The Economics of the Family and the Economics of Child Development: Becker and Tomes and Its Aftermath

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- While there were many other models of intergenerational inheritance of physical wealth, none had examined the intergenerational transmission of human capital.

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  1. One period of childhood
  2. Scalar measure of capability "ability" or "human capital"
  3. Scalar measure of investment (schooling, etc.)
  4. Role of the parent is through active investment and through dealing with credit markets to secure investment in the child.

θ_g: **Capability** of children in generation g

I_{g-1}: **Investment** in children of generation g by parents of generation $g-1$

G_{g-1}: Investment in children of generation g by schooling (and other public goods)

e_g: Endowment of children at birth

Capabilities are created by investment and endowments.

$$\theta_g = \phi(I_{g-1}, G_{g-1}, e_g)$$

- A deterministic relationship.

Endowments: exogenous and subject to shocks u_g:

$$e_g = \lambda_0 + \lambda_1 e_{g-1} + u_g$$

- No direct effect of parents on transmission of endowments.

Markets:

a. Labor market: rewards human capital θ_g
W_g: Reward in generation g (payment per unit human capital)
L_g: "*luck*" in g (out of the control of the agent):

$$Y_g = W_g \theta_g + L_g$$

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b. Credit market in which agents (parents) can lend and borrow
   i. Becker-Tomes (1979) / Sheshadri and Greenwood (2001) Perfect markets (parents can lend and borrow and commit debt to future generation)
   ii. Generalized in Becker-Tomes (1986) to allow for imperfect markets across generations. (Parents cannot commit debt to future generations.)

Preferences:
Parental utility for generation g: U_g
Z_g is parental consumption

$$U_g = \eta(Z_g) + \underbrace{\delta}_{\text{altruism}} U_{g+1}$$

Dynastic form of the utility function:

$$U_g = \sum_{j=0}^{\infty} \delta^j \eta(Z_{g+j})$$

Parents' Problem:
Parents allocate resources between adult consumption Z_g and investment in the child I_{g-1} under different market settings.

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d. Multiple child families and interactions between children and parents and children

These papers are the basis of an active literature on intergenerational transmission
(see, e.g., Bjorklund, Jantti, Mazumbder, Solon, Haider, and Solon).

Good recent summary by Black and Devereux (2011)

Intergenerational Correlations of Earnings and Education

- Y_1 is income in generation "1"; Y_0 is income in generation "0"

$$\underbrace{\ln(Y_1)}_{\substack{\text{child}\\ \text{permanent}\\ \text{earnings}}} = \omega + \beta \underbrace{\log(Y_0)}_{\substack{\text{parent}\\ \text{permanent}\\ \text{earnings}}} + \underbrace{L_1}_{\text{"Luck"}} \tag{1}$$

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- β: the intergenerational elasticity (IGE)
- (1 - β): measure of intergenerational mobility

- Intergenerational correlation (ρ): an alternative to β

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- σ is the standard deviation of log earnings.
- Factors out the cross-sectional dispersion of log earnings in the two generations.
- β can be higher in one society than in another simply because the variance of log earnings in the child's generation is higher in that society.

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  a. Classical measurement error
  b. Alignment error (ages of father and son)

Table: Elasticity and correlations from Jäntti et al. (2006)

Country	**Elasticity** (β)	**Correlation** (ρ)
Men		
Denmark	0.071	0.089
	[0.064, 0.079]	[0.079, 0.099]
Finland	0.173	0.157
	[0.135, 0.211]	[0.128, 0.186]
Norway	0.155	0.138
	[0.137, 0.174]	[0.123, 0.152]
Sweden	0.258	0.141
	[0.234, 0.281]	[0.129, 0.152]
UK	0.306	0.198
	[0.242, 0.370]	[0.156, 0.240]
US	0.517	0.357
	[0.444, 0.590]	[0.306, 0.409]

Numbers in brackets below the point estimates show the bias corrected 95% bootstrap confidence interval.

Source: This reproduces much of Table 2 from Jäntti et al. (2006).

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- Observe I_0 and G_0 are perfect substitutes.

- Child endowments follow AR(1) process:

$$e_1 = \lambda_0 + \lambda_1 e_0 + \tau_1, \tag{5}$$

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- p is the return to a unit of human capital.

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- By maximizing the utility function with respect to parental investment and collecting terms, one arrives at

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  which is the form of the standard IGE regression.
- e_1 correlated with $\ln(Y_0)$ through common shock e_0.

- In steady state, $\sigma_0 = \sigma_1$

$$\beta = \frac{(1-\gamma)\tau p + \lambda_1}{1 + (1-\gamma)\tau p \lambda_1} \quad \uparrow \text{ as } \lambda_1 \uparrow, \tau \uparrow, p \uparrow, \gamma \downarrow .$$

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  4. governmental investment in human capital is less progressive so γ is smaller.

- Cross section variance of log Y_1 (steady state)

$$\text{Var}(\ln Y) = \frac{[1 + (1-\gamma)\tau p\lambda_1]p^2 \,\text{Var}(u)}{[1 + (1-\gamma)\tau p\lambda_1](1-\lambda_1^2)[1-(1-\gamma)\tau p]^2}$$

$$\uparrow \text{ in } \lambda_1, \tau, p, 1-\gamma$$

New term not in β is $\text{Var}(u)$

Can show that out of steady state as income inequality $\uparrow$, $\beta \uparrow$

Extensions of the Models in the *Treatise*

Recent research in the economics of the family (Cunha et al. 2006, 2007, 2008, 2009, 2010; Moon, 2008; Bernal and Keane, 2009; Todd and Wolpin, 2007; Del Boca, Flinn and Wiswall, 2010; Tartari, 2010; Conti et al., 2010; Akabayashi, 1995, 2000; Weinberg, 2006; Cosconati, 2009; Caucutt and Lochner, 2011) and research underway builds on earlier work by Becker and Tomes (1986) in the following ways:

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  4. Multiple capabilities (cognitive, noncognitive, and biological capabilities)
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  6. Interactions between child and parents in shaping investment (principle-agent problems)

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- $\theta_t = (\theta_t^C, \theta_t^N, \theta_t^H)$
- Each component may be a vector.

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- From age $T+1$ to $2T$ the individual lives as an adult and is the parent of a child.
- The individual dies at the end of the period in which he is $2T$ years-old, just before his child's child is born.

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- Parents invest in their children because of altruism.
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- The output of the investment process is a skill vector.

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- The **technology of production of skill** when the child is t years-old:

$$\theta_{t+1} = f_t\left(h, \theta_t, I_t\right), \qquad t = 1, \ldots, T. \tag{8}$$

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- f_t is neoclassical: strictly increasing, strictly concave, and twice continuously differentiable in I_t.
- Solve recursively to obtain:

$$\theta_{t+1} = m_t\left(h, \theta_1, I_1, \ldots, I_t\right). \tag{9}$$

- *Dynamic complementarity* arises when

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  1. Higher stocks of capabilities at age t promote the productivity of investment at that age;
  2. Investment today raises the stock of skills in future periods and raises the productivity of future investment.

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- This includes own and cross effects.
(*Cross complementarity of capabilities*)

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- Early parental emotional environments encourage the animals to explore (and learn) more.
- This technology also captures the critical and sensitive periods in humans and animals.

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   2. If
   $$\frac{\partial f_t}{\partial I_t}(\cdot) > \frac{\partial f_{t'}}{\partial I_{t'}}(\cdot) \qquad t \neq t'$$
   then t is a sensitive period, where "$\cdot$" is a common point of evaluation.

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  - Initially-determined trajectories fully determine life cycle evolution ("Types" as in Keane and Wolpin, 1997).
  - Dynamic complementarity explains why investment in more adults is more productive than for the less able.

1. Parental preferences for child outcomes

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   - Alternative: merit goods: Parents value specific outcomes, not necessarily child utility.

Preferences and the Optimal Life-Cycle Profile of Investments

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- w: wage rate
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- At the beginning of adulthood, the parents draw the initial level of skill of the child, θ_1, from $J(\theta_1)$, which they can influence through investment.

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- State variables for the parent: parental skills, h, the parental financial resources, b, and the initial skill level of the child, θ_1.
- c_1 and c_2 denote the consumption of the household in the first and second period of the life cycle of the child.
- The budget constraint is:

$$c_1 + I_1 + \frac{c_2 + I_2}{(1+r)} + \frac{b'}{(1+r)^2} = wh + \frac{wh}{(1+r)} + b. \qquad (10)$$

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- Problem of the parent:

$$V(h, b, \theta_1) = \max \left\{ \eta(c_1) + \beta \eta(c_2) + \beta^2 \delta E \left[V\left(h', b', \theta_1'\right) \right] \right\}. \tag{11}$$

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- It is essential to invest early to get satisfactory adult outcomes.
- But it is also essential to invest late to harvest the fruits of the early investment.

- More general technology:

$$h' = m_2\left(h, \theta_1, \left[\gamma\left(I_1\right)^{\phi} + \left(1-\gamma\right)\left(I_2\right)^{\phi}\right]^{\frac{1}{\phi}}\right), \tag{15}$$

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- Thus I_1 directly increases θ_2 which in turn affects the productivity of I_2 in forming h'.
- γ captures the net effect of I_1 on h' through both self-productivity and direct complementarity.

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- The other face of CES complementarity is that when ϕ is small, high early investments should be followed with high late investments if the early investments are to be harvested.
- In the extreme case when $\phi \to -\infty$, (15) converges to (14).

- This technology explains — why returns to education are low in the adolescent years for disadvantaged (low h, low I_1, low θ_2) adolescents but are high in the early years.

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- This technology explains — why returns to education are low in the adolescent years for disadvantaged (low h, low I_1, low θ_2) adolescents but are high in the early years.
- In the one-period model of childhood, inputs at any stage of childhood are perfect substitutes.
- Application of the one period model supports the widely held but empirically unsupported intuition that diminishing returns make investment in less advantaged adolescents *more* productive.

Optimal Investment Strategies for $\phi = 1$ (perfect substitutes)

- When $\phi = 1$, early and late investments are perfect CES substitutes, the optimal investment strategy is straightforward.

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- Productivity of early investment: γ; late investment $(1 - \gamma)$.
- Invest early if $\gamma > (1 - \gamma)(1 + r)$

General Case

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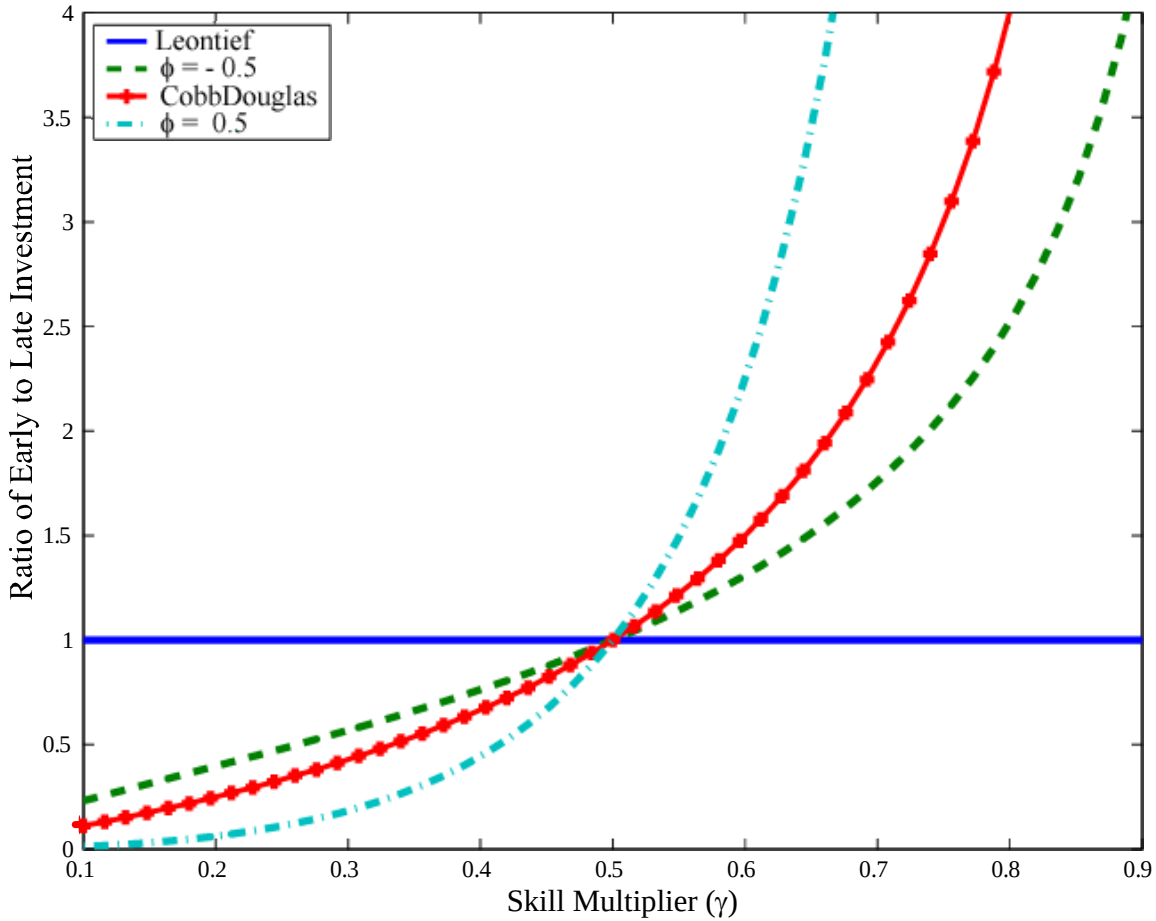
- $-\infty < \phi < 1$:

$$\frac{I_1}{I_2} = \left[\frac{\gamma}{(1-\gamma)(1+r)}\right]^{\frac{1}{1-\phi}}. \tag{16}$$

The Ratio of Early to Late Investment in Human Capital As a Function of the Skill Multiplier for Different Values of Complementarity



(Assumes $r = 0$)

Source: Cunha et al. (2007, 2009).

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- (But not other features of the model.)
- This generalizes Becker-Tomes.
- From the point of view of the child, this is a market failure due to the accident of birth.

Constraints on Borrowing Across Generations

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- Suppose parents cannot borrow against child's future earnings. (Becker-Tomes, 1986)
- A second credit constraint: the parental bequests must be non-negative and parents only have access to of a risk-free bond, and not to contingent claims.
- The problem of the parent is to maximize (11) subject to (10), the technology (15), and the liquidity constraint:

$$b' \geq 0. \tag{17}$$

- If binding, realized investment $\hat{I}_j$ less than optimal I_j^*
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- Under this formulation of market incompleteness, underinvestment in skills starts at early ages and continues throughout the life cycle of the child.
- **Lower investment in both periods $does\ not$ affect $ratio$ of investments** (I_1/I_2)**.**

- Both early and late investments depend on parental initial wealth b for the families for whom the constraint (17) binds.

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- Children who come from constrained families with lower b will have lower early *and* late investments.
- Interventions that occur at early stages would exhibit high returns, especially if they are followed up with resources to supplement late investments.

Parents Themselves Face Lifetime Liquidity Constraints

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- Parents are subject to lifetime liquidity constraints and constraints that prevent the parents from borrowing against their own future labor income, which may affect their ability to finance investments in the child's early years.
- Assume that parents' productivity grows exogenously at rate α.

- s: parental savings.

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- Parents face a sequence of constraints at each stage of the life cycle of the child:

$$c_1 + I_1 + \frac{s}{(1+r)} = wh + b \tag{18}$$

$$c_2 + I_2 + \frac{b'}{(1+r)} = w(1+\alpha)h + s, \tag{19}$$

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- Some parents may be willing to do this, especially when α is high.
- In the case when $s \geq 0$ and $b' \geq 0$ bind, and investments are not perfect substitutes, early income matters.

- Suppose $\eta(c) = \left(c^{\lambda} - 1\right)/\lambda$:

$$\frac{I_1}{I_2} = \left[\frac{\gamma}{(1-\gamma)(1+r)}\right]^{\frac{1}{1-\phi}} \underbrace{\left[\frac{(wh + b - I_1)}{\beta\left((1+\alpha)\, wh - I_2\right)}\right]^{\frac{1-\lambda}{1-\phi}}}_{\leq 1}.$$

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- $(1-\lambda)/(1-\phi) \in [0.8\bar{3}, 1.\bar{3}]$. Family resource influence on investment.

- This analysis of credit constrained families joined with a low value of ϕ interprets the fact that the timing of family income in the early stages of childhood apparently affects the level of ability and achievement of the children, although there is still some controversy about the empirical importance of this effect.

Estimating and Interpreting the Estimates of the Technology of Skill Formation

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- Can identify the technology under many different credit market structures.

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  f. Output as measured by test scores is meaningless.

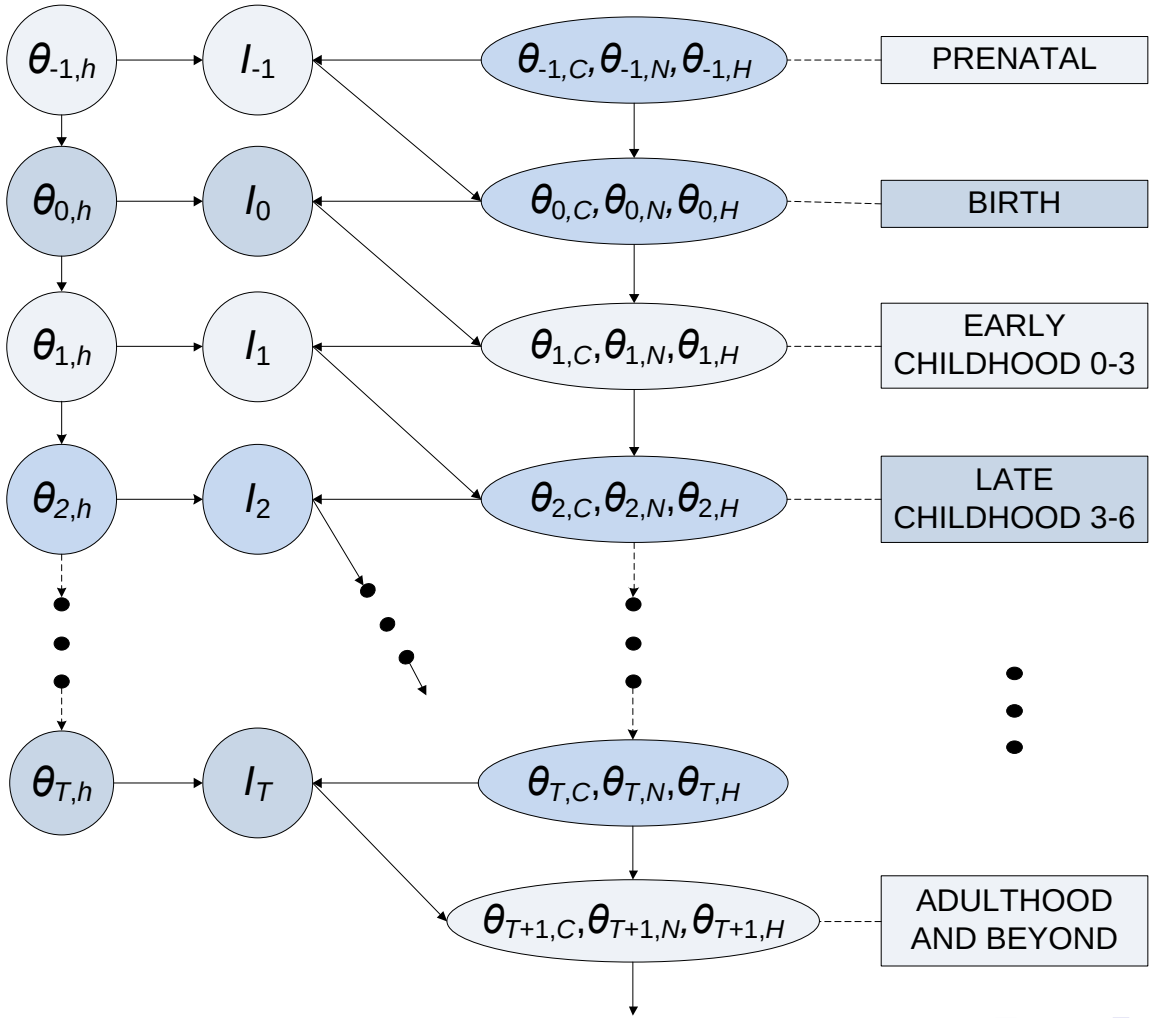
A Life Cycle Framework for Organizing Studies and Integrating Evidence

$\theta_t = (\theta_C, \theta_N, \theta_H)$ capacities at t

$\theta_{t,h}$: parental traits at t

I_t: investment at t

$\theta_{t+1} = f_t(\theta_t, I_t, \theta_{t,h})$: **Technology of Skill Formation**



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  a. Self-productivity becomes stronger as children become older, for both cognitive and noncognitive skill formation (i.e., $\frac{\partial \theta_{t+1}}{\partial \theta_t} \uparrow t$).
  b. Complementarity between cognitive skills and investment becomes stronger as children become older. The elasticity of substitution for cognition is *smaller* in second stage production.

- ($\sigma_C \doteq 0.3$) It is more difficult to compensate for the effects of adverse environments on cognitive endowments at later ages than it is at earlier ages. This pattern of the estimates helps to explain the evidence on ineffective cognitive remediation strategies for disadvantaged adolescents reported in Cunha et al. (2006).

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(d) Complementarity between noncognitive skills and investments becomes slightly *weaker* as children become older.

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- Noncognitive traits promote the accumulation of cognitive traits (but not vice versa).
- This econometric evidence is consistent with a broad array of evidence from interventions studies on life cycle profile of rates of return.

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- 16% is due to adolescent cognitive capabilities.
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- Measured parental investments account for 15% of the variation in educational attainment.
- These estimates suggest that the measures of cognitive and noncognitive capabilities are powerful, but not exclusive, determinants of educational attainment and that other factors, besides the measures of family investment that we use, are at work in explaining variation in educational attainment.

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- 50-60% of the variance in lifetime income determined by factors present at the time college-going decisions are being made (Cunha et al., 2005; Hoffman, 2010; Yaron et al., 2010)

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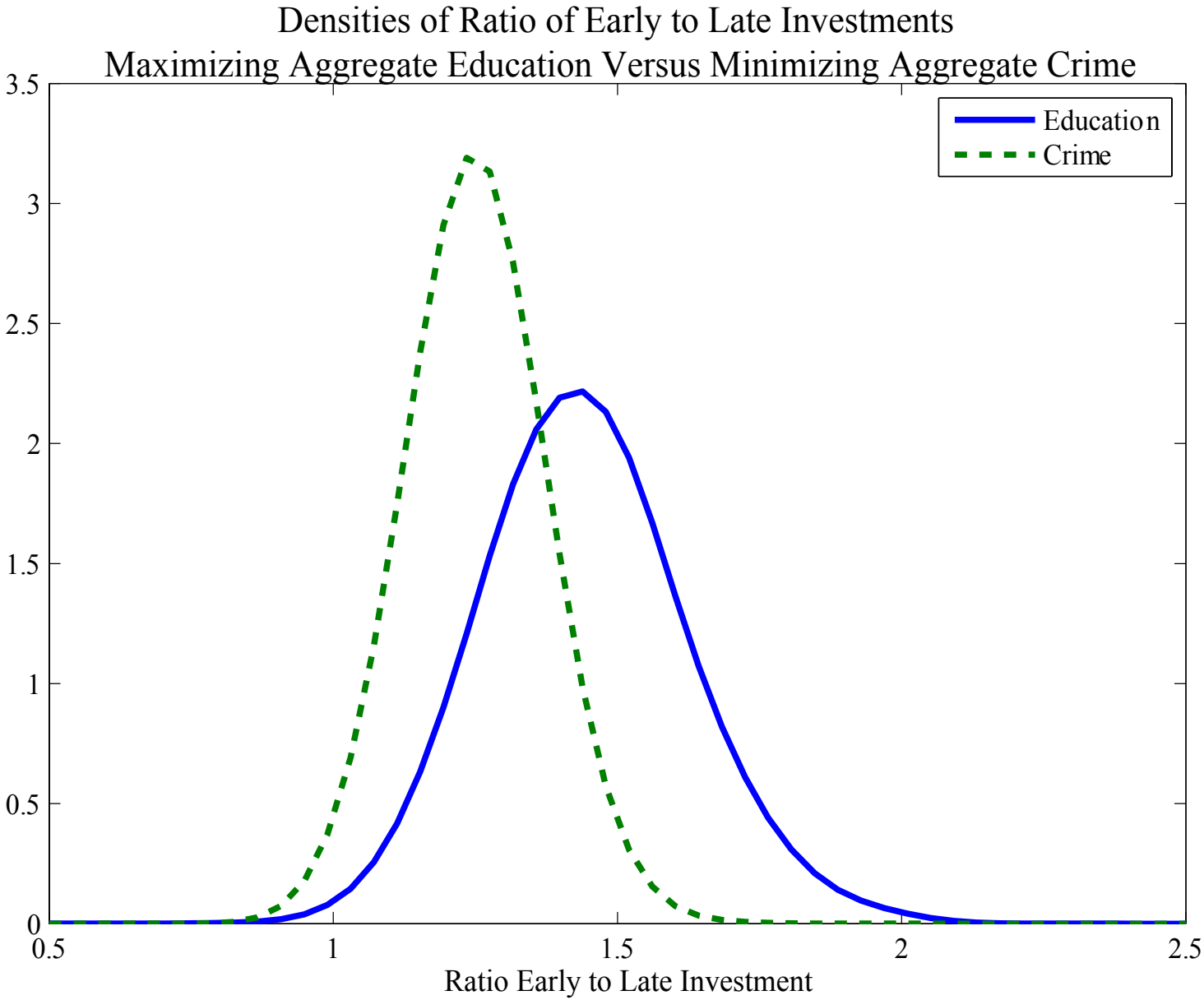
- The opposite is true for cognitive skills.


Densities of Ratio of Early to Late Investments
Maximizing Aggregate Education Versus Minimizing Aggregate Crime
Education
Crime
3.5
3
2.5
2
1.5
1
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Integrating Family Intervention Studies With Family Influence Studies

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- Many experiments that target early childhood—some long running (e.g., Perry Preschool)
- Evidence that they are effective (rate of return is 7–10%), and a primary channel of influence is through noncognitive skills — personality
  (Heckman, Malofeeva, et al., 2008; revised 2011).

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  b. Identify different technologies (public and private) that both produce the same θ_t
     (may use both)

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- Can establish the channels through which government (external) investment promotes capabilities.

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- Experimental interventions that supplement family life show that we can boost θ_t by interventions (surrogate parenting)

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- Skills are multidimensional.
- They produce inequality in education, wages, health, crime, and determine a host of important outcomes.

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- Progress in the economics of the family is essential in shaping understanding of the origins of inequality.
- Much recent work shows the importance of the early years in shaping skills.

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- Schools matter, but what schools do depends on what parents send them, and how parents support the children in school.

Appendix

Interpreting the Estimates of Cunha, Heckman, and Schennach

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- To examine the implications of these estimates, analyze a standard social planning problem that can be solved solely from knowledge of the technology of skill formation and without knowledge of parental preferences and parental access to lending markets.
- Determine optimal allocations of investments from a fixed budget to maximize aggregate schooling for a cohort of children.

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- These simulations produce a measure of the investment that is needed from whatever source to achieve the specified target.

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- Optimal ratio of I_1/I_2 depends on initial conditions.

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- Crime is more intensive in noncognitive skill than educational attainment, which depends much more strongly on cognitive skills.

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- Human capital policy, broadly defined, has important implications for social policy about health, crime, wage inequality, teenage pregnancy.