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THE SUPPLY SIDE OF THE RACE BETWEEN DEMAND AND SUPPLY: POLICIES TO FOSTER SKILL IN THE MODERN ECONOMY**

BY

BY JAMES J. HECKMAN*

Summary

In his celebrated book on income inequality, Jan Tinbergen (1975) wrote about the race between demand and supply in determining the evolution of wages and inequality. The demand side of the recent labor market is well understood. Skill-biased technical change favors skilled workers in many different economic environments. The supply side is less well understood. In the Netherlands, until recently, the supply side was winning and the returns to education were declining or stagnant. The exact reasons for this phenomenon are not well understood. Recently, however, there is evidence that suggests that the returns to schooling are increasing and that demand is outstripping supply, as it has done in most developed countries around the world. This has produced rising wage inequality. Unless more active supply side measures are undertaken, this trend is likely to continue. This problem, joined with the persistent problem of immigrant assimilation and the growing role of immigrants in the Dutch economy, renews interest in the supply side of the labor market. This lecture examines the determinants of the supply of skills in the short run and the long run. It examines the roles of short- term credit constraints and long-term family factors in fostering or retarding skill accumulation. It summarizes the evidence on a number of policy proposals to foster skills including early childhood programs, programs to alleviate short-term financial pressure, job training and second chance programs, and tax policies. This lecture stresses the cumulative dynamic nature of skill production and the importance of recognizing that skill begets skill in designing suitable policies to reduce inequality and foster economic growth. While the evidence is based on American data, the lessons are relevant for economies around the world. Specific lessons for the Netherlands are emphasized.

Key words: human capital, returns to schooling, wage inequality, tuition policy.

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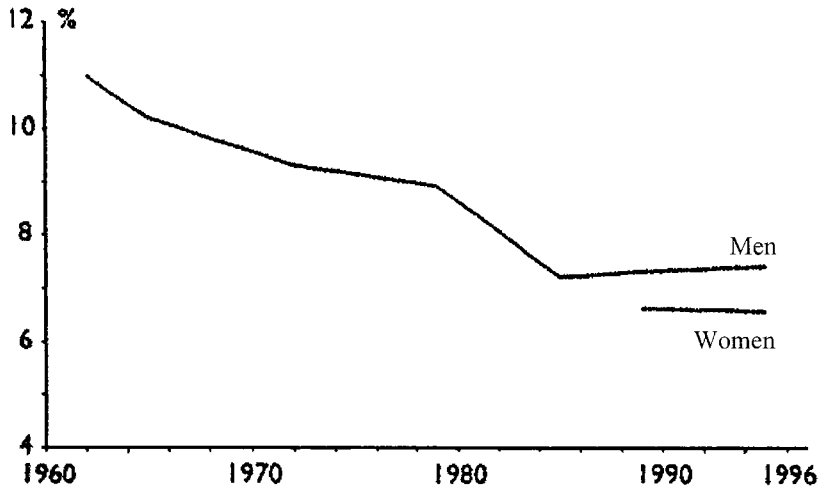
1 INTRODUCTION

In his important book, *Income Distribution*, Jan Tinbergen (1975) wrote about the race between technological development and education. A major contribution of that work was to unite supply-oriented human capital theory with the demand-oriented educational planning approach to bring both supply and demand factors into the foreground in analyzing the determination of labor income. Tinbergen presented a coherent static general equilibrium approach within which it was possible to analyze policies and compute welfare.[1] He explicitly considered optimal tax and subsidy policies, including tuition policy.

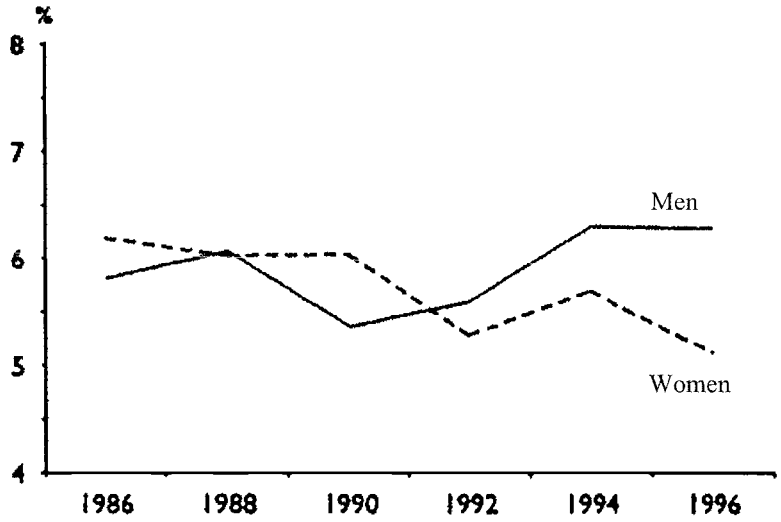
At the time Tinbergen was writing, supply was beating demand in the Netherlands and in most of the rest of the developed world. The return to schooling was high but falling (See Figures 1 and 2). The figures reveal that unlike many countries around the world in the 1980s and early 1990s, Holland did not experience a rise in the return to schooling. Educational attainment rates in higher education were low but rising (See Table 1). Figure 3 reveals that university enrollment rates were rising continuously over most of the post-World War II period. Although international comparisons of educational attainment are difficult given substantial differences in schooling systems during this period, the Dutch

1 Tinbergen did not analyze the full dynamic feedback of subsidies on skill prices and their effects on schooling dynamics and expectations. These dynamic effects play an important role in interpreting and applying conventional cross-sectional partial equilibrium results to forecast effects of national policies. (See Heckman, Lochner, and Taber (1998a, 1998b, 1999)).



Source: CBS loonstructuuronderzoeken 1962, 1965, 1972, 1979, 1985, 1989 and 1995

Figure 1 – Returns to Schooling to Hourly Wages



Source: OSA-panel; Hartog, Odink, and Smits (1999)

Figure 2 – Returns to Schooling to Net Hourly Wages

rate was comparable or superior to rates in many other European countries. In participation in primary and secondary education, Holland was ahead of most countries (See Table 2). Counting advanced vocational training as a form of post-secondary schooling, the Netherlands has a high rate of post-secundary attendance.

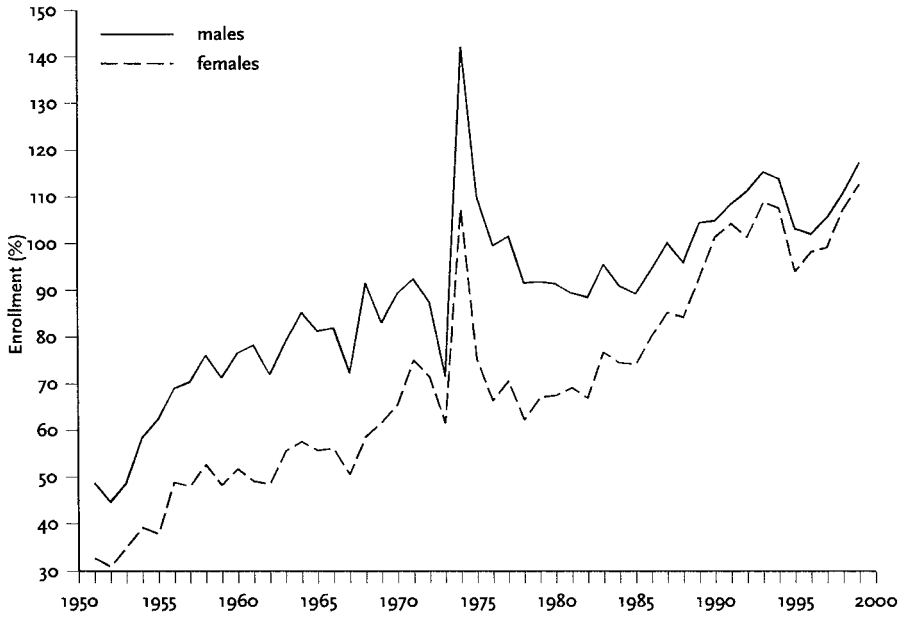
The reasons for this increase in supply of skilled workers in the face of declining or stagnant real returns to schooling are still debated (See Hartog, Odink and Smits (1999) and Oosterbeek and Webbink (1995)). Most Dutch scholars focus on family income as a major determinant of supply although its role in alleviating credit constraints and in financing consumption motives has not yet been empirically resolved.

However this issue is settled, it now seems moot. In the past 5-7 years, there is evidence that the return to schooling has begun to increase after a stagnant decade. A recent paper by Jacobs (2002) presents suggestive calculations that Holland is experiencing the same skill-biased technical change that has been operating around the world since the late 1970s, and that demand is now outstripping supply here as it is elsewhere. This accounts for the evidence of Leuven and Oosterbeek (2000) presented in Table 3. Jacobs goes on to observe that tuition policy is an ineffective lever to pull in eliminating wage inequality by promoting supply. To close the wage gap by increasing the supply of skilled labor, tuition would have to be fully subsidized and students would have to be paid to go to school. His finding supports similar calculations for the US reported in Heckman

TABLE 1 – PARTICIPATION IN HIGHER SECONDARY EDUCATION, AGES 18-24: 1985-1995

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1985-95 change[1]
Australia	–	–	–	–	–	–	22.2	33.3	22.9	18.9	23.9	–
Austria	–	–	–	–	–	–	–	14.5	12.3	12.9	14.7	–
Belgium	17.6	18.0	18.8	19.2	–	–	21.9	22.7	26.5	28.3	31.0	13.4
Canada	–	–	–	–	–	–	21.9	22.6	29.9	34.0	32.2	–
Czech Republic	–	–	–	–	–	–	–	10.0	–	12.4	13.3	–
Denmark	11.3	11.3	11.4	11.9	12.2	12.7	13.3	14.4	14.9	15.1	15.4	4.1
Finland	13.3	–	–	–	–	17.6	–	19.6	21.1	22.3	22.6	9.3
France	15.9	16.4	16.8	17.4	18.5	20.0	21.6	23.7	–	27.3	28.1	12.2
Germany[2]	11.9	11.7	11.4	11.3	11.7	12.2	–	–	13.3	13.2	13.9	2.0
Greece	–	–	–	–	–	–	–	15.2	24.9	25.7	23.7	–
Hungary	–	–	–	–	–	–	8.4	8.6	–	9.8	10.6	–
Iceland	–	–	–	–	–	–	–	–	–	13.1	13.8	–
Ireland	–	11.4	11.7	12.2	13.5	14.5	15.2	19.7	19.5	21.4	21.3	–
Italy	–	–	–	–	–	–	–	–	–	–	–	–
Japan	–	–	–	–	–	–	–	–	–	–	–	–
Korea	–	–	–	–	–	–	–	–	23.7	25.7	27.4	–
Luxembourg	–	2.1	2.3	2.6	2.6	–	–	–	–	–	–	–
Mexico	–	–	–	–	–	–	–	–	0.6	0.6	7.3	–
Netherlands	13.7	13.9	14.2	14.9	15.6	16.7	18.0	19.2	–	21.4	22.3	8.6
New Zealand	–	12.8	15.6	16.2	19.0	16.7	18.1	19.9	–	22.6	21.1	–
Norway	11.3	11.1	12.2	12.5	13.8	15.8	17.1	18.3	–	21.0	21.2	9.9
Poland	–	–	–	–	–	–	–	11.1	12.3	14.2	–	–
Portugal	6.0	5.1	6.3	–	–	–	11.0	–	16.0	17.6	17.7	11.7
Russia[3]	–	–	–	–	–	–	–	21.3	–	–	–	–
Spain	13.7	14.8	15.4	16.5	17.6	18.7	19.2	20.2	20.4	22.6	23.2	9.5
Sweden	9.5	9.4	9.7	9.8	10.0	10.2	10.8	11.9	12.9	14.1	15.1	5.6
Switzerland	8.0	8.0	8.3	8.4	8.7	9.3	9.7	10.3	10.7	11.1	11.4	3.4
Turkey	–	–	–	4.6	5.5	6.2	6.7	7.1	–	9.3	9.3	–
United Kingdom	8.7	10.4	10.6	10.8	11.0	11.7	12.7	13.2	15.4	17.2	18.8	10.1
United States	25.5	25.5	26.3	27.8	28.2	28.8	29.3	31.1	29.4	29.4	29.4	3.9
Average[4]	12.8	13.2	13.6	14.2	14.6	15.2	15.8	16.8	17.3	18.3	18.9	6.1

– No data were reported or data were incomplete or inconsistent.
[1]Percentage points change between 1985 and 1995.
[2]Pre-1991 numbers refer to Western Germany (Federal Republic of Germany before unification).
[3]Not an OECD member country
[4]Average is for countries reporting data for all years included in the table.
Note: Countries in bold are G-7 countries. Enrollment data include full-time and part-time enrollments.
Source: Organization for Economic Co-operation and Development (OECD), Education Database, 1998; U.S. Department of Commerce, Bureau of the Census, International Database, 1998.
Source: Baldi et al. (2000)



Source: Canton and de Jong (2002)

Figure 3 – First-year university enrollment (as percentage of the number of qualified secondary school graduates)

and Lochner (2000) and Heckman (2000). The magnitude of the subsidies to tuition needed to promote skills and reduce inequality are unacceptably large and would also generate massive deadweight unless they are selectively targetted. Accordingly, the tuition subsidy policies advocated by Dur and Teulings (2002) and others are likely to be costly and ineffective in reducing wage inequality.

Contributing to the shortage of skill in the face of rising demand is the problem of immigrant assimilation. The percentage of immigrants in the Dutch economy has grown enormously in the past 30 years from 2% in 1970 to 6% in 1990 and 14% in 2002. Many of these immigrants are unskilled and their children are unskilled as well (See Table 4). Drop out rates from secondary school are 50% for Turks, 55% for Moroccans, and 25% for Surinamese, compared to less than 10% for native Dutch. This reduces growth in the quality of the labor force at a time when skills are in great demand. The inheritance of low socioeconomic status across generations promises to perpetuate or even exacerbate social exclusion of immigrant groups, especially the non-Dutch speaking immigrants who constitute the bulk of the recent immigration (Veenman (2002)).

Policies have been advocated to improve the process of immigrant assimilation and to increase schooling attainment for the children of disadvantaged persons of Dutch origin through improving the quality of schools, through reducing

TABLE 2 – PARTICIPATION IN LOWER AND UPPER SECONDARY EDUCATION, AGES 14-17: 1985-1995

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1985-95 change[1]
Australia	–	–	–	–	–	–	83.2	81.2	91.0	91.7	93.4	–
Austria	85.5	–	–	–	12.1	–	–	–	91.8	93.1	94.4	8.9
Belgium	91.4	92.6	93.0	92.3	–	–	94.3	98.2	101.5	101.6	101.1	9.7
Canada	–	–	–	–	–	–	86.7	81.6	90.3	89.7	89.1	–
Czech Republic	–	–	–	–	–	–	–	81.1	–	88.4	93.9	–
Denmark	89.1	90.1	90.6	91.0	90.8	90.3	90.0	90.6	90.5	91.5	92.8	3.1
Finland	89.8	–	–	–	–	98.0	–	95.1	94.7	96.5	95.2	5.4
France	88.5	88.8	88.4	89.7	90.8	91.2	91.5	91.8	–	95.3	95.3	6.8
Germany[2]	94.5	94.8	95.7	96.3	88.5	94.1	–	–	91.6	95.9	96.4	1.9
Greece	–	–	–	–	–	–	–	77.6	76.5	76.2	77.8	–
Hungary	–	–	–	–	–	–	77.7	77.7	–	88.0	89.0	–
Iceland	–	–	–	–	–	–	–	–	–	89.9	89.4	–
Ireland	–	81.5	83.7	84.9	86.4	87.4	86.8	88.1	91.7	90.3	89.7	–
Italy	60.9	–	–	–	–	–	–	–	–	–	–	–
Japan	–	–	–	–	–	97.3	99.1	100.0	–	100.8	101.2	–
Korea	–	–	–	–	–	–	–	–	89.5	92.2	96.0	–
Luxembourg	–	80.3	81.6	80.6	79.3	–	–	–	–	–	80.4	–
Mexico	–	–	–	–	–	–	–	–	39.9	37.6	43.3	–
Netherlands	92.2	91.5	91.6	91.5	91.3	91.8	92.0	96.8	–	95.8	96.6	4.4
New Zealand	–	73.5	77.0	78.5	81.4	82.9	85.9	88.0	–	93.8	94.9	–
Norway	90.0	90.5	90.3	89.9	91.3	93.2	93.7	94.3	–	95.6	96.1	6.1
Poland	–	–	–	–	–	–	–	61.6	63.4	64.3	–	–
Portugal	40.0	43.6	41.4	54.5	–	–	63.8	–	66.5	75.0	76.3	36.3
Russia[3]	–	–	–	–	–	–	–	56.7	–	–	–	–
Spain	67.2	69.6	71.7	75.1	77.5	79.3	80.2	82.0	84.4	85.8	87.3	20.1
Sweden	91.4	92.5	92.5	92.3	91.9	91.4	91.3	93.0	95.5	96.6	97.1	5.7
Switzerland	88.0	88.1	88.1	88.3	88.3	88.8	88.9	90.1	90.2	90.5	90.7	2.7
Turkey	27.7	28.3	30.2	31.4	32.5	32.9	34.3	43.5	–	39.8	42.9	15.2
United Kingdom	77.3	78.2	79.5	80.4	82.0	82.8	83.6	91.8	87.5	88.6	88.7	11.4
United States	89.7	90.9	91.6	90.8	92.5	91.7	90.8	88.5	92.4	91.3	90.3	0.6
Average[4]	83.9	84.9	85.7	86.3	87.2	87.4	87.5	89.3	90.1	90.7	91.1	7.3

– No data were reported or data were incomplete or inconsistent.
[1]Percentage points change between 1985 and 1995.
[2]Pre–1991 numbers refer to Western Germany (Federal Republic of Germany before unification).
[3]Not an OECD member country.
[4]Average is for countries reporting data for all years included in the table.
Note: Countries in bold are G–7 countries. Enrollment data include full–time and part–time enrollments. See supplemental notes and tables for an explanation of why rates in some countries exceed 100.
Source: Organization for Economic Co–operation and Development (OECD), Education Database, 1998; U.S. Department of Commerce, Bureau of the Census, International Database, 1998.
Source: Baldi et al. (2000).

TABLE 3 – RETURNS TO EDUCATION (IN % FOR AN ADDITIONAL YEAR OF EDUCATION)

	1994	1999	2000
Total	5.8	8.5	8.4
Male	5.7	8.0	8.0
Female	5.7	9.0	9.0

Source: Leuven and Oosterbeek (2000)

TABLE 4 – EDUCATIONAL ATTAINMENT OF PUPILS BY IMMIGRANT STATUS (19-20 YEARS; % OF TOTAL)

	Secondary			Intermediate		Higher University		
	Primary	Vocational	General	Vocational	General	Vocational	General	Total
Turks	15	22	34	11	12	4	3	100
Moroccans	17	22	28	16	12	3	2	100
Surinamese	8	16	18	17	20	8	12	100
Antilleans	8	15	14	14	8	18	23	100
Native Dutch	7	6	13	9	21	17	28	100

Source: Van Ours and Veenman (2001)

tuition, through improving job training, and the like. These policies are the familiar ones and are also widely advocated in the US.

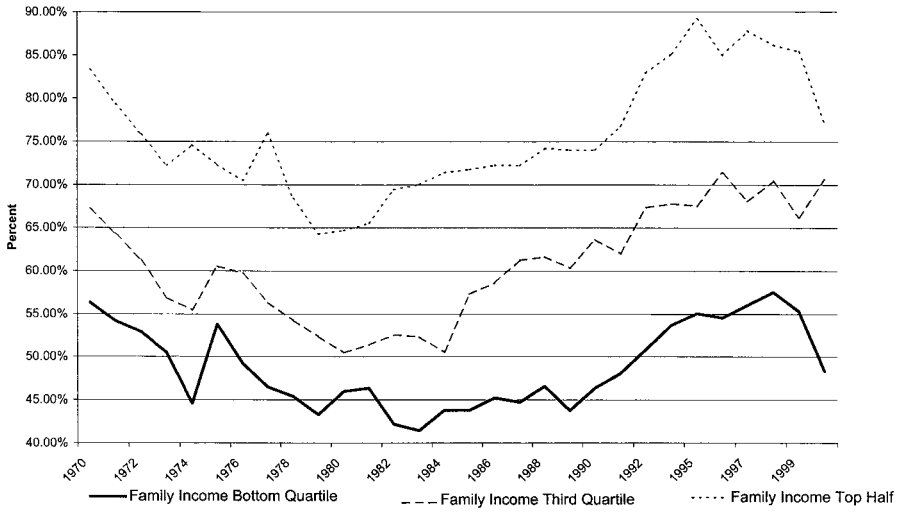
What policies should be pursued to promote the supply of skilled labor? How effective are tuition policies? How much of the family income (or socioeconomic status) -schooling relationship is due to credit constraints that can be solved by using cash transfers to adolescents in their late adolescent years, and how much is due to more fundamental factors? Will improving schooling quality promote immigrant assimilation? Will tax or subsidy policy be effective?

These questions have their counterparts in the American debate. In my lecture today I want to summarize the main lessons from the American debate and apply them to the Dutch situation. There are many points of similarity between the US and Holland as well as some interesting differences. Much current policy on skill formation both in the US and in Holland is misguided. The foundations of the human capital policy should be rethought in both countries. First, I present some relevant background on the US experience.

2 SOME BACKGROUND ON THE US ECONOMY

By many measures, since 1980 the quality of the American workforce has stagnated or its growth has dramatically slowed down (see Carneiro and Heckman (2003)). After a half century of uniform gains, cohorts of Americans born after 1950 did not improve much, or at all, on the educational attainment of their predecessors. This is true for Americans of all racial and ethnic backgrounds. Moreover, the stagnation in educational attainment in the aggregate is not due solely to migration. While immigrants are more unskilled, and contribute to growth in the pool of unskilled labor, stagnation in aggregate college participation is also found among native born Americans.

The measured wage premium for higher-skilled workers in the US began to increase substantially around 1980 (see Autor and Katz (1999)). In response to these economic incentives, children from certain socioeconomic groups increased their post-secondary schooling attendance. However, the response has not been uniform across racial, ethnic, or family income groups even though the return to schooling has increased for all groups. Adolescent white male high school graduates from the top half of the family income distribution began to increase their college-going rate in 1980 (see Figure 4). Those from the third quartile of the family income distribution were less likely to attend college and delayed their



Note: 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.
Source: Carneiro and Heckman (2003)

Figure 4 – College Participation, 18 to 24 Yrs, HS Grads and GED Holders Dependent* White Males

response to the rising wage premium for skill. The response was even more delayed for white male high school graduates at the bottom of the family income distribution. The already substantial gaps in college-going widened. Racial and ethnic gaps in attendance differentials also widened.[2] Because education is a primary determinant of earnings, these responses to the new market for skills will widen racial, ethnic, and family-origin wage differentials in the next generation, making the America of tomorrow more unequal. These American problems have clear counterparts in Holland, especially for immigrant groups and for native Dutch from poorer backgrounds.

The supply of skilled workers is not keeping pace with demand both in the US and Holland. How to increase the supply in an economically efficient way is not so clear, and there are many advocates of fundamentally different policies that are difficult to compare because their costs and benefits are not tabulated and placed on a common footing. Many recent discussions seize upon the gaps in schooling attainment by family income, evident in Figure 4, as a major causal factor. The growth in tuition costs in the US over the past twenty years and the decline in the earnings of families headed by low-skill workers are often cited to explain post-secondary schooling attendance patterns (see Carnevale and Fry (2000) and Hauser (1993)). Policies are proposed to reduce tuition or supplement family resources of children in the college-going years. Tinbergen (1975) discusses such policies, and Dur and Teulings (2002) have recently endorsed tuition policy as a means of combatting inequality.

The evidence presented by Carneiro and Heckman (2003) suggests that longer-term factors such as parental environments and family income available to children over their entire life cycle are far more decisive in promoting readiness for post-secondary schooling and social attachment than family income in the adolescent years. This evidence suggests that factors operating during the early childhood years and culminating in adolescence in the form of crystallized cognitive abilities, attitudes, and social skills play far more important roles than tuition or family credit constraints during the late adolescent years in explaining minority-majority gaps in socioeconomic attainment. It suggests that tuition policy may be much less effective than policies that foster cognitive abilities.

In my joint work with Carneiro, I critically examine the claim that liquidity constraints facing families in their child's adolescent years play a fundamental role in explaining the gaps evident in Figure 4. We present evidence that in the US a small group of people is credit-constrained in this short-run sense, and that policies that relieve such constraints may be cost effective. Nonetheless, relieving all short-term credit constraints will not substantially reduce gaps in schooling participation. I summarize this evidence here.

2 For women, the substantial ethnic, racial and family income gaps did not widen but they did not shrink either. Secular trends dominate the female time series. See Carneiro and Heckman (2003).

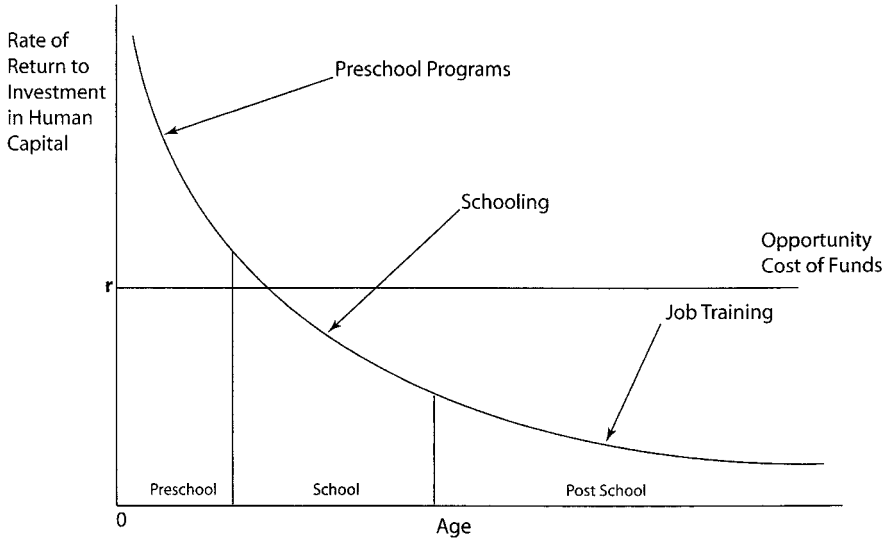
I also summarize the evidence on a variety of other policies to improve the quality of skills. Policies to improve the quality of secondary schools are often put forward, and debates over such policies are intense. I argue that at current levels of expenditure, they are unlikely to be effective. Second chance remediation programs such as publicly provided job training are sometimes suggested as low-cost, effective strategies to overcome early disadvantage. I show that the economic return to such programs is low. Tax and subsidy policies are also advocated. I find that they are likely to have only modest effects on skill formation. Policies to limit the immigration of the unskilled are proposed to alleviate the downward pressure on wages and to reduce inequality (Borjas (1999)). I argue that such policies are likely to be very effective in the Dutch context, especially if incentives can be reconfigured to promote immigrant assimilation into the workplace rather than the welfare system.

Effective policy is based on empirically grounded studies of the sources of the problems that the proposed policies address (see Carneiro and Heckman (2003)). While it is possible through trial and error to stumble onto effective policies without understanding the sources of the problems that motivate them, a more promising approach to policy formulation is to understand the mechanisms and institutions that produce skill.

Human capital accumulation is a dynamic process. The skills acquired in one stage of the life cycle affect both the initial capacities and the technology of learning at the next stage. Human capital is produced over the life cycle by families, schools and firms, although most discussions of skill formation focus on schools as the major producers of skills. A substantial body of evidence documents that families and firms are major producers of abilities and skills. A major determinant of successful schools is successful families. Schools work with what parents bring them. They operate more effectively if parents reinforce them by encouraging and motivating children. Job training programs, whether public or private, work with what families and schools supply them, and cannot remedy 20 years of neglect. Parents isolated from the larger society do not promote assimilation of their children into the larger society.

Recent studies in child development (Shonkoff and Phillips (2000) and Huttenlocher (2002)) emphasize that different stages of the life cycle are vital to the formation of different types of abilities. When the opportunities for formation of these abilities are missed, remediation is costly and full remediation is often prohibitively costly. These findings highlight the need to take a comprehensive view of skill formation over the life cycle that is grounded in the best science and economics in order to devise effective policies.

A study of human capital policy grounded in economic and scientific fundamentals improves on a purely empirical approach to policy evaluation that relies on evaluations of programs and policies in place or previously experienced. While any trustworthy study of economic policy must be grounded in data, it is also important to recognize that the policies that can be evaluated empirically are only



Source: Carneiro and Heckman (2003)

Figure 5-1 – Rates of Return to Human Capital Investment Initially Setting Investment to be Equal Across all Ages

a small subset of the policies that might be tried. If we base speculation about economic policies on economic fundamentals, rather than solely on estimated 'treatment effects' that are only weakly related to economic fundamentals, we are in a better position to think beyond what has been tried to propose more innovative solutions to human capital problems. In my joint work with Carneiro (2003) and in Heckman (2000), I investigate the study of human capital policy by placing it in the context of economic models of life cycle learning and skill accumulation rather than focusing exclusively on what policies have 'worked' in the past.[3]

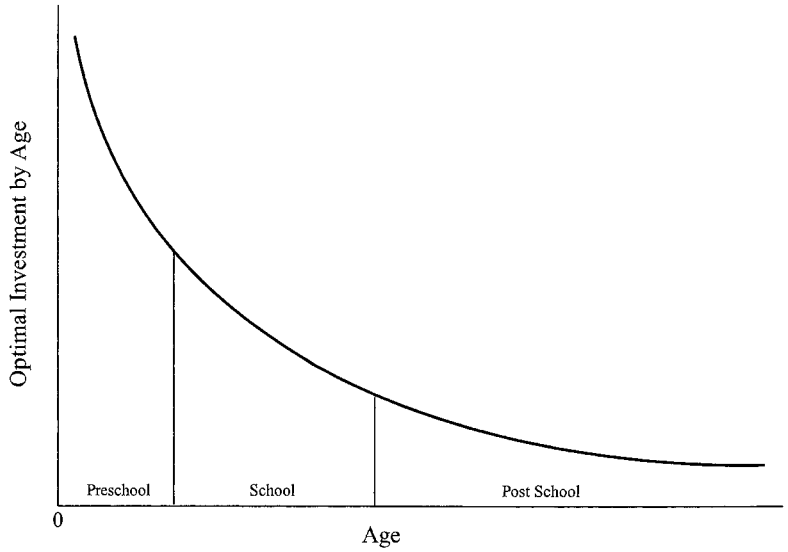
Figure 5-1 summarizes the major theme of this lecture and my research with Carneiro. It plots the rate of return to human capital at different stages of the life cycle for a person of given abilities. The horizontal axis represents age, which is a surrogate for the agent's position in the life cycle. The vertical axis represents the rate of return to investment, assuming the same investment is made at each age. *Ceteris paribus,* the rate of return to a dollar of investment made while a person is young is higher than the rate of return to the same dollar made at a later age. Early investments are harvested over a longer horizon. In addition, because early investments raise the productivity (lower the costs) of later investments, human capital is synergistic. This dynamic complementarity in human in-

3 Jacobs (2000) summarizes some of the main ideas of these papers in Dutch.

vestment was ignored in the early work on human capital (Becker (1964)). Learning begets learning, skills (both cognitive and non-cognitive) acquired early on facilitate later learning. For an externally specified opportunity cost of funds r (represented by the horizontal line with intercept r in Figure 5-1), an optimal investment strategy is to invest less in the old and more in the young. Figure 5-2 presents the optimal investment quantity counterpart of Figure 5-1.

A second interpretation of Figure 5-1 that I develop in this lecture and in my work with Carneiro is that it is an empirical description of the economic returns to investment at current levels of spending in many economies throughout the world: the return to investment in the young is apparently quite high; the return to investments in the old (and less able) is quite low. A socially optimal investment strategy would equate returns across all investment levels. A central empirical conclusion of this lecture is that at current investment levels in most countries, efficiency in public spending would be enhanced if human capital investment were directed more toward the young and away from old, unskilled and illiterate persons for whom human capital is a poor investment.

My analysis with Carneiro also challenges the conventional point of view that equates skill with intelligence, and draws on a body of research that demonstrates the importance of both cognitive and non-cognitive skills in determining socioeconomic success. Both are affected by families and schools but they differ in their malleability over the life cycle with non-cognitive skills being more mal-



Source: Carneiro and Heckman (2003)

Figure 5-2 – Optimal Investment Levels

leable than cognitive skills at later ages. Cognitive and non-cognitive differences by family income and family background emerge early and persist. If anything, schooling widens these early differences.

Current educational policy and much economic analysis of education and skill formation focus on tested academic achievement as the major output of schools. Proposed performance educational evaluation systems are often premised on that idea. Recent evidence challenges these views.

Cognitive ability is a well-established major factor in schooling and labor market outcomes. At the same time, non-cognitive abilities, while harder to measure, also play an important role. They matter both for success in the labor market and in schooling. These findings are supported by studies of early childhood interventions that primarily improve non-cognitive skills, with substantial effects on schooling and labor market outcomes, but only weakly affect cognitive ability. Mentoring programs in the early teenage years can also affect these traits. Current analyses of skill formation focus too much on cognitive ability and too little on non-cognitive ability in evaluating human capital interventions.

2.1 *The Evidence on Credit Constraints*

The strong relationship between family income and participation in post-secondary schooling that is displayed in Figure 4 is found in many countries (see the essays in Blossfeld and Shavit (1993)). There are two, not necessarily mutually exclusive, interpretations of this evidence. The common interpretation of the evidence and the one that guides current policy in many countries is the obvious one. Credit constraints facing families in a child's adolescent years affect the resources required to finance a college education. A second interpretation emphasizes more long-run factors associated with higher family income. It notes that family income is strongly correlated over the life cycle. Families with high income in the adolescent years are more likely to have high income throughout the child's life at home. Better family resources in a child's formative years are associated with higher quality of education and better environments that foster cognitive and non-cognitive skills.

Both interpretations of the evidence are consistent with a form of credit constraint. The first, more common, interpretation is clearly consistent with this point of view. But the second interpretation is consistent with another type of credit constraint: the inability of the child to buy the parental environment and genes that form the cognitive and non-cognitive abilities required for success in school, work and life. This interpretation renders a market failure as a type of credit constraint.[4]

4 The suggested market failure is somewhat whimsical since the preferences of the child are formed, in part, by the family into which he/she is born. *Ex post*, the child may not wish a different family, no matter how poor the family.

An emerging empirical and theoretical literature (see Carneiro and Heckman (2002, 2003) and the references they cite) argues on quantitative grounds that the second interpretation of Figure 4 is by far the more important one. Controlling for ability formed by the early teenage years, parental income plays only a minor role. The evidence from the US suggests that at most 8% of American youth are subject to short-term liquidity constraints that affect their post-secondary schooling. Most of the family income gap in enrollment is due to long-term factors that produce the abilities needed to benefit from participation in such schooling.

The essential arguments are as follows. They are fully developed in Carneiro and Heckman (2002, 2003). Conditioning on ability as measured in the early adolescent years, most of the gap in college enrollment between high income and low income families disappears. For minorities, it completely disappears.

A large and influential literature finds that the 'instrumental variable' estimator (IV) of the returns to schooling exceeds the least squares estimator (OLS) (see Card (1999, 2001)). Since instrumental variables estimators identify persons at the margin of going to school attracted into school by the instrument, this evidence is interpreted to mean that the marginal person earns a higher return than the average attendee. This in turn is interpreted to mean that credit constraints are operative on people attending school because marginal returns exceed average returns (see, e.g., Kane (2001)). The evidence from this literature is not informative on this question because (a) the instruments used are generally invalid (Carneiro and Heckman (2002)); (b) even if the instruments were valid, the OLS-IV comparison does not identify the marginal *versus* the average return (Carneiro and Heckman (2002)) and (c) the comparison ignores the choice of schooling quality margin. Constrained people induced into school by the instrument will generally pick lower quality schools. Thus their measured return would be *lower* than the average return since the empirical literature does not correct for the quality of schooling (Carneiro and Heckman (2002)). While a small group of people are credit-constrained in a short-run sense and policies narrowly targeted toward them would be cost effective, existing broadly-based tuition and subsidy policies to promote schooling generate a large deadweight loss because many people who would attend school in any event would be subsidized to do so.

The evidence summarized in Carneiro and Heckman (2003) suggests that the first-order explanation for gaps in enrollment in college by family income is long-run family factors that are crystallized in ability. Short-run income constraints play only a quantitatively minor role. There is scope for intervention to alleviate these short-term constraints, but one should not expect to substantially eliminate the enrollment gaps in Figure 4 by eliminating such constraints. These lessons have applicability to many other developed countries.

Ellwood and Kane (2000) accept the main point of Cameron and Heckman (2001) that academic ability is a major determinant of college entry. At the same time, they argue that family income operates as an additional constraint, not as powerful as academic ability, but more easily addressed by policy than ability.

Figure 6 presents a version of their case using data from the National Longitudinal Survey of Youth for 1979. This analysis is taken from Carneiro and Heckman (2003). Classifying people by ability, there is a clear ordering that more able people are more likely to go to college. Classifying white males by their test score terciles, Carneiro and Heckman further display college enrollment rates by family income measured during the child's adolescent years. There is a clear ordering in the high-ability group and in other ability groups as well. Persons from families with higher income are more likely to enroll in post-secondary school. This ordering occurs in many other data sets.

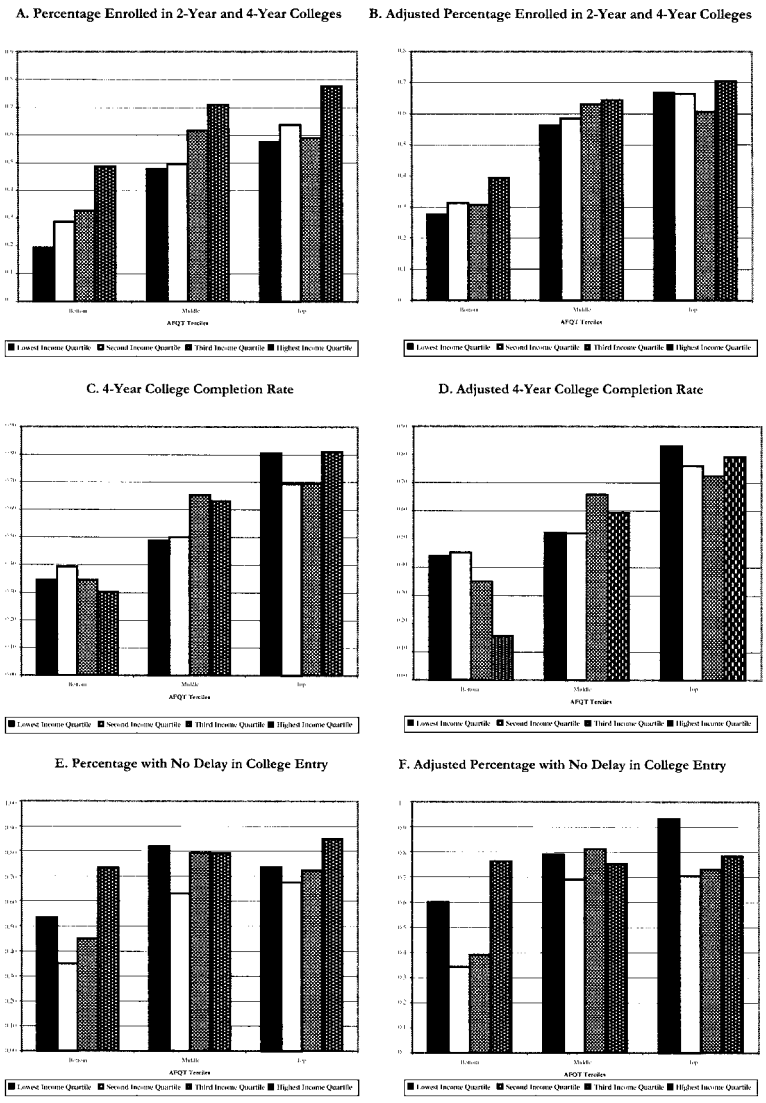
These graphs indicate a subsidiary but still quantitatively important role for family income in accounting for schooling enrollment. Does this mean that short-run credit constraints are operative in the post-secondary attendance years? Not necessarily. Family income in the adolescent years is strongly correlated with family income throughout the life cycle. In addition, long-run family resources are likely to produce many skills that are not fully captured by a single test score. Most of the analysis in the literature focuses on college enrollment and much less on other dimensions of college attendance such as completion, quality of school and delay of entry into college.[5] Carneiro and Heckman (2003) look at many dimensions of post-secondary schooling participation.

When they control for early family background factors (parental education, family structure, and place of residence), they greatly weaken the relationship found by Ellwood and Kane (2000). Plots of the adjusted rates for three measures of post-secondary schooling participation are presented in Figures 6-B, 6-D and 6-F corresponding to the unadjusted Figures 6-A, 6-C and 6-E, respectively. Only 5.2% of all white males are constrained relative to the top income group.

For completion of four-year college, they find no evidence of constraints for white males and in fact over-adjust college enrollment. Figures 6-C and 6-D present the raw and adjusted gaps for completion of four-year college. Figures 6-E and 6-F are the raw and adjusted gaps for delay of entry into college. There is no evidence of short-run credit constraints in these dimensions. There is evidence of short-run credit constraints for the 'dumb poor' in completing two years of college (corresponding to advanced vocational training in Holland), but not for the 'bright poor'. There is weak evidence for short-term credit constraints in years of delay of entry and for choice of two-year *versus* four-year colleges, which is a measure of quality. Depending on the measure of college participation selected, the estimated percent of white males constrained ranges from 0 to 9%. Setting statistically insignificant gaps to zero, Carneiro and Heckman obtain a much smaller range of values (0-7%). Comparable results are found for other demographic groups.

Overall, the estimated percent constrained ranges from 8% (for completion of two year postsecondary schooling) to zero percent for completion of four-year

5 Work in school is studied in Keane and Wolpin (2001). Delay in entry is studied in Kane (1996).



Note: To draw these graphs we performed the following steps. 1) Within each AFQT tercile, we regress percentage enrolled, completion rate, and percentage with no delay on family background: $y = \alpha + F\gamma + Q_1\beta_1 + Q_2\beta_2 + Q_3\beta_3$, where y is percentage enrolled, completion rate, or percentage with no delay, F is a vector of family background variables (southern origin, broken home, urban origin, mother's and father's education), Q_1 is a dummy for being in the first quartile of the distribution of family income at 17, Q_2 is for being in the second quartile and Q_3 is for being in the third quartile. 2) Then, within each AFQT tercile, the height of the first bar is given by $\alpha + \bar{F}\gamma + \beta_1$, the second is given by $\alpha + \bar{F}\gamma + \beta_2$, the third by $\alpha + \bar{F}\gamma + \beta_3$ and the fourth by $\alpha + \bar{F}\gamma$ (where $\bar{F}$ is a vector of the mean values for the variables in F). See Carneiro and Heckman (2003) for the derivation of these figures.

Figure 6 – Enrollment, Completion and No Delay Rates by Family Income Quartiles and Age-Adjusted AFQT Terciles, White Males, NLSY 79

college. The strongest evidence for short-term credit constraints is for Hispanic males. For this group, illegality of many Hispanics may make them appear to be constrained because they do not have the same eligibility for schooling aid as legals. The weakest evidence for credit constraints is for black males. On many dimensions for this group, the effective constraint is zero. There is little evidence that short-term credit constraints explain much of the gap in college participation. For additional analyses see Carneiro and Heckman (2003).

Policies that improve the financing of the education of identified constrained subgroups will increase their human capital and are justified on objective cost-benefit criteria. The potential economic loss from delay of schooling can be substantial. If V is the economic value of attending school, and schooling is delayed one year, then the costs of delay of schooling by one year are $[(r)/(1 + r)]\, V$ where r is the rate of return. For $r = .10$, which is not out of line with estimates in the literature, this delay is 9% of the value of lifetime schooling (roughly $20,000). For these groups, the benefits to reducing delay, and promoting earlier college completion, higher college quality and graduation, are likely to be substantial.

In designing policies to harvest this benefit, it is important to target the interventions toward the constrained. Broad-based policies generate dead weight. For example, Dynarski (2001) and Cameron and Heckman (1999) estimate that 93% of President Clinton's Hope Scholarship Funds, which were directed toward middle-class families, were given to children who would attend school even without the program.

While targeting the identified constrained may be good policy, it is important not to lose sight of the main factors accounting for the gaps in Figure 4. Family background factors crystallized in ability are the first-order factors explaining college attendance and completion gaps. These ability gaps open up early and, if anything, widen with age. I discuss the evidence in Section 2.4.

A major conclusion of this lecture and my work with Carneiro is that the ability that is decisive in producing schooling differentials is shaped early in life. If society is to substantially eliminate ethnic and income differentials in schooling and skill attainment, it must start early and cannot rely on tuition policy applied in the child's adolescent years to compensate for neglect of the early years. I next consider some popular, but inexact, arguments that are claimed to document the importance of credit constraints.

2.2 *High Rate of Return to Schooling Compared to the Return on Physical Capital*

Estimates of the rate of return to schooling, based on the Mincer earnings function, are often above 10% and sometimes as high as 17%-20%. Estimates based on instrumental variables are especially high. See, for example, the evidence surveyed by Card (1999, 2001). It is sometimes claimed that these returns are very

high and therefore people are credit-constrained or some other market failure is present.

The cross-section Mincerian rate of return to schooling does not, in general, estimate the marginal internal rate of return to schooling. See Heckman, Lochner and Taber (1998a) for an example where cross-section rates of return are uninformative about the return to schooling that any person faces. Willis (1986) and Heckman, Lochner and Todd (2001) state the conditions under which the Mincerian rate of return will be equal to the marginal internal rate of return to schooling. Even if these conditions are satisfied, implicit comparisons are usually made against a risk-free interest rate. However this is not the relevant comparison for evaluating schooling decisions. Illiquidity and irreversibility of human capital investments drive the premium on human capital far above the safe interest rate (see Judd (2000)). Comparisons of Mincer returns and returns to capital are intrinsically uninformative about the existence of credit constraints or the need for intervention in human capital markets.

2.3 *Are Rates of Return to Schooling Higher for Persons from Low-Income Families?*

Assuming the same technology of educational investment across families, and no comparative advantage in the labor market, if low-income families are credit-constrained, then at the margin the returns to schooling for constrained children should be higher since they are investing less than the efficient amount.[6] The empirical literature finds that returns to schooling are *higher* for high-ability people than for low-ability people. See for example Meghir and Palme (1999), Cawley et al. (2000), Taber (2001), or the evidence presented in Carneiro and Heckman (2003). Family income and child ability are positively correlated so one would expect higher returns to schooling for children of high-income families for just this reason. Altonji and Dunn (1996) find in their preferred empirical specification that the returns to schooling are higher for children of more-educated families than for children of less-educated families. There is no evidence that rates of return to schooling are higher for children from low-income families than for children from high-income families.[7] If anything, the literature suggests just the opposite.

6 Carneiro and Heckman (2002) establish that if choices are made at the quality margin, the estimated Mincer return may be *lower* for constrained persons unless adjustments for quality are made.

7 The take-up rate on Pell Grants and Perkins Loans targeted toward students from low-income families is low (Orfield (1992)). Many more people are eligible for support than those who claim it. Binding borrowing constraints are not a plausible explanation for the lack of utilization of these potential resources. Similarly, the take-up rate for comparable Dutch loan programs is low. (See the Ministry of Education, Culture and Sciences (2002)).

2.4 *Early Test Score Differentials*

Important differences in ability across family types appear at early ages and persist. Figure 7A, taken from Carneiro and Heckman (2003), presents plots of average percentile rank in PIAT-Math scores, by age and family income quartile.[8] For all race and ethnic groups, there are important differences by family income quartile in how children rank in cognitive test scores as early as age 6. These gaps in ranks across income quartile remain stable as children grow and for some test scores they widen. At the same time, just as racial differences in schooling participation rates are evident, similar patterns emerge in early test scores. Figure 7C presents evidence of the emergence of racial gaps in ranks of test scores as measured by PIAT-Math test scores.

The ability that drives schooling participation is shaped early in life. The available evidence indicates that cognitive ability is relatively more malleable early in the life cycle (see Heckman (1995)). Having access to more and higher quality resources that contribute to improving cognitive ability early in life affects skill acquisition later in life.

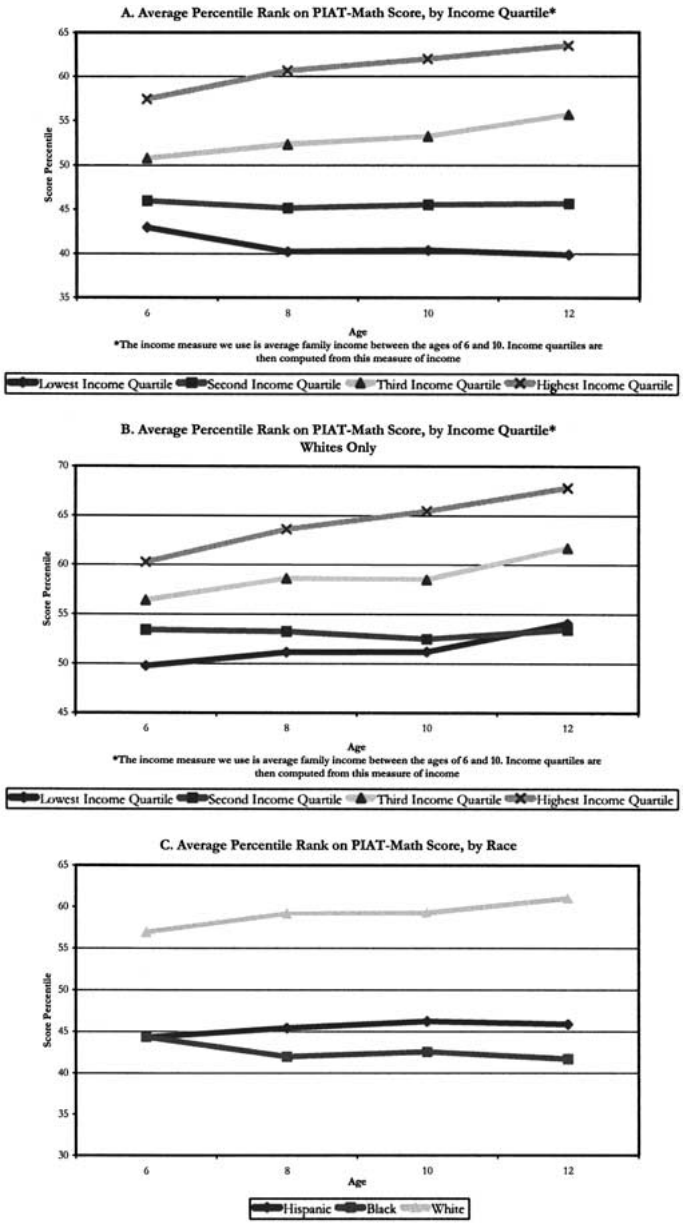
Figure 8 taken from Carneiro and Heckman (2003) presents ranks of adjusted test scores gaps in Figure 7 controlling for the long-term family factors listed at the top of the table. The gaps in rank across racial and income groups are significantly reduced when they control for mother's education, mother's ability, and family structure in the test score equation.[9] However, the gaps at age 12 do not disappear when they compare the highest and lowest income quartiles or whites with blacks. Measured long-term family factors play a powerful role but do not fully eliminate the gaps.

The emergence of early test score differentials is not only limited to cognitive measures. At early ages, differences in children's behaviors and attitudes across income and racial groups are also evident. Figure 9A illustrates this point. It pre-

8 The Peabody Individual Achievement Test-Math (PIAT-M) is administered to children ages 5 and older. Results for other test scores such as the Peabody Picture Vocabulary Test, and PIAT-Reading Recognition, PIAT-Reading Comprehension, and Memory for Location are also available upon request. The Memory for Location test is given to children ages 0 to 3; by age 1, test score gaps similar to those presented in this section emerge.

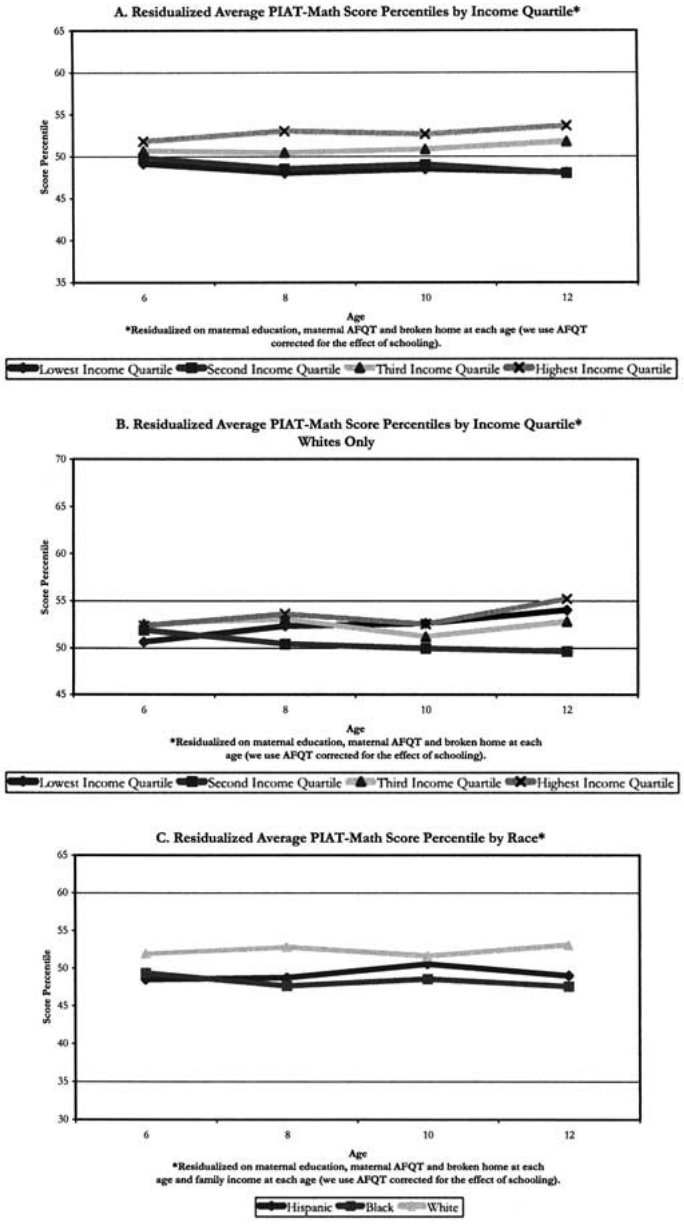
In making this graph, for each person, Carneiro and Heckman compute the percentile rank in the distribution of test scores at each age. Then they group individuals in different quartiles of family income and compute the average percentile rank within each group at each age the test is taken. They use ranks because the absolute values of test scores or their growth have no meaning. Any monotonic transformation of a test score is also a valid test score. Use of ranks avoids this difficulty.

9 Carneiro and Heckman first regress the test score on mother's education, mother's AFQT and broken home at the same age the test is taken. They then rank individuals on the residuals of this regression and construct percentiles. The pictures I present show the average percentile by income group at different ages. Figure 8C presents gaps by race. They further include family income at the age of the test in the regression as well as the other variables mentioned above before taking the residuals and constructing the ranks.



Source: Carneiro and Heckman (2003)

Figure 7 – Children of NLSY



Source: Carneiro and Heckman (2003)

Figure 8 – Children of NLSY

sents differences in ranks of Anti-Social test scores across different income and racial groups.[10] These gaps open up early and, if anything, widen. It is common knowledge that motivation, trustworthiness and other behavioral skills are important traits for success in life. Hence, understanding these gaps in behavioral skills and how to eliminate them is also important for understanding the determinants of socioeconomic success. Figure 10 presents adjusted ranks of test scores for behavioral measures for mother's ability, mother's AFQT and broken home. Adjusting for early family background factors substantially reduces gaps in ranks in non-cognitive skills (see Carneiro and Heckman (2003) for details). Comparing adjusted cognitive and non-cognitive test scores reveals the importance of long-term factors in reducing the gaps in behavioral scores across income and racial groups. While cognitive ability gaps cannot completely be eliminated at later ages, controlling for mother's ability, family income and family structure, and location significantly reduces the gaps in ranks both at early and later ages.[11]

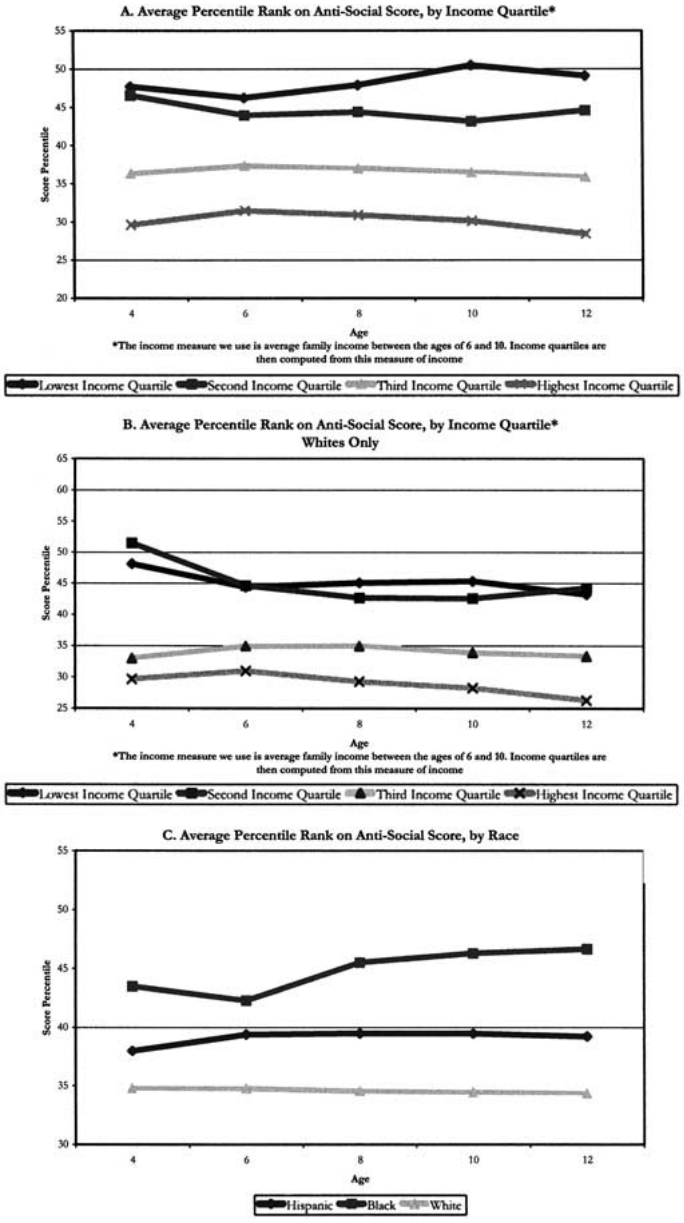
This evidence, like that of the entire literature, is very crude. Good families promote cognitive, social and behavioral skills. Bad families do not. The relevant policy issue is to determine what interventions in bad families are successful. I discuss this question after presenting evidence on the importance of non-cognitive skills. Manipulating non-cognitive skills is more feasible (less costly) than manipulating cognitive skills. In addition, remediation efforts for non-cognitive skills are effective at later ages. But first I discuss the evidence on the importance of non-cognitive skills for socioeconomic success.

2.5 *The Evidence on the Importance of Non-Cognitive Skills*

Numerous instances can be cited of high IQ people who failed to achieve success in life because they lacked self-discipline and of low IQ people who succeeded by virtue of persistence, reliability and self-discipline. It is thus surprising that academic discussions of skill and skill formation focus almost exclusively on measures of cognitive ability and ignore non-cognitive skills. The early literature on human capital (Becker (1964)) contrasted cognitive ability models of earnings with human capital models, ignoring non-cognitive traits entirely. Most discussions of ability bias in the estimated return to education treat omitted ability as cognitive ability and attempt to proxy the missing ability by cognitive tests. Most assessments of school reforms stress the gain from reforms as measured by the

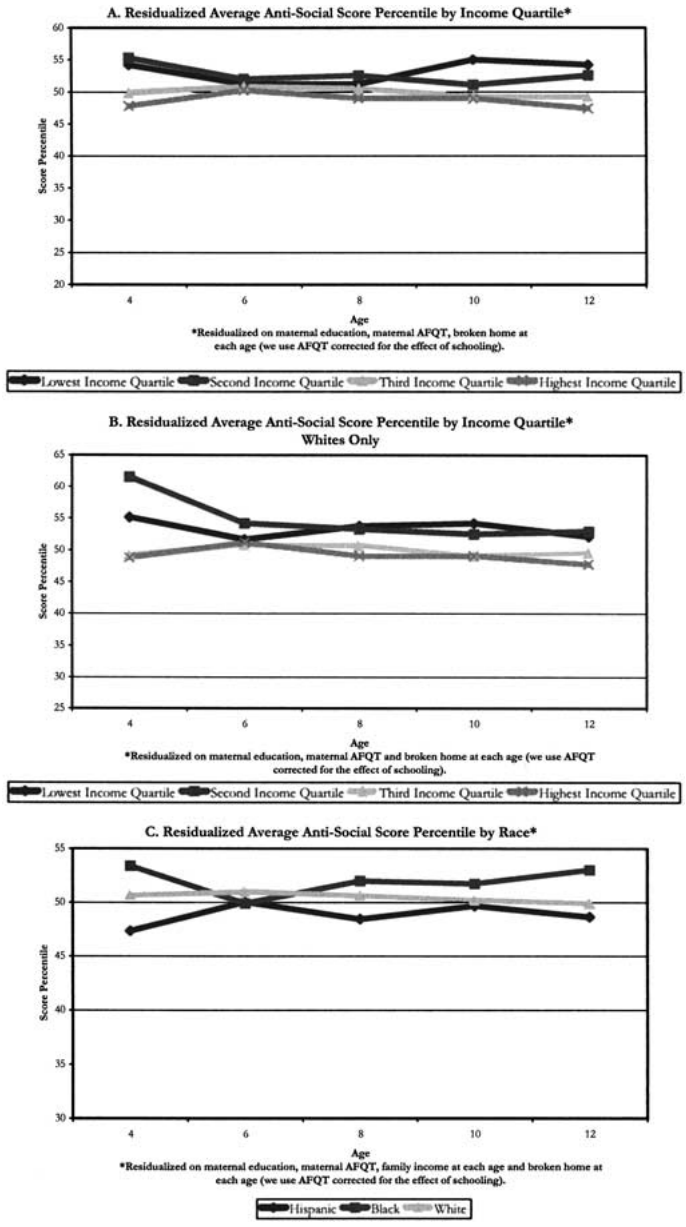
10 The Anti-Social score is calculated on the basis of frequency of dishonest, cruel, non-cooperative, violent or disobedient behaviors (BLS (2001)). Carneiro and Heckman first rank individuals by their Anti-Social scores and then construct percentiles. The figures plot average percentiles by income and race groups.

11 No meaning can be attached to the absolute levels or growth rates in levels of the test scores since any monotonic transformation of a test score is still a valid test score. However, statements can be made about relative ranks within an overall distribution and how they change. This analysis is made about relative ranks.



Source: Carneiro and Heckman (2003)

Figure 9 – Children of NLSY



Source: Carneiro and Heckman (2003)

Figure 10 – Children of NLSY

ability of students to perform on a standardized achievement test. Widespread use of standardized achievement and ability tests for admissions and educational evaluation are premised on the belief that the skills that can be tested are essential for success in schooling and the workplace.

Much of the neglect of non-cognitive skills in analyses of earnings, schooling, and other lifetime outcomes is due to the lack of any reliable measure of them. Many different personality and motivational traits are lumped into the category of non-cognitive skills. Psychologists have developed batteries of tests to measure non-cognitive skills (Sternberg (1985)). These tests are used by companies to screen workers but are not yet used to ascertain college readiness or to evaluate the effectiveness of schools or reforms of schools. The literature on cognitive tests ascertains that one dominant factor ('*g*') summarizes cognitive tests and their effects on outcomes. No single factor has emerged in the literature on non-cognitive skills and it is unlikely that one will ever be found given the diversity of traits subsumed under the category of non-cognitive skills.

Studies by Bowles and Gintis (1976), Edwards (1976), and Klein et al. (1991) demonstrate that job stability and dependability are the traits most valued by employers as ascertained by supervisor ratings and questions of employers although they present no direct evidence on wages and educational attainment. Perseverance, dependability and consistency are the most important predictors of grades in school (Bowles and Gintis (1976)).

Self-reported measures of persistence, self-esteem, optimism, time preference and the like are now being collected and some recent papers discuss estimates of the effects of these measures on earnings and schooling outcomes (see Bowles, Gintis, and Osborne (2001)). These studies shed new light on the importance of non-cognitive skills. Yet they are not without controversy. For example, *ex post* assessments of self-esteem may be as much the consequence as the cause of the measures being investigated.

Heckman and Rubinstein (2001) avoid these problems by using evidence from the GED (General Education Degree) testing program in the United States to demonstrate the quantitative importance of non-cognitive skills in determining earnings and educational attainment. The GED program is a second-chance program that administers a battery of cognitive tests to self-selected high school dropouts to determine whether or not they are the academic equivalents of high school graduates. Study of the GED program is of interest in its own right. It is a major output of US government training programs. GED-certified persons constitute 15% of all persons certified with new high school credentials.

Heckman, Hsee and Rubinstein (2001), and Heckman and Rubinstein (2001) show that the GED exam is successful in psychometrically equating GED test takers with ordinary high school graduates who do not go on to college. Recipients are as smart as ordinary high school graduates who do not go on to college, where cognitive ability is measured by an average of cognitive components of the Armed Forces Qualifying Test (AFQT) or by the first principle component

('*g*'). By these same measures, GED recipients are smarter than other high school dropouts who do not obtain a GED. The pattern is the same for other groups. GED recipients earn more than other high school dropouts, have higher hourly wages and finish more years of high school before they drop out. This is entirely consistent with the literature that emphasizes the importance of cognitive skills in determining labor market outcomes.

Controlling for measured ability, however, GED recipients earn *less*, have lower hourly wages and obtain lower levels of schooling than other high school dropouts. Some unmeasured factor accounts for their relatively poor performance compared to other dropouts. Heckman and Rubinstein identify this factor as non-cognitive skill, recognizing that a subsequent analysis should parcel out which specific non-cognitive factors are the most important.

The GED is a mixed signal. Dropouts who take the GED are smarter (have higher cognitive skills) than other high school dropouts and yet at the same time have lower levels of non-cognitive skills. Both types of skill are valued in the market and affect schooling choices. The findings of Heckman and Rubinstein (2001) challenges the conventional signaling literature which assumes a single skill. It also demonstrates the folly of a psychometrically-oriented educational evaluation policy that assumes that cognitive skills are all that matter. Inadvertently, a test has been created that separates out bright but non-persistent and undisciplined dropouts from other dropouts. It is, then, no surprise that GED recipients are the ones who drop out of school, fail to complete college (Cameron and Heckman (1993)) and who fail to persist in the military (Laurence (2003)). GEDs are 'wiseguys' who lack the ability to think ahead, persist in tasks, or to adapt to their environments. The performance of the GED recipients compared to both high school dropouts of the same ability and high-school graduates demonstrates the importance of non-cognitive skills in economic life. The study of GEDs is of interest in its own right because they represent a growing proportion of all new high school graduates.

There are two main conclusions to be drawn from this analysis: (i) Current systems of evaluating educational reforms are based on changes in scores on cognitive tests. These tests capture only one of the many skills required for a successful life (see Heckman (1999)). A more comprehensive evaluation of educational systems would account for their effects on producing the non-cognitive traits that are also valued in the market. There is substantial evidence that mentoring and motivational programs oriented toward disadvantaged teenagers are effective. Much of the effectiveness of early childhood interventions comes in boosting non-cognitive skills and in fostering motivation (see Carneiro and Heckman (2003) and Heckman (2000) for comprehensive reviews of the literature); (ii) IQ is fairly well set by age eight. Motivation and self-discipline are more malleable at later ages (Heckman (2000)). Given the evidence on the quantitative importance of non-cognitive traits, social policy should be more active in attempting to alter them, especially for children from disadvantaged environments who

receive poor discipline and encouragement at home. This would include mentoring programs and stricter enforcement of discipline in the schools.

2.6 *What We Know About Life Cycle Skill Formation*

The evidence summarized in this lecture demonstrates that long-term environmental factors crystallized in cognitive and non-cognitive abilities play the major role in accounting for gaps in schooling attainment across socioeconomic groups, while the short-term credit constraints and tuition factors that receive prominent attention in current policy discussions do not. However, short-term credit constraints affect a small group of persons and targeted subsidy policies appear to be cost effective for them. One cannot expect tuition reduction policies to eliminate the substantial gaps in schooling attainment by socioeconomic background. Gaps in cognitive and non-cognitive skills open up early and are linked to family environments at early ages, not parental income in the adolescent years. Non-cognitive skills substantially determine socioeconomic success.

An emphasis on the early years is clearly warranted by the facts of the Dutch experience. Most of the students who are 'qualified' to do so go on to university or advanced vocational training. This is implicit in Figure 3 where the percentage going on to post-secondary schooling exceeds 100% of the 'qualified' pool.[12] In the 1990s, more than 90% of persons eligible for post-secondary school attended it (Ministry of Education, Culture, and Sciences (2002)). The shortfalls in the Dutch system come earlier. Children from disadvantaged and unassimilated families start behind and stay behind. The most promising lever to pull to promote skill formation focuses on the early years.

3 SPECIFIC POLICY PROPOSALS

Carneiro and Heckman (2003) and Heckman (2000) analyze specific policy proposals to foster skill. They show that policies proposed to boost school quality in the US do not pass a cost-benefit test in primary and secondary schools. Given the high quality of Dutch schools, it would not be surprising to find similar results here. Raising school quality from existing levels will do little to reduce gaps in schooling and skill formation.

Early childhood investments have substantial documented returns when interventions are evaluated over the life cycle. A major component of the payoff is in non-cognitive skills that lead to less crime, more education, and more integration into the larger society. A full accounting of these early interventions must reckon with their effects on non-cognitive skills. These payoffs are substantial. Starting early makes a big difference. There are important lessons for the Dutch, especially in promoting immigrant assimilation. Schools can only go so far in reme-

12 Persons can enter post-secondary schooling even if they are not qualified.

diating the damage done by poor families. It is unreasonable to assume that schools can compensate for bad early backgrounds. The lessons from a substantial remediation literature should be studied closely by Dutch scholars. See the evidence in Heckman (2000), Karoly (2001) or Carneiro and Heckman (2003).

The evidence on public job training as summarized in Heckman, LaLonde, and Smith (1999) or Carneiro and Heckman (2003) suggests that with the exception of classroom training or job search assistance, job training programs in the late adolescent years for disadvantaged children are ineffective. Even the effective interventions have only modest returns and rarely raise people out of poverty. See the valuable survey by Martin and Grubb (2001).

Tax policy, educational tuition subsidy policy, and wage subsidies are frequently treated in isolation of each other even though they are closely related. Tinbergen's pioneering achievement was to provide a framework for integrating these into a common framework. Bovenberg and Jacobs (2001, 2002) continue this tradition using more modern frameworks.

Tuition policies of the sort recently emphasized by Dur and Teulings (2002) for Holland are unlikely to be effective in substantially promoting skill formation. First of all, estimated tuition responses are low (see the evidence summarized in Jacobs (2002)) and accounting for general equilibrium feedback effects, the true responses to tuition subsidies are likely to be substantially lower than the partial effects conventionally estimated and reported in the labor economics and economics of education literatures (see Heckman, Lochner, and Taber (1998b, 1999)). Across the board tuition subsidies will generate huge deadweight losses of the sort found for the Hope Scholarship program in the US (see Cameron and Heckman (1999) and Carneiro and Heckman 2003)). Moreover, partial equilibrium tuition policy analyses ignore the substantial welfare loss of the taxation used to finance the subsidy and the ensuing disincentives for skill acquisition.

Heckman, Lochner, and Taber (1998a, 1998b, 1999) and Heckman (2001), using an empirical dynamic general equilibrium model, show that tax reform is unlikely to have substantial effects on skill formation, although it can promote welfare by boosting capital formation. This, joined with their analysis of tuition policy, suggests empirical grounds that the policies advocated by Tinbergen (1975) are unlikely to have any substantial effect on skill formation in the Dutch economy, or to be effective in promoting skill or alleviating inequality.

3.1 *Migration Policy*

Both Holland and the US encourage the migration of the unskilled. Holland in particular encourages participation of unskilled immigrants in its generous welfare system. This promotes welfare dependence, impedes both economic and cultural assimilation, and perpetuates inequality across generations. It is instructive to compare the outcomes of the immigration policies of the Swiss with the policies of the Dutch. In Switzerland, immigrants must work for at least five years

before they claim any benefits from the social welfare system. Immigrants are also distributed much more uniformly across regions than they are in Holland. It is no accident that in Switzerland even unskilled immigrants succeed in the general economy and the problems of cultural and economic assimilation that plague Dutch society are absent there. The enclaves of low skilled, and disaffected Dutch immigrants perpetuate poverty into the next generation. (see Table 4).

The evidence on skill formation and the importance of the early years in forming skills, abilities and attitudes that is presented in this lecture strongly suggests that early interventions directed toward the children of unassimilated families are likely to be far more effective than increases in schooling quality or decreases in tuition advocated in recent Dutch policy debates (see e.g. Oosterbeek and Webbink (1995) or Dur and Teulings (2002)). Such interventions are inherently controversial because they intervene in family child rearing. At the same time, they are likely to be effective. They are worth putting on the table front and center in the Dutch policy debate.

4 SUMMARY AND CONCLUSIONS: GENERAL POINTS

This lecture presents a framework for thinking about human capital policy. It stresses the need to recognize the dynamic nature of the human capital accumulation process and the multiplicity of actors and institutions that determine human capital investments. It emphasizes heterogeneity in skills, and the need to account for heterogeneity in designing policies to foster skill.

Because human capital is an investment good, it is important to account for the life cycle dynamics of learning and skill acquisition in devising effective policies. Schooling is only one phase of the lifetime skill accumulation process. Families, firms and schools all create human capital.[13] Any comprehensive analysis of human capital policy must account for the full range of institutions that produce it.

Learning begets learning because of dynamic complementarities. The empirical evidence presented in this paper all points in this direction, although substantial gaps in the empirical knowledge base remain to be filled. Recent research demonstrates the importance of the early years in creating the abilities and motivations that affect learning and foster productivity. Recent research also demonstrates the importance of both cognitive and non-cognitive skills in the workplace and in the skill acquisition process. These skills are a form of human capital and can be produced. Some of the most effective interventions operate on non-cognitive skills and motivations (Carneiro and Heckman (2003)).

I have summarized the substantial body of evidence on the first-order importance of ability and motivation in producing skills. Cognitive and non-cognitive

13 In this lecture I focus on families and schools. See Carneiro and Heckman (2003) for an integration of the economic effect of families, firms and schools on skill formation.

deficits emerge early, before schooling, and, if uncorrected, create low-skilled adults. A greater emphasis needs to be directed toward family policy. The evidence on high quality, early interventions summarized in Heckman (2000), Heckman and Lochner (2001), Karoly (2001), and Carneiro and Heckman (2003) reveals that early deficits can be partially remedied.

The traditional approach to human capital policy focuses on schools. But families are just as important, if not more important than schools in promoting human capital. The evidence from failed families points to possible benefits from interventions in them. This raises a new set of questions about whether or not society should respect the sanctity of the family for certain dysfunctional groups.

The evidence on credit constraints reveals the unimportance of short-term family income constraints in accounting for the schooling differentials manifest in Figure 4. A lot of the evidence that is alleged to support widespread credit market problems is found to be ambiguous on the problem. At the same time, there is a small group of high school graduates (0-8%) who are constrained and for whom a *targeted* transfer policy may be effective. Broadly-based policies, like President Clinton's HOPE Scholarship, cut too wide a swath. More than 90% of its recipients would have gone to college without the program, so it generates massive dead weight.

5 SOME LESSONS FOR THE DUTCH ECONOMY

This lecture contains important lessons for Dutch educational policy. Problems in the US have clear counterparts in Holland, although the market for labor and the educational institutions and policies are not identical in the two countries. Both countries are experiencing a slowdown in the rate of growth of the skill of the workforce relative to the growth in demand for skilled labor. In the US this is due to migration and to a slowdown in the long-term secular increase in the growth of college enrollment related to adverse family and social backgrounds of children, even among native-born Americans. In Holland, the slowdown is due to a large influx of unskilled immigrants, the drop in the fertility rate of indigenous Dutch families, and a slow process of assimilation of second generation migrant children who perform poorly in school, drop out, and do not acquire skills needed for the modern economy (see van Ours and Veenman (2001)). The slowdown in skill formation threatens to retard economic growth and promote economic and social inequality.

Holland, with a well defined and easily policed border, can substantially affect the flow of unskilled immigrants from outside the Schengen region, and can raise skill requirements in a way that the United States cannot. The appropriate policy toward immigrants already settled in the country is less obvious. Barring expulsion, policies that increase absorption and raise skill levels are desirable. Such policies should start early - before the schooling years. Current policy in Holland uses schools to attempt to remedy bad environments. Such policies ignore the

early years and the role of the family in producing successful students. The best evidence suggests that school-based interventions are only partially effective and that starting earlier will greatly improve the success of interventions. Successful programs would emphasize formation of both cognitive and non-cognitive skills.

The evidence from the US suggests that training policies directed toward adult, unskilled, first-generation immigrants are unlikely to be effective. Wage subsidies of the sort advocated by Phelps (1997), and policies that promote wage flexibility in the Dutch labor market are much more likely to be effective in promoting employment, but they have to be selectively applied to avoid perpetuating poverty in the next generation (for a discussion of such policies see Carneiro and Heckman (2003)). For second generation immigrants, early childhood and mentoring programs are likely to be effective remedies for adverse environments. Policies directed at school reform or tuition subsidies are much less likely to be effective, given the importance of the early years on the success of later interventions. Tax and tuition policies are also unlikely to be effective in substantially eliminating skill gaps.

Early intervention policies are also much more likely to be effective in promoting an increase in college-going and advanced skill training among indigenous Dutch youth. Increasing schooling attendance at higher skill levels is the only way to offset the decline in the fertility rate among the native Dutch. Otherwise the twin confluence of a decline in the fertility rate among natives and a growth in the unskilled immigrant rate threaten to undermine productivity growth, reduce the growth of real wages, and promote inequality.

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