)**
Child is Female	0.0750	0.0950	0.2000	0.1940	0.0890	-0.0300	0.0660	0.0510	0.1410
	(1.3300)	(1.6200)	(3.38)**	(3.57)**	(1.6000)	(0.5800)	(1.1900)	(0.9500)	(2.45)*
Mother's Age At Child's Birth	-0.0410	-0.0360	-0.0240	-0.0180	-0.0280	-0.0030	-0.0250	-0.0050	-0.0120
	(3.27)**	(2.93)**	(1.7900)	(1.5400)	(2.26)*	(0.2300)	(2.06)*	(0.4500)	(0.9200)
Teen Mother	-0.2600	-0.2210	-0.2370	-0.1950	-0.1240	-0.1130	-0.1490	-0.0830	-0.2130
	(3.18)**	(2.78)**	(2.71)**	(2.71)**	(1.5600)	(1.5500)	(1.8000)	(1.0400)	(2.49)*
Permanent Income ages 0 - 18 of the child***	0.0070	0.0130	0.0040	0.0090	0.0110	0.0090	0.0110	0.0030	0.0070
	(2.09)*	(3.46)**	(1.1800)	(2.52)*	(3.34)**	(2.08)*	(2.61)**	(1.0800)	(2.10)*
Constant	0.6720	0.5100	0.4050	0.1700	0.4490	-0.1260	0.4840	0.0900	0.2840
	(2.08)*	(1.6700)	(1.1900)	(0.5800)	(1.4300)	(0.4300)	(1.5300)	(0.3000)	(0.8400)
Observations	1025	1061	1058	1164	1104	1174	1032	1073	940
R-squared	0.0900	0.0900	0.1000	0.1800	0.1400	0.2000	0.1800	0.2000	0.2400

Robust t statistics in parentheses
* significant at 5%; ** significant at 1%

*** Per Capita Net Family Income (in thousands of dollars) from ages 0-18 of the child is calculated as follows. First, we obtain the total net family income and family size from NLSY. We then deflate the reportedincome values using the CPI with 2000 as the base year. Next, we divide the deflated dollar figures by the number of people in the family. Therefore, for each year of the survey we have the per capita deflated total net income of the family. Using the year of birth of the child, we transform it into per capita total net family income by age of the child. We then compute the average earnings over the period 0 to 18 (not considering missing values). We discard families that have income missing for more than 10 periods. Using the average per capita income, we calculate the present value of per capita income, and therefore, the constant stream of income that has the same present value. This constant flow of per capita income is our measure of per capita permanent income. For other ages, the calculation proceeds similarly.

****Residualized Mother's AFQT score is calculated in the following manner. First, we obtain the raw AFQT score from NLSY survey. Second, we standardize the raw AFQT score. Then, we regress the standardize raw AFQT scores against a constant, a dummy for south residence at age 14, a dummy for urban residence at age 14, a dummy for broken home, number of siblings, mother's mother and mother's father highest grade completed, family income in 1979, the age of the mother at test date in 1980 and the mother's schooling at test date. We then obtain the residual of this regression. The standardized residual is our measure of Residualized Mother's AFQT Test Score.

Table A3
OLS Full Sample
Test Scores Against Per Capita Permanent Income of Family from ages 0-18 of the Child

	Standardized PIAT Math Score at Age 6	Standardized PIAT Math Score at Age 7	Standardized PIAT Math Score at Age 8	Standardized PIAT Math Score at Age 9	Standardized PIAT Math Score at Age 10	Standardized PIAT Math Score at Age 11	Standardized PIAT Math Score at Age 12	Standardized PIAT Math Score at Age 13	Standardized PIAT Math Score at Age 14
Mother Completed High School	0.1390	0.2310	0.1300	0.2790	0.0740	0.2680	0.0880	0.1510	0.2070
	(1.9000)	(3.39)**	(1.6500)	(3.64)**	(0.9800)	(3.54)**	(1.1900)	(2.03)*	(2.67)**
Mother Completed Some College	0.1970	0.4330	0.2610	0.3320	0.2430	0.4560	0.2140	0.2330	0.3920
	(2.45)*	(5.52)**	(3.05)**	(3.87)**	(3.01)**	(5.41)**	(2.60)**	(2.81)**	(4.47)**
Mother Completed College or More	0.2970	0.6600	0.4270	0.6200	0.3090	0.5800	0.3830	0.4010	0.3860
	(2.61)**	(6.07)**	(3.66)**	(5.82)**	(2.86)**	(5.13)**	(3.04)**	(3.20)**	(3.25)**
Residualized Mother's AFQT Score****	0.1110	0.0820	0.1620	0.1520	0.1620	0.1520	0.1870	0.2070	0.2120
	(3.47)**	(2.62)**	(5.44)**	(5.01)**	(4.98)**	(4.80)**	(5.50)**	(6.42)**	(6.34)**
Child is Black	-0.1970	-0.2750	-0.3600	-0.3830	-0.2610	-0.3830	-0.2930	-0.4040	-0.3820
	(2.89)**	(3.86)**	(5.17)**	(5.39)**	(3.77)**	(5.54)**	(3.90)**	(5.38)**	(5.15)**
Child is Hispanic	-0.2970	-0.2310	-0.3200	-0.2760	-0.2950	-0.3960	-0.2700	-0.3840	-0.2910
	(4.63)**	(3.23)**	(4.40)**	(3.92)**	(4.40)**	(5.68)**	(3.76)**	(5.08)**	(3.82)**
Child is Female	-0.0390	0.0690	-0.0520	-0.0270	-0.0890	-0.1400	-0.0500	-0.1390	-0.0320
	(0.7300)	(1.3000)	(0.9600)	(0.5200)	(1.6300)	(2.77)**	(0.8800)	(2.46)*	(0.5400)
Mother's Age At Child's Birth	-0.0060	-0.0030	-0.0050	0.0160	0.0150	0.0120	0.0050	0.0260	0.0090
	(0.5100)	(0.3000)	(0.4100)	(1.3400)	(1.1900)	(1.0100)	(0.3600)	(2.09)*	(0.6600)
Teen Mother	-0.1150	-0.1740	-0.1660	-0.0350	0.0130	-0.0560	-0.0470	0.0050	-0.1490
	(1.4300)	(2.36)*	(2.02)*	(0.4900)	(0.1600)	(0.7700)	(0.5400)	(0.0700)	(1.6700)
Permanent Income ages 0 - 18 of the child***	0.0100	0.0060	0.0060	0.0100	0.0110	0.0090	0.0110	0.0070	0.0100
	(3.13)**	(1.8600)	(2.19)*	(3.00)**	(3.68)**	(3.54)**	(2.87)**	(2.88)**	(2.85)**
Constant	0.0410	-0.0950	0.1950	-0.5040	-0.4100	-0.2650	-0.0760	-0.4450	-0.1580
	(0.1400)	(0.3400)	(0.6100)	(1.7500)	(1.3100)	(0.9300)	(0.2300)	(1.4400)	(0.4600)
Observations	1121	1152	1116	1190	1116	1195	1039	1080	946
R-squared	0.1000	0.1300	0.1400	0.1800	0.1300	0.2000	0.1600	0.1900	0.2100

Robust t statistics in parentheses
* significant at 5%; ** significant at 1%

*** Per Capita Net Family Income (in thousands of dollars) from ages 0-18 of the child is calculated as follows. First, we obtain the total net family income and family size from NLSY. We then deflate the reportedincome values using the CPI with 2000 as the base year. Next, we divide the deflated dollar figures by the number of people in the family. Therefore, for each year of the survey we have the per capita deflated total net income of the family. Using the year of birth of the child, we transform it into per capita total net family income by age of the child. We then compute the average earnings over the period 0 to 18 (not considering missing values). We discard families that have income missing for more than 10 periods. Using the average per capita income, we calculate the present value of per capita income, and therefore, the constant stream of income that has the same present value. This constant flow of per capita income is our measure of per capita permanent income. For other ages, the calculation proceeds similarly.

****Residualized Mother's AFQT score is calculated in the following manner. First, we obtain the raw AFQT score from NLSY survey. Second, we standardize the raw AFQT score. Then, we regress the standardize raw AFQT scores against a constant, a dummy for south residence at age 14, a dummy for urban residence at age 14, a dummy for broken home, number of siblings, mother's mother and mother's father highest grade completed, family income in 1979, the age of the mother at test date in 1980 and the mother's schooling at test date. We then obtain the residual of this regression. The standardized residual is our measure of Residualized Mother's AFQT Test Score.

Table A4
Seemingly Unrelated Regressions: The Timing of Income
The Children of NLSY

	Standardized Math Score Age 9	Standardized Math Score Age 11	Standardized Math Score Age 13	Standardized Reading Comprehension Age 9	Standardized Reading Comprehension Age 11	Standardized Reading Comprehension Age 13	Standardized Reading Recognition Age 9	Standardized Reading Recognition Age 11	Standardized Reading Recognition Age 13
Mother Completed High School	0.3220	0.2700	0.3050	0.2170	0.3170	0.4090	0.1300	0.2630	0.3370
	(3.16)**	(2.79)**	(3.27)**	(2.05)*	(3.10)**	(4.22)**	(1.2100)	(2.76)**	(3.52)**
Mother Completed Some College	0.5650	0.4020	0.5580	0.4120	0.5310	0.6210	0.2960	0.4220	0.5680
	(5.22)**	(3.89)**	(5.60)**	(3.66)**	(4.88)**	(6.01)**	(2.58)**	(4.15)**	(5.57)**
Mother Completed College or More	0.7990	0.6650	0.7800	0.5990	0.6870	0.7990	0.5600	0.6160	0.7860
	(5.78)**	(5.04)**	(6.12)**	(4.15)**	(4.94)**	(6.06)**	(3.82)**	(4.75)**	(6.03)**
Residualized Mother's AFQT Score****	0.1100	0.1510	0.1510	0.1920	0.1820	0.1950	0.2020	0.2210	0.1970
	(2.74)**	(3.94)**	(4.06)**	(4.56)**	(4.48)**	(5.08)**	(4.74)**	(5.85)**	(5.19)**
black	-0.1760	-0.2810	-0.2950	0.1450	-0.2190	-0.1430	0.0460	-0.0490	-0.1770
	(2.00)*	(3.35)**	(3.64)**	(1.5800)	(2.48)*	(1.7100)	(0.4900)	(0.5900)	(2.13)*
hisp	-0.2990	-0.3420	-0.3710	-0.0480	-0.2180	-0.1130	-0.1100	-0.1400	-0.1140
	(3.30)**	(3.95)**	(4.45)**	(0.5100)	(2.39)*	(1.3000)	(1.1400)	(1.6500)	(1.3300)
female	0.0870	-0.0460	-0.1570	0.1230	0.1640	-0.0640	0.1220	0.1930	0.0820
	(1.2800)	(0.7200)	(2.54)*	(1.7500)	(2.43)*	(1.0000)	(1.7100)	(3.05)**	(1.2800)
Mother's Age At Child's Birth	0.0010	0.0030	0.0040	-0.0380	-0.0480	-0.0070	-0.0300	-0.0270	-0.0330
	(0.0800)	(0.2200)	(0.3000)	(2.44)*	(3.22)**	(0.5000)	(1.9100)	(1.9100)	(2.34)*
Teen Mother	-0.2060	-0.1540	-0.0570	-0.3090	-0.3610	-0.1470	-0.2510	-0.3070	-0.2460
	(2.25)*	(1.7600)	(0.6700)	(3.25)**	(3.93)**	(1.6900)	(2.59)**	(3.58)**	(2.86)**
Permanent Income ages 0 - 18 of the child***	**0.0150**	0.0120	-0.0090	**0.0220**	**0.0170**	0.0100	**0.0190**	**0.0150**	0.0040
	(2.40)*	(1.5200)	(0.9100)	(3.50)**	(2.07)*	(0.9500)	(3.19)**	(2.18)*	(0.4200)
Permanent Income ages 0 - 6 of the child***	-0.0050			-0.0080			-0.0060		
	(0.8500)			(1.4300)			(1.0200)		
Permanent Income ages 0 - 8 of the child***		-0.0010			-0.0050			-0.0050	
		(0.1700)			(0.6900)			(0.7300)	
Permanent Income ages 0 - 10 of the child***			0.0170			0.0010			0.0060
			(1.7600)			(0.0900)			(0.6100)
Constant	-0.2800	-0.1180	-0.1320	0.5380	0.9420	-0.0750	0.4570	0.3720	0.5630
	(0.7500)	(0.3300)	(0.3900)	(1.3900)	(2.52)*	(0.2100)	(1.1600)	(1.0700)	(1.6100)
Observations	734	734	734	734	734	734	734	734	734

Absolute value of z statistics in parentheses: * significant at 5%; ** significant at 1%

*** Per Capita Net Family Income (in thousands of dollars) from ages 0-18 of the child is calculated as follows. First, we obtain the total net family income and family size from NLSY. We then deflate the reportedincome values using the CPI with 2000 as the base year. Next, we divide the deflated dollar figures by the number of people in the family. Therefore, for each year of the survey we have the per capita deflated total net income of the family. Using the year of birth of the child, we transform it into per capita total net family income by age of the child. We then compute the average earnings over the period 0 to 18 (not considering missing values). We discard families that have income missing for more than 10 periods. Using the average per capita income, we calculate the present value of per capita income, and therefore, the constant stream of income that has the same present value. This constant flow of per capita income is our measure of per capita permanent income. For other ages, the calculation proceeds similarly.

****Residualized Mother's AFQT score is calculated in the following manner. First, we obtain the raw AFQT score from NLSY survey. Second, we standardize the raw AFQT score. Then, we regress the standardize raw AFQT scores against a constant, a dummy for south residence at age 14, a dummy for urban residence at age 14, a dummy for broken home, number of siblings, mother's mother and mother's father highest grade completed, family income in 1979, the age of the mother at test date in 1980 and the mother's schooling at test date. We then obtain the residual of this regression. The standardized residual is our measure of Residualized Mother's AFQT Test Score.

Table A5
Timing of Per Capita Permanent Income
Dependent Variable: College = 1, High School = 0

Variable Name	Probit 1	Probit 2	Probit 3	Probit 4	Probit 5	Probit 6	Probit 7
Per Capita Permanent Income 0-18	**1.3141**	**1.0899**	**1.5549**	**1.4008**	**1.4748**	1.1329	**1.5243**
t-statistic	5.2100	2.9900	3.2900	2.9600	4.6100	1.7000	3.6000
Per Capita Permanent Income 0-5		0.5595					
t-statistic		0.8400					
Per Capita Permanent Income 6-10			-0.8128				
t-statistic			-0.6100				
Per Capita Permanent Income 11-15				-0.4154			
t-statistic				-0.2200			
Per Capita Permanent Income 16-18					-1.6531		
t-statistic					-0.7400		
Per Capita Permanent Income 0 - 11						0.2373	
t-statistic						0.2900	
Per Capita Permanent Income 12 - 18							-0.5944
t-statistic							-0.6100
Mother's Schooling	**0.1318**	**0.1330**	**0.1295**	**0.1321**	**0.1393**	**0.1329**	**0.1346**
t-statistic	3.0300	3.0500	2.9800	3.0300	3.1700	3.0500	3.0800
Child Ability (Math at age 12)	**0.0291**	**0.0292**	**0.0290**	**0.0291**	**0.0288**	**0.0291**	**0.0291**
t-statistic	3.9400	3.9700	3.9200	3.9400	3.8800	3.9500	3.9500
Mother's AFQT	-0.0260	-0.0286	-0.0247	-0.0267	-0.0269	-0.0271	-0.0279
t-statistic	-0.4400	-0.4900	-0.4200	-0.4500	-0.4500	-0.4600	-0.4700
Constant	-0.4394	-0.4617	-0.4331	-0.4412	-0.4671	-0.4443	-0.4453
t-statistic	-1.4500	-1.5100	-1.4300	-1.4500	-1.5400	-1.4600	-1.4700
Observations	668	668	668	668	668	668	668

Per capita permanent income between child's age s and t is constructed in the following way. For each age x of the child, I get household earnings and divide by the number of household members at age x, to compute the per capita household earnings at age x. Then, I calculate the mean earnings between ages s and t by simple average. Next, I discount per capital mean household eaernings at age x to dollars at age 0. I add the resulting values to compute the present value. This variable is the permanent income between ages s and t.

Dummies for year of birth, sex, race, urban and south birth are included as additional controls, but not reported here.

The sample consists of children of NLSY/1979 born between 1975 and 1981, for whom we observe all of the variables. In order to obtain household earnings, and parental background variables, I use the respondents of the NLSY/1979 sample.

Table A6
OLS Full Sample
Test Scores Against Per Capita Permanent Income of Family and Home Score

	Standardized PIAT Math Score at Age 6	Standardized PIAT Math Score at Age 7	Standardized PIAT Math Score at Age 8	Standardized PIAT Math Score at Age 9	Standardized PIAT Math Score at Age 10	Standardized PIAT Math Score at Age 11	Standardized PIAT Math Score at Age 12	Standardized PIAT Math Score at Age 13	Standardized PIAT Math Score at Age 14
Mother Completed High School	0.0820	0.2050	0.1020	0.2260	0.0190	0.2210	-0.0600	0.0890	0.1480
	(1.0200)	(2.73)**	(1.1900)	(2.73)**	(0.2200)	(2.83)**	(0.7800)	(1.1300)	(1.8100)
Mother Completed Some College	0.2130	0.3940	0.1840	0.2540	0.1970	0.4000	0.1260	0.1450	0.3580
	(2.31)*	(4.69)**	(1.99)*	(2.69)**	(2.16)*	(4.64)**	(1.5000)	(1.6000)	(3.81)**
Mother Completed College or More	0.2000	0.5850	0.2860	0.5650	0.2180	0.5170	0.3180	0.3080	0.3370
	(1.5700)	(5.08)**	(2.32)*	(5.01)**	(1.8400)	(4.36)**	(2.65)**	(2.20)*	(2.70)**
Residualized Mother's AFQT Score****	0.1080	0.1000	0.1720	0.1680	0.1500	0.1390	0.1870	0.1910	0.1810
	(3.06)**	(2.96)**	(5.47)**	(5.31)**	(4.22)**	(4.40)**	(5.16)**	(5.59)**	(5.16)**
black	-0.2730	-0.2250	-0.3830	-0.3000	-0.2860	-0.3140	-0.2590	-0.3690	-0.3510
	(3.57)**	(2.90)**	(5.20)**	(3.95)**	(3.78)**	(4.22)**	(3.41)**	(4.48)**	(4.49)**
hisp	-0.3050	-0.1960	-0.2350	-0.2300	-0.2750	-0.3400	-0.2600	-0.2590	-0.2150
	(4.11)**	(2.51)*	(2.95)**	(3.02)**	(3.90)**	(4.42)**	(3.38)**	(3.16)**	(2.59)**
female	-0.0260	0.0790	-0.0180	-0.0410	-0.1350	-0.1830	-0.1040	-0.1710	-0.0650
	(0.4200)	(1.3900)	(0.3000)	(0.7600)	(2.30)*	(3.42)**	(1.7500)	(2.80)**	(1.0400)
Teen Mother	-0.0840	-0.1700	-0.1540	-0.0960	-0.0360	-0.0830	-0.0760	-0.1070	-0.1690
	(1.1500)	(2.55)*	(2.15)*	(1.4900)	(0.5400)	(1.3500)	(1.1000)	(1.4900)	(2.28)*
Permanent Income ages 0 - 18 of the child***	**0.0090**	0.0010	0.0030	0.0060	**0.0070**	**0.0070**	0.0070	**0.0070**	**0.0080**
	(2.69)**	(0.3800)	(1.0400)	(1.8500)	(2.55)*	(3.32)**	(1.8800)	(2.69)**	(2.01)*
Standardized Cognitive Home Score	0.0390	0.1990	0.1400	0.1790	0.1210	0.1330	0.1150	0.1160	0.1270
	(1.1400)	(6.28)**	(4.29)**	(5.49)**	(3.66)**	(4.20)**	(3.29)**	(3.47)**	(3.66)**
Constant	-0.0320	-0.0550	0.1590	-0.0090	0.0820	0.0890	0.2210	0.2470	0.1160
	(0.3000)	(0.5700)	(1.4200)	(0.0900)	(0.7900)	(0.9800)	(2.08)*	(2.43)*	(1.0400)
Observations	843	975	903	1021	896	1036	870	935	827
R-squared	0.1100	0.1900	0.1900	0.2200	0.1600	0.2300	0.2000	0.1900	0.2200

Robust t statistics in parentheses
* significant at 5%; ** significant at 1%

*** Per Capita Net Family Income (in thousands of dollars) from ages 0-18 of the child is calculated as follows. First, we obtain the total net family income and family size from NLSY. We then deflate the reportedincome values using the CPI with 2000 as the base year. Next, we divide the deflated dollar figures by the number of people in the family. Therefore, for each year of the survey we have the per capita deflated total net income of the family. Using the year of birth of the child, we transform it into per capita total net family income by age of the child. We then compute the average earnings over the period 0 to 18 (not considering missing values). We discard families that have income missing for more than 10 periods. Using the average per capita income, we calculate the present value of per capita income, and therefore, the constant stream of income that has the same present value. This constant flow of per capita income is our measure of per capita permanent income. For other ages, the calculation proceeds similarly.

****Residualized Mother's AFQT score is calculated in the following manner. First, we obtain the raw AFQT score from NLSY survey. Second, we standardize the raw AFQT score. Then, we regress the standardize raw AFQT scores against a constant, a dummy for south residence at age 14, a dummy for urban residence at age 14, a dummy for broken home, number of siblings, mother's mother and mother's father highest grade completed, family income in 1979, the age of the mother at test date in 1980 and the mother's schooling at test date. We then obtain the residual of this regression. The standardized residual is our measure of Residualized Mother's AFQT Test Score.