



Published in final edited form as:

Econ Hum Biol. 2009 March ; 7(1): 1–6. doi:10.1016/j.ehb.2009.01.002.

Investing in Early Human Development: Timing and Economic Efficiency

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Abstract

Policy discussions to ameliorate socioeconomic (SES) inequalities are increasingly focused on investments in early childhood. Yet such interventions are costly to implement, and clear evidence on the optimal time to intervene to yield a high economic and social return in the future is meagre. The majority of successful early childhood interventions start in the preschool years. However socioeconomic gradients in cognitive skills, socio-emotional functioning and health can be observed by age three, suggesting that preventative programmes starting earlier in childhood may be even more effective. We discuss the optimal timing of early childhood intervention with reference to recent research in developmental neuroscience. We motivate the need for early intervention by providing an overview of the impact of adverse risk factors during the antenatal and early childhood periods on outcomes later in life. We provide a brief review of the economic rationale for investing early in life and propose the “antenatal investment hypothesis”. We conclude by discussing a suite of new European interventions that will inform this optimal timing debate.

Keywords

Early childhood intervention; SES inequalities; brain development

1. Introduction

Inequalities in health, cognitive development, and socio-emotional functioning emerge early in life. Many subsequent social issues, such as crime, teenage pregnancy, low education and unemployment can be traced to an adverse early years’ environment. Limited evidence suggests that targeted, early intervention programmes aimed at disadvantaged children and their families are an effective means of reducing these inequalities. Such early childhood interventions can partially compensate for risk factors that compromise children’s most critical stages of early development. Pioneering experimental studies, such as the Carolina Abecedarian programme (Ramey et al., 2000), High/Scope Perry Preschool programme

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Contributors: All authors contributed to conception and design of the paper. All authors contributed to the revising the intellectual content of the article. This draft was written by OD and CH, with comments by JH and RT. Background studies that underpin the views presented in this paper were carried out by all authors. OD is guarantor. All authors have seen and approved the final version.

Conflict of Interests: No conflict of interest to declare.

(Schweinhart et al., 2005), Chicago Parent-Child Programme (Reynolds et al., 2002), and the Nurse-Family Partnership (Olds, 1997), have long been used to justify investing in early childhood in policy discussions worldwide.

These longitudinal studies find that the personal benefits (cognitive development, behaviour and social competence, educational attainment, earnings), social benefits (reduced delinquency and crime) and government savings (higher tax revenues, reduced social welfare spending), associated with intervening early in a child's life clearly outweigh the costs (Karoly et al., 2005). Investment in the early years is subsequently increasing, yet the question of the optimal age to intervene remains. This article describes the risk factors that motivate early intervention and reviews both the economic rationale for investing in early childhood and the evidence on the optimal timing of intervention to reduce inequalities. Based on the economic and biological arguments for early intervention we propose the "antenatal investment hypothesis" which suggests that investments made during the pregnancy period may yield the highest return. The article concludes by discussing a suite of new European interventions that will inform this optimal timing debate.

2. Early Childhood Inequalities

The intergenerational transmission of socioeconomic inequalities in children's health, and cognitive, behavioural and emotional development emerge early and, without intervention, may persist through life (Najman et al., 2004). Evidence based on UK data finds that for children born in 1970, there is a 13 percentile gap in an index of cognitive development at 22 months between children from high and low socioeconomic status (SES) families (Feinstein, 2003). More recent data from the UK Millennium Cohort Study, also show a significant socioeconomic gradient in children's development by age 3 upon controlling for a range of parental and child characteristics. Figure 1 demonstrates that children of low-educated mothers typically have poorer pregnancy outcomes, as measured by child birthweight; lower cognitive skills, as measured by the Bracken School Readiness Index; and poorer socioemotional and behavioural skills, as measured by the Strengths and Difficulties Questionnaire, compared to children from high-educated families. The goal of early childhood interventions is to reduce such inequalities in the early years so as to prevent the further acceleration of these problems later in life.

3. Why Intervene Early?

3.1 Risk factors

Intervening in the zero-to-three period, when children are at their most receptive stage of development, has the potential to permanently alter their development trajectories and protect them against risk factors present in their early environment. Both biological and environmental conditions play a role. Children from low socioeconomic backgrounds typically have poorer health in terms of the prevalence of illness, the severity of illness, the likelihood of mortality, and the incidence of disease (Chen et al., 2002). Possible explanations for this include genetic influences, environmental exposures to toxins, quality of medical care, and behavioural factors (Anderson & Armstead, 1995). Adverse childhood experiences have also been linked to adult conditions such as ischemic heart disease and depression (Dong et al., 2004; Chapman et al., 2004).

Children from poorer households also have lower verbal and cognitive ability (Brooks-Gunn et al., 1999) and more emotional and behavioural problems (McLoyd, 1998) on average. Parental education, particularly that of the mother (Haveman & Wolfe, 1995), plays a major role in the child's development as educated parents are, in general, better equipped to provide stimulating home environments. Evidence shows that the availability of learning materials in

the home can impact on the child's cognitive development (Molfese et al., 1996). Maternal depression is also linked with increased developmental difficulties in the child's behaviour and mental health (Cummings & Davies, 1994). Evidence also shows that children from low socioeconomic (SES) backgrounds may benefit more from formal childcare early in life than high SES children (Geoffroy et al., 2007).

3.2 Developmental neuroscience

Research in developmental neuroscience showing greater plasticity of the brain in the early periods, suggests that intervention programmes should begin as early as possible.¹ By demonstrating that the child's brain is far from mature at birth and is substantially changed by experiences, this literature has highlighted the importance of both intervening early and the timing of these experiences (Halfon et al., 2001). In particular, "sensitive periods", or windows of opportunity for certain developments to take place, have been identified (Wynder, 1998). For example, the sensitive period of phonology is from the sixth month of fetal life through the first year (Ruben, 1997). Similarly, there is a decline in the average proficiency of language with increasing ages of exposure, beginning as early as 4 to 6 years of age (Johnson & Newport, 1989). The zero-to-three age period is vital for the production and subsequent retention of synapses, therefore inadequate stimulation during this period can have large and lasting negative effects on subsequent development (Kotulak, 1998). More recent work has shown that the early environment can directly affect the expression of genes which control the development of the brain and nervous system (Weaver et al., 2004). This work is preliminary and further research on the interaction between biological and environmental factors is needed.

4. Economic Return to Early Intervention

While equity considerations are central to the early intervention argument, another consideration for policy makers is economic efficiency. Early investment in preventive programmes aimed at disadvantaged children is often more cost effective than later remediation (Carneiro & Heckman, 2003). By investing early, the benefits are larger and are enjoyed for longer, which in turn increases the return to investment. The curve in Figure 2 summarises the body of evidence on the rate of return to investment at different stages of the life cycle as developed by Carneiro and Heckman. It illustrates that there is a higher rate of return at younger ages for a constant level of investment. In addition, as the technology of skill formation and accumulation posits that skill begets skill and early skill facilitates later skill acquisition (Heckman, 2006), early investment raises the productivity of later investment. This return is generated from returns to the individual in terms of increased earnings, higher education, improved physical and mental well-being, and also through the positive externalities to society in terms of reduced crime and delinquency, public expenditure savings and increased tax revenues. The economic argument for early investment does not preclude later investment; rather it argues that there are dynamic complementarities to be gained from investing at different stages of the life cycle, starting as early as possible (Heckman et al., 2006).

4. How Early is Early?

Evidence on early childhood interventions is largely based on a number of US-led experimental studies. However, as these interventions were diverse in terms of treatment, environment and duration, direct comparisons to determine their relative effectiveness is difficult. Randomised control trials of the Carolina Abecedarian programme, a centre-based intervention with home visiting, showed that intervening in the zero to five age period was more successful at improving cognitive ability and educational outcomes, than the school-age intervention

¹While the growth of neurons does not increase substantially after birth, the neural connections between these these cells (synapses) are formed rapidly up to the age of three (Hannon, 2003).

(Campbell et al., 2002). Yet the Infant Health and Development Programme, which targeted low birthweight babies, showed that the age zero-to-three intervention had few long term effects on cognitive, educational, and behavioural outcomes at age 8 and 18 (Goldman et al., 2006). In contrast, the Perry Preschool programme, which was a two year, high-quality, high-intensive programme beginning at age three, produced large effects across multiple domains (Schweinhart et al., 2003). The Head Start programme, created in 1965, is the longest running federal US early intervention programme targeting low income children between the ages of 3 and 5. While similar to the Perry programme in style, the evidence on its effectiveness is mixed, with reports of the initial positive effects on IQ fading-out over time (Barnett, 1995), yet long-term impacts on high-school drop-out, earnings and crime have also been identified (Garces et al., 2002). The evidence on the optimal timing of intervention is therefore conflicting.

Most successful interventions start before age three, however a truly preventative programme should begin pre-birth as the fetal environment and maternal behaviour during pregnancy has significant long-term consequences for the child's health and development. For example, substance misuse during pregnancy can lead to birth defects and developmental delays (Okah et al., 2005), intrauterine growth restrictions resulting in low birthweight (Ventura et al., 2003), and a higher incidence of behavioural problems, such as increased hyperactivity and chronic aggression (Tremblay et al., 2004). The first trimester is particularly important as infectious diseases, neurotoxins and nutrient deficiencies may have a detrimental effect on future brain development (Shonkoff & Phillips, 2000).

Low birthweight subsequently affects a child's cognitive abilities leading to poorer performance on IQ tests (Saigal et al., 1991), lower academic performance in the future (McCormick et al., 1996), increased likelihood of need for special education or grade retention (Ross et al. 1991), and poorer language and social skills (Hack et al., 1992). Low birth weight can also lead to a higher incidence of behavioural problems such as increased attention deficit (Pharoah et al., 1994). The literature has also identified a relationship between poor antenatal nutrition and cognitive and behavioural outcomes (Korenman et al., 1995). Poor maternal nutritional intake during the prenatal period can have an adverse effect on the child's neurodevelopment and health in later life (Barker, 1998).

Although there are few rigorously evaluated interventions which start during the antenatal period, the Nurse-Family Partnership programme, whereby nurses deliver home visits to families which begin during pregnancy and continue until the child is age two, has proven results. The programme has been tested in three randomised control trials in the US. A follow-up study at age 6 found that children visited by nurses had higher intellectual functioning and receptive vocabulary scores and fewer clinical behavioural problems compared to the control group (Olds et al., 2004). A study conducted in adolescence reported that the treatment children experienced lower rates of child abuse and neglect, and reported fewer sexual partners and arrests than the control group (Olds et al., 1997). These effects were strongest for children of young, primiparous, unmarried, low socioeconomic status mothers. The mothers of these treatment children had fewer subsequent pregnancies and improved birth spacing and employment rates.

5. The Antenatal Investment Hypothesis

Current evidence on antenatal interventions, while limited, would therefore suggest that the returns to investing in this period are high, yet an explicit test of this hypothesis is lacking. By amending Figure 2 to incorporate the antenatal period from conception to birth Figure 3 presents a graphical illustration of the antenatal investment hypothesis. The hypothesis can be displayed as two downward sloping investment curves representing the rate of return to

investment starting in the antenatal period (upper curve), and the postnatal period (lower curve). If the hypothesis is correct, the return in both cases is greatest for earlier rather than later investment. This hypothesis also indicates that the return on the antenatal investment will be higher than the postnatal investment, both initially and in the long-term, and may increase the rate of return on investment at every subsequent period. As the Nurse-Family Partnership had a greater impact on young women having their first child, the hypothesis may be further extended to investigate whether supporting women at the beginning of their reproductive life leads the benefits of the intervention to be carried over to subsequent births.

An explicit study which tests the antenatal investment hypothesis and models the impact of intervening at different stages of the child's and mother's life is needed. Current knowledge in this area is based on a small number of predominantly US studies, and it cannot be assumed that the effectiveness of a US-style intervention can be replicated in a European setting given the differences in social welfare systems and cultural contexts. For example, social welfare spending in Ireland is half that of Sweden (OECD, 2006). An optimal study design would incorporate a series of randomised interventions with programmes starting at different ages. A longitudinal study would reveal the impact of the timing.

6. Discussion

Interventions are costly to implement, therefore in order to derive the greatest benefits for children, while simultaneously having a high rate of return for investors, further research on the optimal time to intervene is needed. New policy initiatives recently launched in Europe represent a significant move towards investment in the antenatal and early years period. The UK Government has launched a large-scale pilot study of the Nurse-Family Partnership which will recruit 1,000 families in 10 areas across England (UK Cabinet Office Social Exclusion Task Force, 2007). In addition, similar experimental antenatal interventions are taking place in France, Germany and Italy, enabling an important cross-national comparison. Finally, the first large-scale European childhood intervention programme has been initiated in Ireland. The Irish Government is co-funding, with Atlantic Philanthropies, a series of childhood interventions, many of which will be evaluated by randomised control trial. The programme is characterised by a large number of interventions which vary in terms of treatments, duration, and intensity. However, unlike the US studies there is some comparability across sites as the interventions are taking place simultaneously, and with elements of a common measurement framework. This enables a systematic comparison of the relative merits of one form of intervention over another. Importantly, as some of the interventions start in the antenatal period and others at later stages of childhood, this programme may shed light on the optimal timing debate.

Acknowledgments

Thanks to Lori Timmins for excellent research assistance. Thanks also to colleagues at the Coombe Womens Hospital, Dublin, and Liam Delaney for discussions on the antenatal investment hypothesis.

Funding: This research is supported by the Irish Government National Development Plan through the Programme for Research in Third Level Institutions.

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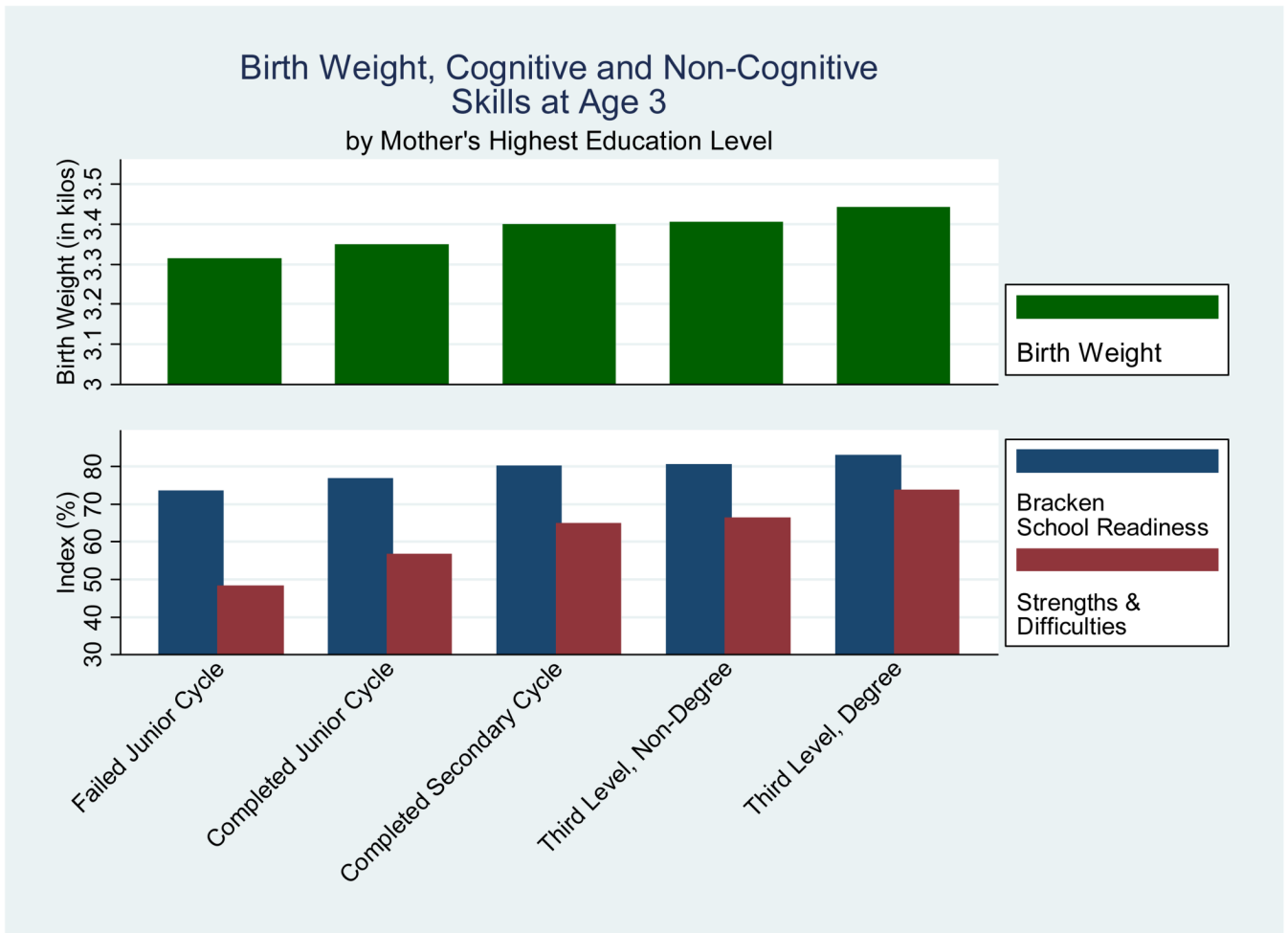
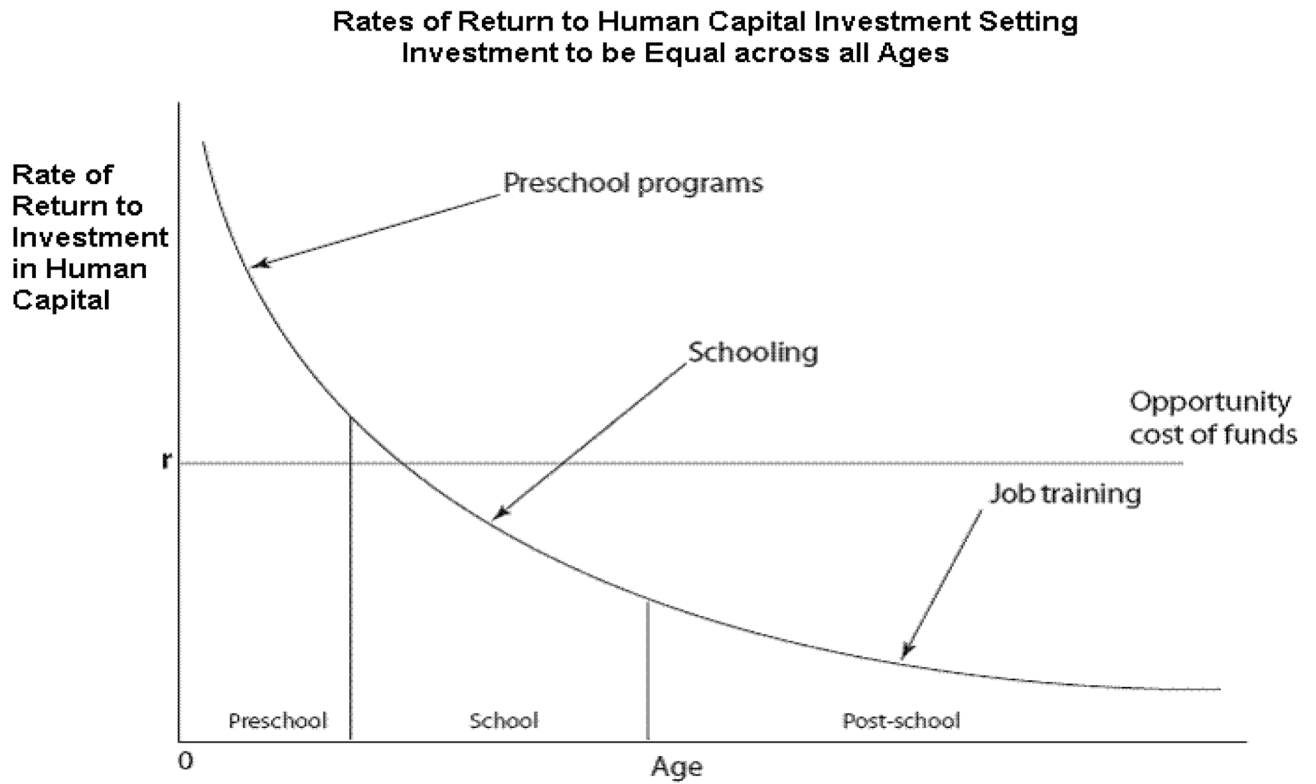


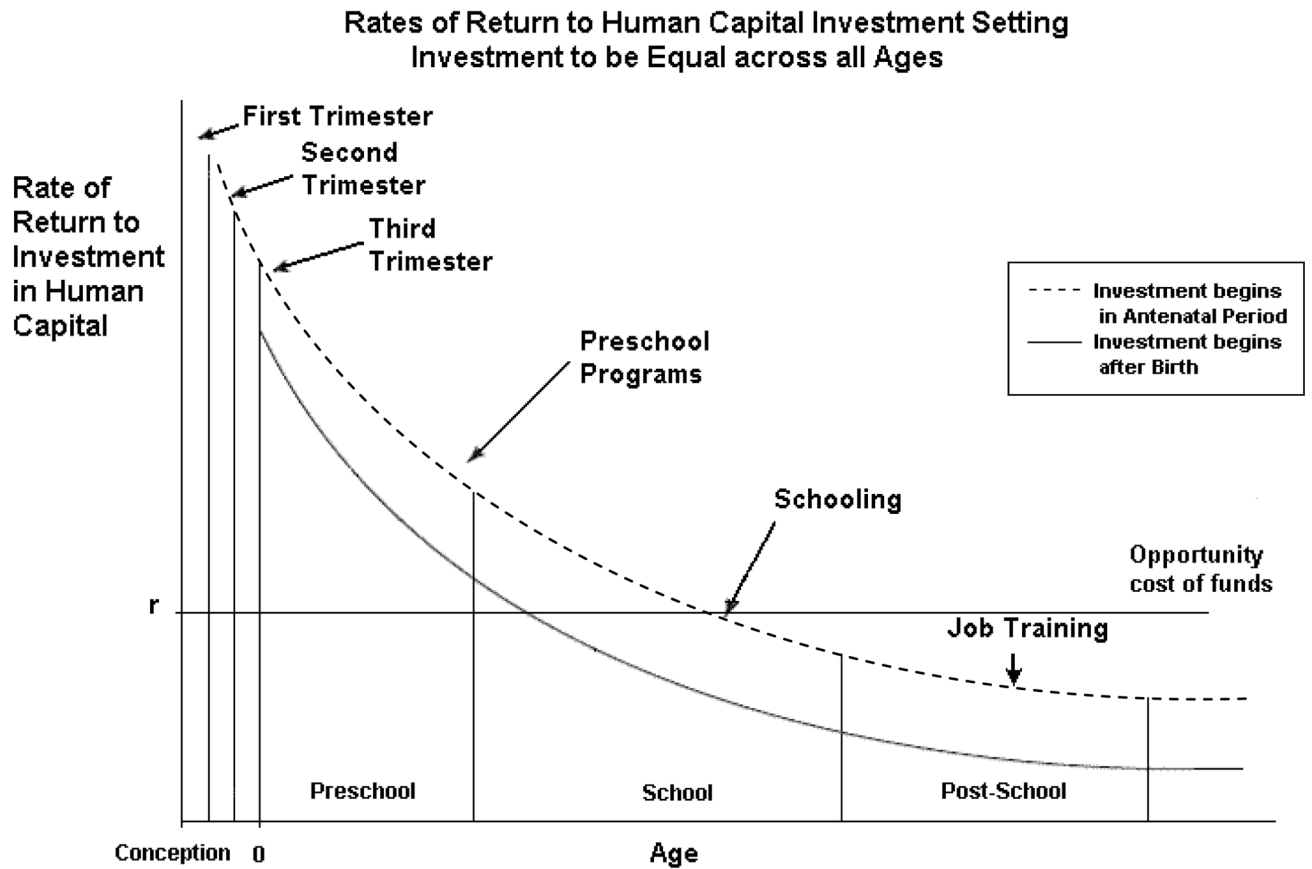
Figure 1.

Figure 2a



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

Figure 2b



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

Figure 2.
Source: Carneiro and Heckman, 2003.