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„The Role of Early Childhood Education for Individual Earnings”

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Contents

1 Introduction

Education is commonly perceived as one of the main determinants of earnings.[1] Traditional human capital theory, however, has paid little attention to the exact timing of investment in skills, abilities and knowledge during the period of childhood. Figure 1 emphasizes the important role of the first years in life for the development of children. It shows the evolution of mean cognitive test scores for groups with different maternal education over the first 18 years in life. A crucial observation is that mean cognitive scores evolve over the first 5 years for all groups. During this time period gaps in cognitive scores between different groups emerge and remain almost constant afterwards. This observation indicates that the first years in life are essential for the development of certain skills. Furthermore, the evolution of skills is correlated with parental characteristics, such as maternal education. According to Figure 1, the level of cognitive skills is already determined when children enter compulsory school. Skills and Abilities are crucial for educational attainment and thus influence the distribution of individual earnings.[2] If one aims at reducing inequality, it is necessary to understand the mechanisms behind the dynamic process of skill production during childhood. Additionally, the relationship between different generations within families is crucial for an appropriate analysis, because children are highly dependent on their parents, especially during the first years of life.[3]

The main contribution of this thesis is an investigation of the link between early childhood education and future individual earnings. Section 2 presents two theoretical models where the underlying assumptions and the resulting implications can be directly related to the research question. The theoretical analysis focuses on the connection between parental investment decisions and the development of children. From the perspective of economic theory, section 3 discusses the role of parental characteristics for the development of children. Section 4 contains an overview of related empirical literature. The main part consists of an empirical study for Austria. I use data from the International Social Survey Program (ISSP) 2009 to examine the connection between parental investment in education

[1] Ben-Porath (1967) presents an economic model to describe the connection between the production of human capital and earnings over the life cycle. Card (1999) summarizes broad empirical literature on the link between schooling and earnings.

[2] The human capital literature considers innate ability as a crucial determinant of human capital and resulting inequalities. See, for example, Checchi (2006).

[3] See Cunha et al. (2006).

of children and net income. A critical assessment of methodological problems and a discussion of shortcomings complete the empirical analysis. Section 5 summarizes the main findings of this thesis.

2 Theory

This chapter presents two economic models to simplify the complex connection between different generations within families and to derive economic implications for the relationship between education and individual earnings. The first model by Becker & Tomes (1986) serves as a benchmark. Their model is based on classical human capital theory according to Becker (1975) and provides insights about the general connection between investment in human capital of children and their future earnings. In the second model, Cunha & Heckman (2007) extend the benchmark model to shed light on the link between early childhood investment and adult income. The theoretical implications build the basis for further discussion in the following sections.

2.1 Human Capital Theory

Becker & Tomes (1986) develop a model to analyze the transmission of earnings within families over generations. In this model a family consists of two generations, parents and their children. Parents are utility maximizing decision makers. They decide how to allocate family resources between their own consumption and investment in their children´s human capital. The model provides implications for different market settings. In the first section, parents have access to perfect capital markets, while in the second part they face capital market imperfections.

2.1.1 Perfect Capital Markets

The first interaction between parents and children takes place when a child is born. At this time, parents transmit biological factors and cultural environments to their descendants. Every child receives an initial endowment of these factors from their parents. It is impossible for individuals to influence the initial endowment. The level of endowments is exogenously given and constant over the whole life cycle. It only depends on the endowment level of parents. A stochastic-linear process models the transmission of endowments between generations:

$$E_t^i = \alpha_t + hE_{t-1}^i + v_t^i . \quad (1)$$

E_t^i is a vector of endowments of the ith family in generation t. The level of social endowment is represented by α_t, which is the same for all families of generation t.[4] The parameter h reflects the degree of inheritability. Becker & Tomes (1986) argue that endowments are only partially transmitted, i.e. $h \in (0;1)$. An implication of this assumption is that endowments over generations regress to the mean. Children from parents with endowments above the average receive a lower level of endowments than their parents, but are still better endowed than the average. The last term, v_t^i, accounts for luck in the transmission process. For further analysis the initial endowment level is considered as individual ability and the superscript i is omitted from equations.

This model assumes that all adults participate in the labor market. Their income Y_t is determined by their stock of human capital H_t and some market luck l_t.[5] It is assumed that the marginal productivity of human capital is exogenous and normalized to one. Then, the following equation describes adult income

$$Y_t = H_t + l_t . \quad (2)$$

Additionally, human capital is assumed to be homogenous. Thus, there is no distinction between skills, abilities or any other conceivable form of human capital. Parents can influence future earnings of their children by private expenditures in human capital.

Parental expenditures on human capital are denoted as x_{t-1} and public expenditures as s_{t-1}. Adult human capital is modelled as a function of parental and public expenditures during childhood as well as the level of inherited endowments:

$$H_t = \psi(x_{t-1}, s_{t-1}, E_t) . \quad (3)$$

Human capital is positively related to all inputs in the production function, therefore $\psi_j > 0$ for $j = x, s, E$. A higher level of endowments raises the effectiveness of expenditures in the

[4] Investments of a government are the only way to change the social endowment of a society.
[5] Market luck accounts for the fact that individuals with the same amount of human capital might differ in their income.

production process of human capital, hence $\partial^2 H_t / \partial j_{t-1} \partial E_t = \psi_{jE} > 0$ for $j = x, s$. Private expenditures are an investment of parents in their children. The marginal rate of return of such an investment, r_m, is determined by

$$\frac{\partial Y_t}{\partial x_{t-1}} = \frac{\partial H_t}{\partial x_{t-1}} = \psi_x = 1 + r_m(x_{t-1}, s_{t-1}, E_t). \quad (4)$$

From the assumption about the human capital function (3), it follows that $\partial r_m / \partial E_t > 0$. That is, individuals with more endowments have a higher marginal rate of return on private expenditures. Becker & Tomes (1986) argue that the marginal rate of return is a decreasing function of parental investment, therefore $\partial r_m / \partial x_t < 0$.[6] In this model, parents have full information about the market luck and about the marginal rate of return on private expenditures. Furthermore, parents have access to perfect capital markets. Individuals can borrow as much as they need at a fixed interest rate r_t and they are allowed to leave debt to their children.[7] Parents maximize the net income of their children as long as their own consumption is not affected. The net income is defined as earnings minus debt. Parents have to decide how much to invest in their children´s human capital. How much parents are willing to spend depends on the initial endowment of their child, public expenditures and the market interest rate. They invest until the marginal benefits equate the marginal costs. Marginal benefits of investment in human capital are equal to the marginal rate of return on private expenditures, r_m. Instead of investing in their children, parents can also invest on the capital market and earn a fixed interest of r_t. This determines the marginal costs. The optimal level of private expenditures is then defined by the following condition

$$r_m = r_t \text{ or } x^*_{t-1} = g(E_t, s_{t-1}, r_t). \quad (5)$$

Since capital markets are assumed to be perfect, parents can borrow whatever they need to realize the optimal expenditure level. The optimal investment level in human capital is therefore independent of parental income and preferences. It is a function of initial ability,

[6] The argument is that a higher level of investment raises forgone earnings and therefore opportunity costs of investment increase.

[7] This assumption is most likely not fulfilled in real life, but it simplifies the analysis. Section 2.1.2 investigates a scenario where parents are not allowed to leave debt to their children.

public expenditures and the market interest rate. The optimal level of private expenditures is defined by the intersection of the demand curve and the horizontal supply curve of funds (see Figure 2). From equation (4) it follows that the optimal expenditure level is positively related to initial endowments, i.e. $g_E > 0$. Children with higher initial endowments accumulate more human capital and have higher earnings. This positive relation is the result of a direct effect of endowments on the human capital level and the fact that higher initial endowments raise the optimal level of private expenditures. A higher optimal level of investment leads again to an increase in human capital and earnings. Since a higher market interest rate causes higher marginal costs of private expenditures, the optimal level of investment is a negative function of the interest rate, i.e. $g_r < 0$. The effect of an increase in public expenditures on the optimal level of private expenditures is less clear. Becker & Tomes (1986) consider the case, when private and public expenditures are perfect substitutes. Then the human capital production function (3) is determined by initial endowments and the sum of public and private expenditures. This leads to a situation of perfect crowding out. An increase in public expenditures is matched up by an equal decrease in private expenditures and the level of human capital remains unaffected. Nevertheless, private expenditures cannot become negative. Therefore, relatively high public expenditures can lead to an increase in the level of human capital.

In the case of perfect capital markets, the optimal amount of private expenditure is independent of parental income. Parents have free access to capital markets and can borrow as much as they need to finance the optimal level of investment. However, earnings of two generations are not fully independent from each other. The inheritability of endowments indirectly relates income levels over generations. A higher degree of inheritability leads to a closer connection between earnings of parents and children.

2.1.2 Imperfect Capital Markets

In some cases the assumption of perfect capital markets might not be appropriate. For instance, lenders might behave differently when the collateral is human capital and not physical capital. Parents might not be able to borrow as much as they need to finance

investment in their children´s human capital.[8] In this section, parents cannot contract debt for their children. They have to sell assets, reduce their own consumption or reduce their children´s consumption to finance investment. Now, parents decide how they allocate income between consumption and investment in their children´s human capital. As a consequence, the utility of parents depends on their own consumption as well as on their children´s future utility, which enters through a separable utility function. Children´s utility depends on their future income and is weighted by parental altruism parameter a. Utility functions are increasing and concave. An optimal solution to the maximization problem of parents balances the marginal costs of investing in children against the marginal benefits. Marginal costs are determined by foregone consumption. An additional unit of investment increases children´s human capital and consequently raises their future income. This determines the marginal benefits of parental expenditures in child education. The optimal level of private expenditure is then a function of initial endowments, public expenditures, parental income, the altruism parameter and uncertainty about children´s luck ε_{t-1}:

$$x^*_{t-1} = g(E_t, s_{t-1}, Y_{t-1}, a, \varepsilon_{t-1}) . \tag{6}$$

The optimal level of private expenditures is again determined by the intersection of the demand and the supply curve (see Figure 3). Now, the supply curve is no longer constant, because higher private expenditure implies a reduction in consumption. This raises the subjective discount rate, called the shadow cost of funds. Subjective discount rates are smaller for high income parents and parents of less endowed children. A higher parental income means that parents have more resources available for their own consumption and for expenditures for children. Hence, the optimal amount of private expenditures is positively related to parental income, $g_{Y_{t-1}} > 0$. In that case, parental income has not only an indirect effect on children´s earnings through inherited endowments, but also a direct effect. Future children´s income can be written as

$$Y_t = \psi[g(E_t, Y_{t-1}, k_{t-1}), s_{t-1}, E_t] + l_t = \phi(E_t, Y_{t-1}, k_{t-1}) + l_t , \tag{7}$$

[8] See Checchi (2006) p.19-20 for a discussion of different market failures due to the differences between human capital and physical capital.

where k_{t-1} includes a, s_{t-1} and ε_{t-1}. The derivative with respect to parental income leads to the following expression

$$\frac{\partial Y_t}{\partial Y_{t-1}} = \phi_{Y_{t-1}} + h\frac{\phi_{E_t}}{\phi_{E_{t-1}}} > 0\,. \tag{8}$$

The first term describes the direct effect of parental income on the income of children. The second term is the indirect effect through the transmission of endowments.[9]

The effect of initial endowments on the optimal amount of parental expenditures is now ambiguous. Higher endowed children produce more human capital and have higher earnings. This decreases the marginal utility of future consumption and thus the optimal amount of private expenditure falls. On the other hand, higher initial endowments raise the marginal productivity of investment in human capital. This leads to a higher optimal level of private expenditure. If public and private expenditure are perfect substitutes, the optimal amount of private spending will depend on the sum of s_{t-1} and Y_{t-1}. Therefore, an increase in public expenditures causes an income effect and raises consumption and investment in human capital.

2.1.3 Model Predictions

The formal model by Becker & Tomes (1986) describes the relationship between investment in human capital and individual earnings. Education is not an explicit ingredient in the model, but it can be interpreted as expenditure in human capital. Education is a process for the accumulation of human capital at financial costs. These can be direct costs or opportunity costs. In the model, private expenditure directly influences the amount of human capital and can therefore be interpreted as expenditures in education. In that sense, parents decide how much education their children receive during the period of childhood. According to the model of Becker & Tomes (1986), this decision depends on children´s ability, public expenditure in education, the market interest rate, parental preferences and the financial situation of the household. Education is proportional to the total amount of human capital, which directly transforms into income. Hence, education during the period of childhood is the main determinant of adult earnings. Childhood is modelled as a single period. It starts

[9] See Becker & Tomes (1986) p.12-13 for the derivation of the indirect effect.

when a child is born and it ends when an individual becomes an adult, enters the labor market and earns income. Thus, the period of childhood is a long period of time including years of early childhood and adolescent years. In general, private expenditure over such a long time period consists of many single payments. In the model, private investment in education can be interpreted as the sum of all single expenditures over the period of childhood. An implicit assumption is that expenditures over all years of childhood are perfect substitutes.[10] Therefore, it does not matter when an investment takes place. Investing one unit in education in the years of early childhood can be replaced by investing one unit in adolescent years without affecting the total amount of human capital. Hence, early childhood education is a main determinant for individual earnings, but it has the same effect on future income as education at any other point in time during the period of childhood.

2.2 The Technology of Skill Formation

In this section a model from Cunha & Heckman (2007) is presented to provide a deeper insight into the role of early childhood for adult outcomes. They develop a simple economic model to organize a large body of evidence on economics, psychology, education, neuroscience and the development of skills.[11] According to several empirical facts, the main differences to the model by Becker & Tomes (1986) can be summarized as follows. Parental characteristics are a direct input in the human capital production function. Childhood now consists of several periods. There is no distinction between abilities and skills and the terms can be used interchangeably. Abilities and skills consist of multiple components. They can be separated into cognitive and non-cognitive skills.[12]

2.1.1 Formal Model

The facts presented above build the basis for the formal economic model from Cunha & Heckman (2007). Abilities are produced by family characteristics, investment and genes. The production of skills is a dynamic process over several stages:

$$\theta_{t+1} = f_t(h, \theta_t, I_t)\,. \tag{9}$$

[10] See Cunha&Heckman (2007), p.31.
[11] See Cunha et al. (2006) for a broad discussion of the empirical literature and empirical findings.
[12] Cognitive skills are for example IQ. Non-Cognitive skills can be considered as motivation, self-discipline or patience.

At each period t an individual possesses a vector of skills, θ_t, including components of cognitive and non-cognitive skills. Each stage represents a period in the life cycle. The first period of the skill formation process starts when a child is born. At this point in time it receives an initial set of skills, θ_1. At each stage parents can invest in their children to improve cognitive and non-cognitive skills. I_t denotes parental investment at time t. Another input in the production function are parental characteristics h, such as IQ or education of parents. The output of the skill production process is a vector of skills in the next period. This model assumes that the function f_t is increasing and concave in I_t and twice differentiable in all of its arguments. The initial stock of skills θ_1 and parental characteristics h are exogenous. Parents can only influence the level of skills at time $t+1$ by previous investment. The recursive form of the technology above is given gy

$$\theta_{t+1} = m_t(h, \theta_1, I_1, ..., I_t). \tag{10}$$

Cunha & Heckman (2007) present several characteristics of the technology of skill formation, namely sensitive and critical periods, self-productivity and dynamic complementarity. In some stages certain skills can be produced more easily than in other stages. These stages are called sensitive periods. The formal definition of a sensitive period is

$$\frac{\partial f_t^*(h, \theta_t, I_t^*)}{\partial I_{t^*}} > \frac{\partial f_t(h, \theta_t, I_t)}{\partial I_t} \text{ for } t \neq t^*.$$

The time index t^* represents a sensitive period. In that period it is more efficient to produce a certain output, given the same level of inputs. If a certain skill can only be produced at a single stage, this stage will be called a critical period. The formal definition of a critical period is

$$\frac{\partial f_t(h, \theta_t, I_t)}{\partial I_t} = 0 \text{ for } t \neq t^* \text{ and } \frac{\partial f_t^*(h, \theta_t, I_t^*)}{\partial I_t^*} > 0.$$

It means that investment is productive only at stage t^*, but not at any other stage. The implication of sensitive and critical periods for investment decisions is that timing matters. Another characteristic of the technology f_t is called self-productivity. It is defined as

$$\frac{\partial f_t(h,\theta_t,I_t)}{\partial \theta_t} > 0,$$

which means that a higher stock of skills at stage t leads to a higher stock of skills in the next period. Since θ_t is a vector of multiple components of skills, the concept of self-productivity includes own and cross effects. One specific component of the skill vector θ_t^k can raise the stock of the same component at stage $t+1$ as well as any other component of the skill vector θ_t^m , $m \neq k$. The last feature of the technology of skill formation is called dynamic complementarity. It describes the fact that a higher stock of skills raises the productivity of investment at later stages:

$$\frac{\partial^2 f_t(h,\theta_t,I_t)}{\partial \theta_t \partial I_t} > 0.$$

Individuals with greater skills can use investment in a more efficient way than individuals with a lower skill level.

For simplicity, Cunha&Heckman (2007) analyze the case when childhood is divided into two periods: early childhood and late childhood. For a formal analysis the variables θ_1, I_1 and I_2 are assumed to be scalars and not vectors. The adult stock of skills is defined as $h' = \theta_3$. It determines the stock of adult human capital. Wages are exogenous and equal to the marginal productivity of human capital. The technology of skill formation is represented by a constant elasticity of substitution (CES) production function. The adult stock of human capital is given by the following expression

$$h' = m_2\left(h, \theta_1, [\gamma I_1^{\phi} + (1-\gamma) I_2^{\phi}]^{1/\phi}\right) \tag{11}$$

with $\phi \leq 1$ and $0 \leq \gamma \leq 1$. The adult stock of skills is a function of the initial stock of skills, parental characteristics, parameters ϕ and γ as well as early and late investment. The CES share parameter γ can be interpreted as a skill multiplier. It measures the productivity of early investment. Early investment directly increases the stock of skills in the second period, θ_2. As a consequence, self-productivity increases the amount of adult skills. A higher stock of skills in the second period also increases the productivity of late investment. This is a

consequence of dynamic complementarity. The parameter γ captures the net effect of I_1 on h'. The net effect includes both, the effect triggered by self-productivity and the effect of dynamic complementarity. The parameter ϕ measures the degree of complementarity between early and late investment. $1/(1-\phi)$ is the elasticity of substitution and measures how easy it is to substitute between early and late investment. A small value of ϕ indicates that it is hard to compensate low levels of early investment by late investment. To make early investment productive for adult skills they have to be complemented with late investment.

Cunha & Heckman(2007) derive the optimal investment decision of utility maximizing parents. For every unit of adult human capital parents earn a given wage w. The market interest rate is denoted by r. At the beginning of adulthood, parents receive a bequest b and obtain the initial condition θ_1 of their child. Parents decide how they allocate their resources between consumption in the first and second period, c_1 and c_2, investment in their child in periods one and two, I_1 and I_2, and the amount of financial bequest they leave to their child, b'. Capital markets are perfect and bequests to children can be positive or negative. The budget constraint of the parents is given by

$$c_1 + I_1 + \frac{c_2 + I_2}{(1+r)} + \frac{b'}{(1+r)^2} = wh + \frac{wh}{(1+r)} + b\,. \tag{12}$$

Parents maximize their utility, which consists of consumption over both periods and the expected future utility of their child. They discount future utility by the utility discount factor $\beta \in (0;1)$. The parental altruism factor is denoted by $\delta \in (0;1)$. The recursive formulation of the maximization problem is then defined as

$$V(h,b,\theta_1) = \max\left\{u(c_1) + \beta u(c_2) + \beta^2 \delta E\left[V(h',b',\theta_1')\right]\right\}. \tag{13}$$

This expression is maximized with respect to the budget constraint (12) and the technology of skill formation (11).

In the case of $-\infty < \phi < 1$, the optimal ratio of early to late investment is determined by[13]

$$\frac{I_1}{I_2} = \left[\frac{\gamma}{(1+r)(1-\gamma)} \right]^{\frac{1}{1-\phi}}. \tag{14}$$

The optimal allocation of investment is a function of the market interest rate r, the productivity of early investment relative to late investment γ and the elasticity of substitution $1/(1-\phi)$. In the case of perfect complements the optimal ratio is constant at value 1 and independent of the skill multiplier γ (see Figure 4). When ϕ is low and therefore complementarity high, the role of the skill multiplier is limited. Whereas, when ϕ increases, the skill multiplier becomes relatively more important. The higher the skill multiplier is, the more should be invested in early years. In the case of perfect capital markets the optimal ratio of early to late investment does not depend on parental resources or preferences. However, it does depend on parental characteristics h, because these characteristics affect the productivity of the technology of skill formation and therefore the productivity of investment. Cunha & Heckman (2007) argue that this can be interpreted as a market failure from the point of view of the child. Children would like to choose their optimal parents to complement their initial endowments θ_1 in an optimal way. The accident of birth is an important and inevitable constraint in the development of a child.

2.2.2 Imperfect Capital Markets

In addition to the natural constraint by the accident of birth, financial restrictions can influence investment decisions of parents. The first constraint considers the case where parents are not allowed to borrow against the future income of their children. They cannot leave debt to their children. Parental bequests to children must be non-negative $b' \geq 0$. If the constraint is binding, the resulting level of investment in period one $\hat{I}_1$ will be lower than the optimal amount in the case of perfect capital markets, $\hat{I}_1 < I_1^*$. This is also true for investment in the second period, $\hat{I}_2 < I_2^*$. This underinvestment is the result of an income effect. Parents do not have enough resources to finance their optimal level of investment. In that case, investment decisions depend on parental wealth. Higher parental wealth leads to

[13] See Cunha & Heckman (2007) for the special cases of perfect substitutes and perfect complements.

higher investment, since parents have more resources to spend. If the constraint is not binding, equation (14) will determine the optimal ratio between early and late investment.

A second constraint arises when parents cannot borrow against their own future income. In that case, let s denote parental savings from one period to the next and α is introduced to account for exogenous productivity growth of parents. The budget constraints for the first two periods are given by

$$\text{first stage: } c_1 + I_1 + \frac{s}{(1+r)} = wh + b \tag{15}$$

$$\text{second stage: } c_2 + I_2 + \frac{b'}{(1+r)} = w(1+\alpha)h + s$$

with $b' \geq 0$ and $s \geq 0$, i.e. savings have to be non-negative. Thus, parents cannot borrow against their next period income. The sub-utility function of parental consumption is defined as $u(c) = (c^{\sigma} - 1)/\sigma$. If the constraints $b' \geq 0$ and $s \geq 0$ are binding, the optimal ratio of early to late investment will be determined by

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

In this market setup family income plays an important role. The first factor shows the optimal condition in the case of perfect capital markets, equation (14). The second factor describes the influence of family income on the optimal investment decision. It is the ratio of early income to late income. If early income is low relative to late income, the ratio between early and late investment will be lower than in a perfect capital market framework. The size of this deviation is determined by the elasticity of intertemporal substitution of consumption, σ. The larger this elasticity is, the lower the deviation. If consumption in the first and second period are perfect substitutes, i.e. $\sigma = 1$, income in the first stage does not matter. The presence of credit constraints combined with a high degree of complementarity between early and late investment implies that family income in the first period matters for

the development of children, whereas family income in later years is not important for investment decisions.[14]

As already mentioned, skills and abilities are multiple in nature. Cognitive as well as non-cognitive skills play an important role in determining adult outcomes. The model presented in this section treats skills and abilities as a scalar. A more general technology of skill formation denotes θ_t as a vector of cognitive and non-cognitive skills, $\theta_t = (\theta_t^C, \theta_t^N)$. Investment and parental characteristics are also modelled as vectors with separated components, i.e. $I_t = (I_t^C, I_t^N)$ and $h = (h^C, h^N)$. The technology of cognitive and non-cognitive skills is then formulated as

$$\theta_{t+1}^k = f_t^k(\theta_t^C, \theta_t^N, I_t^k, h^C, h^N), \text{ with } k \in \{C, N\}. \quad (17)$$

Cross-productivity effects are an additional feature of this technology. The vector of non-cognitive skills is an input in the production function of cognitive skills and vice versa. Furthermore, this technology features critical and sensitive periods for different skills at different points in time.

2.2.3 Model Predictions

The model of the technology of skill formation has a similar structure as the model by Becker & Tomes (1986). The adult stock of human capital determines individual earnings. Education and schooling is not explicitly modelled, but it can be interpreted as a component of parental investment.[15] Education is a main determinant of income. The important difference compared to the model of Becker & Tomes (1986) is that childhood consists of two periods. The importance of early childhood investment depends on the degree of complementarity between early and late investment and the skill multiplier. In the presence of dynamic complementarity and self-productivity early childhood education is essential for future earnings. Early and late investment are not perfect substitutes as shown in the model of Becker & Tomes (1986). Therefore, early childhood education cannot be substituted by education in later years. It is essential for the development of individuals. The intuition of

[14] See Cunha&Heckman (2007), p. 42.
[15] See Cunha&Heckman (2007), p. 36.

this result is that education during the early period lays the foundation for later success, but early childhood education has to be followed by late investment to be effective.

3 Synthesis

According to the models described above, early childhood is particularly important for the development of children. In particular, the model of Cunha & Heckman (2007) emphasizes that investment during early childhood are essential for economic success at adult age. During this period, children are highly dependent on their parents. Parents make important decisions for their children and have a huge impact on their development. To improve the understanding of the role of early childhood education for individual earnings, it is essential to analyze how different family environments influence the development of children. Typically, a family environment has many components. This analysis, however, focuses on the role of parental characteristics, like IQ or education of parents.

3.1 The Role of Parental Characteristics

The model by Becker & Tomes (1986) includes a transmission process of endowments from one generation to the next. They argue that endowments consist of genetic and cultural components. Hence, parental characteristics are interpreted as parental endowments E_{t-1}. Parental characteristics are no direct input in the production process of human capital, but they determine the ability level of children E_t. The ability of children is a main determinant of optimal private investments in human capital. According to equation (1), parental characteristics do not transmit one by one into the ability level of children, but higher educated parents tend to have more able children than parents with a lower educational attainment. In the case of perfect capital markets, children from highly educated parents observe higher investment in their human capital and as a consequence higher incomes. In the presence of credit constraints the effect of a higher ability level on optimal parental investment is ambiguous.[16] However, parents with a relatively high level of education E_{t-1} earn more income than low educated parents. According to equation (6), this has a positive effect on the optimal amount of private investment in children. The optimal level of parental investment in children also depends on the altruism parameter a. A higher altruism

[16] See section 2.1.2 for a detailed explanation.

parameter means that parents care more about children's utility. As a consequence, these parents lower their own consumption and invest more in their children. In the model of Becker & Tomes (1986) the altruism parameter is exogenous, but one can argue that it depends positively on parental education. If for high educated parents the education of their children is more important than for low educated parents, the altruism parameter will be a positive function of parental characteristics, $a = f(E_{t-1})$ with $f_{E_{t-1}} > 0$. In that case, parents with a relatively high education level have more able children, more resources and a higher altruism parameter. An increase in the ability level of children has a positive as well as a negative effect on optimal private investment. The effects of a higher altruism parameter and higher income are positive. Thus, the overall effect of parental education on the development of children is positive, given that all three positive effects taken together exceed the negative effect.

In the model of Cunha & Heckman (2007) family characteristics are a direct input in the production function of skills at each stage, but they present no explicit assumption about the relationship between family characteristics and the output of the skill production. In this analysis it is assumed that parental characteristics have a positive effect on the production of skills, $\partial f_t / \partial h > 0$. Thus, children from higher educated parents can produce more skills. Higher educated parents possess more knowledge and are more able to transfer this knowledge to their children. In that sense, parents with a higher education are assumed to be better teachers for their children in early years. Another hypothesis emphasizing this assumption is that education has a higher value for higher educated individuals. The additional assumption of $\partial f_t / \partial h > 0$ leads to a positive relationship between parental characteristics and the development of children. Consider two children with the same initial condition $\tilde{\theta}_1$ and the same amount of investment $\tilde{I}$ in both periods. The only difference is due to family characteristics. Child 1 observes parents with a higher education than parents of child 2, i.e. $h^1 > h^2$.[17] From the assumption $\partial f_t / \partial h > 0$ follows that child 1 produces a higher stock of skills during the first period than child 2, i.e. $\theta_2^1 > \theta_2^2$. Hence, in the second period child 1 faces not only higher parental characteristics, but also a higher stock of skills.

[17] The superscript indicates the index of the child.

In the presence of dynamic complementarity and self-productivity a higher stock of skills is more productive in the generation of adult human capital, independent of family characteristics. This multiplier effect amplifies the direct effect of family characteristics on adult human capital. In the presence of imperfect capital markets, higher educated parents additionally earn more income and face a lower risk of being credit constraint.

Both theoretical models point in the direction of a positive relation between parental characteristics and the accumulation of human capital during childhood. Parents with a relatively high education are more likely to have children with a relatively high stock of human capital and therefore relatively high individual earnings. Additionally, in the case of imperfect capital markets, high educated parents are able to invest more in their children than parents with a lower educational attainment.

3.2 Investment in Disadvantaged Children

Since children cannot choose their parents, a natural constraint exists by the accident of birth.[18] This raises the question how and at which age children from disadvantaged families should be compensated.

According to Becker & Tomes (1986) it does not matter when an intervention for disadvantaged children takes place, because investments over time are perfect substitutes. Furthermore, they argue that investment in children from relatively poor families yields a higher rate of return than investment in children from richer parents. There is no equity-efficiency trade off in redistribution towards less advantaged children, at least in the case of imperfect capital markets. Carneiro & Heckman (2002) argue that the timing of credit constraints matters. They find evidence that family income is unimportant for educational decisions in adolescent years. It is rather the case that the financial situation of families in early years is essential for educational attainment. This is consistent with the model by Cunha & Heckman (2007). They argue that intervention programs toward disadvantaged children should occur in early years. The dynamic and complementary skill formation process makes interventions in early years more efficient than later interventions. Furthermore, Cunha & Heckman (2007) claim that no equity-efficiency trade off exists in early years, but in contrast to Becker & Tomes (1986), a trade off exists in later years, because investment in

[18] See Cunha&Heckman (2007), p.39.

disadvantaged adolescents yield lower marginal rates of return than investments in high-able adolescents.

Certain policy reforms are aware of the important role of early childhood education. Dustman&Schönberg (2012) investigate the effect of an expansion of maternity leave coverage on long-term outcomes of children. The idea of such an expansion is that mothers can spend more time at home and therefore foster early childhood development.[19] They find no evidence that an expansion of maternity leave coverage has a significant effect on long-run outcomes. Morchio (2013) argues that child care time is correlated with the education level of parents. Hence, one possible explanation for the ineffectiveness of an expansion of maternity leave coverage for long-run outcomes is that this policy reform does not account for the role of parental characteristics. It might be the case that not all mothers are capable of spending time with their children in the most efficient way. Additionally, non-cognitive skills are important for certain adult outcomes. It can be argued that these skills are produced more efficiently by the interaction with other children and not with parents.

Overall, differences in the family environment are a main cause for different developments of children. According to economic theory, intervention programs towards disadvantaged children should occur in early years of the life cycle, because they are most efficient at this point.

4 Empirics

The previous sections provide several theoretical results about the relationship between the development of children and future outcomes. This chapter compares the theoretical implications with empirical evidence. An empirical analysis is necessary to develop a thorough understanding of the role of early childhood education for individual earnings. This section starts with a short overview on the empirical literature. The main part of this chapter consists of an empirical analysis of the relationship between parental investment in education of children and individual net income in Austria. It is followed by a critical assessment of the empirical work.

[19] According to Morchio (2013) child care time is a major component of investment in early years.

4.1 Empirical Literature

One of the most widely used methods, to detect the causal relationship between education and earnings, is called the human capital earnings function. [20] It is based on Mincer (1974) and serves as a benchmark in the empirical literature on returns to education. The human capital earnings function is specified by the following expression:[21]

$$\log(y) = a + bS + cX + dX^2 + \varepsilon . \tag{18}$$

The dependent variable is the logarithm of individual earnings, i.e. $\log(y)$. The years of completed education is written as S, while X is the number of work experience, which also enters as a quadratic term.[22] Under certain additional assumptions, the Mincer-coefficient b can be interpreted as the average internal rate of return.[23] The coefficient b represents the percentage change of earnings if schooling increases by one additional year. One of the major problems of this approach is that schooling is endogenous. Individuals choose how long they stay in school and this decision is likely to be influenced by omitted variables. For example, unobserved ability is considered to be correlated with schooling and earnings. Griliches (1977), Ashenfelter & Krueger (1994), Angrist & Krueger (1991) and Card (1993) use different approaches to reveal causalities between education and earnings. A variety of estimation results of the human capital earnings function suggest that education is a main determinant of earnings. However, the literature on returns to education does not provide any information about the role of early childhood education for individual earnings.

Cunha & Heckman (2008) develop an empirical strategy to estimate the technology of skill formation. They use a linear representation of the skill formation process

$$\theta_{t+1}^j = \gamma_C^j \theta_t^C + \gamma_N^j \theta_t^N + \gamma_I^j I_t^j + \gamma_P^j \theta_t^P + \eta_{t+1}^j \text{ for } j \in \{C, N\}. \tag{19}$$

The main problem of estimating this technology of skill formation is that cognitive skills, noncognitive skills and parental investment (θ_t, I_t) are unobservable. To address this problem, Cunha&Heckman (2008) use a dynamic linear factor model to obtain a weighted

[20] For a broad review and a discussion of methodological problems see Card (1999) and Heckman et.al. (2006).
[21] See Card(1999), p.1804.
[22] The coefficient of the quadratic term is expected to be negative. The marginal effect of experience on log-earnings is decreasing as the amount of experience is increasing.
[23] The internal rate of return equates marginal costs and benefits of an investment in education.

combination of several measurements for every unobserved factor. Parental investment is measured by a combination of the number of books available to children, the number of musical instruments, whether the family receives a daily newspaper, whether the child receives special lessons and how often the child goes to museums and to theatres. The measurements for non-cognitive skills consist of subscores of a behavioural problems index. This index includes information on antisocial, anxious, headstrong and hyperactive behaviour as well as data on peer problems. Cognitive skills are measured by test scores in reading comprehension and mathematics. The output of the skill formation process is the level of skills at the next period in the life cycle. Since skills are measured by normalized test score results, a meaningful interpretation of estimation coefficients is impossible. Cunha and Heckman use adult earnings and the probability of high school graduation to anchor the scale of the test scores. Additional methodological problems are measurement errors in the proxy variables and endogeneity of inputs. The rich source of panel data allows accounting for these problems. Cunha & Heckman (2008) find evidence of strong self-productivity effects for cognitive and non-cognitive skills. Additionally, non-cognitive skills have a high positive impact on the production of cognitive skills. The cross-productivity effect of cognitive skills on non-cognitive skills is relatively weak. Sensitive periods of parental investment exist for both skills, but they occur at different stages in time. Investment in cognitive skills is more productive in earlier stages of the life cycle, whereas investment in non-cognitive skills has a higher return in later stages. Furthermore, skills have different effects on different adult outcomes. Cognitive skills are relatively more important for the probability of high school graduation, while adult earnings are relatively more affected by non-cognitive skills.[24]

Cunha, Heckman & Schenach (2010) estimate a non-linear version of the technology of skill formation to identify the key substitution parameters. They find evidence for an increasing self-productivity effect over time. Thus, when a child becomes older, it can use its existing stock of skills more productively for the formation of new skills. Complimentarity between cognitive skills and investment is higher at later stages of childhood. Hence, when a child becomes older it is harder to compensate for disadvantages in cognitive capabilities.

[24] Cunha &Heckman (2008) simulate the effect of a 10% increase of investment on adult outcomes (Table 1).

Complimentarity between non-cognitive skills and investment is weaker at later stages. It is easier to compensate for disadvantages in non-cognitive skills when a child becomes older.

Altzinger et al. (2013) use data from the EU-SILC 2011 survey to detect a general relationship between pre-school education and adult outcomes for Austria. They compare educational attainment and income between individuals who attended kindergarten and individuals without pre-school education. Their results suggest that respondents are more likely to be placed in kindergarten if their parents have a higher education level or higher income. The average educational attainment as well as the average net income is significantly higher for individuals who attended kindergarten.

4.2 Empirical Analysis

This section presents an empirical analysis for the special case of Austria. I investigate whether a general connection between early childhood investment and future individual earnings exists. Furthermore, I look at how early investment exactly influences earnings. According to economic theory, investment in children raises the amount of human capital which transforms into earnings. Therefore, parental investment does not affect individual earnings directly. The effect operates through human capital accumulation. Additionally parental investment is influenced by parental characteristics. Investment in children from parents with higher educational attainment is considered to be more productive. Hence, I want to examine if Austria is a country in which parental characteristics are a main determinant for the development of children.

One of the main challenges for my analysis is that parental investment is unobservable. To address this problem, I use a proxy variable to examine the effect of early childhood education on earnings. The number of books in the parental household when individuals were young serves as a proxy for investment in childhood education. It is unlikely that the number of books is a perfect indicator for parental investment. Nevertheless, it serves as an appropriate proxy for investment in education for several reasons. According to Cunha & Heckman (2008), the number of books is correlated with parental investment, because parents who invest more in children will also spend more resources on books. Additionally, the number of books in a household reflects the socioeconomic background of families. According to Schütz et al. (2008), a large number of books represents a family environment that appreciates education and academic success and therefore higher investment in

childhood education. For similar reasons, Evans et al. (2010) also use the number of books in a household to investigate the relationship between family background and educational attainment. They argue that the size of a library reveals family preferences for education. Their main result suggests that children from families with a high number of books in their household attain three more years of schooling than children from bookless homes. In summary, the number of books in the parental household indicates certain parental characteristics, which are positively related to investment in children´s education.

My empirical analysis starts with a description of the data set. I explain how the variables of interest are measured and present summary statistics. After displaying my identification strategy, I present my main results and discuss whether my findings are in accordance with economic theory and other empirical work from above.

4.2.1 Data

I use data from the International Social Survey Program (ISSP) 2009 on social inequality. It includes cross-section data of individuals from multiple countries. For my analysis, I extract the relevant subsample for Austria, which consists of 1019 observations. The ISSP 2009 contains information on the number of books in a household when the respondent was young, net income, educational attainment, respondent´s occupation as well as other characteristics. The main reason for using the ISSP 2009 data is that respondents are asked how many books were around their family´s home when they were about 14 years old. Respondents could choose between 9 categories to report the appropriate amount of books (Table 2). Since I am interested in the effect of parental investment during the early years of childhood on the development of children, the number of books in the household when respondents were 0-5 years would be more reasonable. Nevertheless, the available measure of the number of books serves as a sufficient proxy for early childhood investment. It is unlikely that the number of books in a household changes drastically over 10 years. Households with a small amount of books when the respondent was 14 years old are assumed to have owned a small amount of books 10 years earlier as well. Otherwise, they would have sold most of their books during this time period. It is assumed that families are more likely to buy books than to sell them. It could be the case that certain households increased their amount of books over time. However, to cause a significant change in the distribution of the number of books, households from low categories have to raise the

amount of books in a sufficient way. It is unlikely that the number of books increased from 1 or 2 books to around 500 books over 10 years, unless a sufficient inheritance of books took place. This scenario is considered to be negligible. Therefore, the number of books in the household when a respondent was 14 years old is considered to reflect early childhood investment in an appropriate way.

The ISSP 2009 also reports individual net income, which is categorized into 12 groups (Table 3). Educational attainment is measured by the highest educational level respondents have obtained. Completed years of schooling is another measure for educational performance in the ISSP 2009. It is defined as the average years of schooling needed for the corresponding educational level of individuals. The two measures of educational attainment are interchangeable. Therefore, I use the highest educational level of respondents as a measure of educational attainment, because the interpretation is more meaningful. The highest educational level is represented by 7 categories (Table 4). Respondent´s current occupation is measured by the international standard classification of occupations (ISCO)-88, which is a 4-digit code to account for a variety of different occupations. Additional characteristics are age, sex, and working hours per week. Age and working hours per week are reported by discrete values.

Most of the variables are measured by categorical data. For certain statistical methods I treat them as continuous variables. One should take the inappropriate scale into account when interpreting results of these estimations. Furthermore, I rearrange the main variables of interest into main categories to perform a more comprehensible analysis.

For individual net income I construct a categorical variable, $NETINC3_i$, which consists of 3 groups namely: low, middle and high net income (Table 5). I define the group of middle net income individuals as 70 to 150 percent of the median net income. According to Statistik Austria (2011), the median net income in 2009 is 1716 euro. Based on this value, the resulting middle net income group is located between 1201 and 2574 euro. According to these boundaries and the reported categories in the ISSP 2009 the low net income group consists of individuals with a net income of 150, 450, 750 and 1050 euro. The middle net income group covers the categories of 1350, 1650, 1950 and 2250 euro. High net incomes are defined as 2750, 3500, 4000 euro and more.

The number of books is also divided into 3 main categories (Table 6). Since no reference value for the number of books in the parental household exists, the assignment into groups is arbitrary. A low number of books is considered to be 0, 1-2 and around 10. A moderate number of books is defined as around 20, 50 and 100. Around 200, 500, 1000 and more books classify the group with a high amount of books. The constructed variable is denoted by $BOOKS3_i$.

The highest educational levels are rearranged into three groups to represent the qualification level of individuals (Table 7). Respondents who attained no formal schooling or completed compulsory school form the group of unqualified individuals. Qualified individuals are defined by educational levels of compulsory school with an additional vocational training, vocational middle school, general high school and vocational high school. University graduates are considered to be highly qualified. $DEGREE3_i$ denotes the constructed categorical variable.

Individual current occupation is measured by the ISCO-88. Based on this 4-digit code, occupations are classified into four different groups to account for associated skill levels and the average net income of different occupations (Table 8). From now on, the constructed variable is denoted by $OCCUP4_i$.

My analysis concentrates on a subsample of individuals who are in paid work. After droping missing values of net income, the number of books, the highest educational level as well as current occupation, the sample size reduces to 587 observations.

4.2.2 Summary Statistics

This section presents summary statistics for all variables included in my analysis (Table 9). For categorical variables certain measures have no meaningful interpretation. Therefore I report frequency distributions to improve the understanding of the structure of these variables.

The mean of monthly net income is 1428 euro, with a standard deviation of 724 euro. The median of 1350 euro is lower than the mean which refers to a right skewed net income distribution (see Figure 5). The most frequent net income group is 1350 euro and most

respondents are located in the range between 750 to 1650 euro. The tail on the right side of the distribution is longer and flatter than on the left side.

Mean and median of the number of books are both around 5, which refers to the category of around 50 books. About 2 percent of the respondents grew up in a bookless household, which is the least frequent category (see Figure 6). Most households have a library consisting of about 50 books. Around these two categories the distribution appears to be symmetrical.

Compulsory school with an additional vocational training is the most frequent educational level of respondents (see Figure 7). About 40 percent of individuals belong to this group. All other educational categories are rather equally distributed among the respondents, except for individuals without any formal schooling. This group consists of only 3 individuals.

In my sample 137 respondents belong to the group of personal services, sale and elementary occupations. The most frequent category of occupations, with a total number of 239 individuals, is the group of office workers, skilled agricultural workers, craft and trade workers, plant and machine operators and assemblers. 108 individuals are classified as technicians and the group of legislators, senior officials, managers and professionals consist of 103 observations.

The subsample consists of 301 men and 286 women, which are therefore equally represented in the sample. This is also indicated by a mean of 1.5. Additionally, respondents are on average 46 years old and work around 38 hours per week.

4.2.3 Identification Strategy

The main interest of my analysis is to detect the link between early childhood investment and adult net income. I start with the analysis of a general connection between investment in children´s education in the early years and future outcomes, such as educational attainment and net income. I present a cross correlation table to provide an overview of the overall dependence between all variables of interest. I report spearman rank correlation coefficients, to account for the ordinal scale of certain variables. I use the original categorization of the variables net income, number of books and highest obtained educational level. From now on, these variables are denoted by $NETINC_i$, $BOOKS_i$ and $DEGREE_i$, respectively. Respondent´s occupation is measured by the constructed variable

$OCCUP4_i$. I present contingency tables and perform likelihood ratio tests of independence. These methods provide a deeper insight on the link between net income, the number of books and educational attainment. Furthermore, an analysis of contingency tables is a more appropriate method to deal with ordinal scaled variables. I use the constructed variables $NETINC3_i$, $BOOKS3_i$ and $DEGREE3_i$ to provide a more comprehensive analysis of the dependence between the variables of interest. These variables consist of categories presented in Tables 5-7.

After a first overview of the general connection between early investment in children and net income, I want to verify how exactly the number of books influences future net income. Economic theory suggests that investment in children raises educational attainment of individuals. As a consequence, a higher educational level translates into higher income. I use different regression techniques to examine this indirect effect. First, I employ ordinary least square (OLS) regressions. These estimation results serve as a benchmark to detect a link between the variables of interest. As a first step, I regress the highest educational level on the number of books. The number of books is represented by the categories of the variable $BOOKS3_i$. I construct dummy variables for the categories "middle" and "high" to observe group specific effects. The resulting regression equation is given by

$$DEGREE_i = \beta_0 + \beta_1 BOOKS\_M_i + \beta_2 BOOKS\_H_i + \beta_3 SEX_i + \eta_i . \qquad (20)$$

The dependent variable $DEGREE_i$ denotes the highest educational level of individual i. The variable $BOOKS\_M_i$ indicates whether an individual belongs to a household with a moderate number of books. It reports the value 1 if individual i belongs to this group and 0 otherwise. $BOOKS\_H_i$ denotes the corresponding dummy variable for the group with the highest number of books. The group with the lowest amount of books is not included into the regression equation and therefore serves as a reference group. If the parameter β_1 is significantly different from zero, individuals from a household with a moderate number of books will have a significantly different completed educational level than individuals from a household with a low number of books. The same interpretation holds for parameter β_2. A positive influence of the number of books on educational attainment will be indicated by significantly positive parameters β_1 and β_2. In addition to the number of books, regression

equation (20) also includes the variable SEX_i. It tests whether differences in the education level between men and women exist. η_i denotes the error term with the usual OLS assumptions. It captures the fraction of the highest educational level that is not explained by different amounts of books and by differences between men and women.

After evaluating the effect of the number of books on educational attainment, I take a closer look on the connection between the number of books and net income. As a first step, I regress individual net income only on the number of books in parental households. This reveals the overall influence of the number of books on net income. Additionally, one has to include the educational level into the regression to verify if this effect operates through educational attainment. If the effect of the number of books on net income remains significant after controlling for educational attainment, a direct effect of early investment on net income will exist. On the other hand, an insignificant influence of books on net income, in the presence of educational attainment, provides evidence for an indirect effect. The human capital earnings function (18) suggests to perform a log-transformation of net income, but since net income is measured in an ordinal scale a log-transformation would not be meaningful. I include additional variables in the regression to control for other possible effects. The resulting regression equation for individual net income is given by

$$\begin{aligned} NETINC_i = {} & \beta_0 + \beta_1 BOOKS\_M_i + \beta_2 BOOKS\_H_i + \beta_3 DEGREE\_Q_i + \beta_4 DEGREE\_HQ \\ & + \beta_5 OCCUP\_C2_i + \beta_6 OCCUP\_C3_i + \beta_7 OCCUP\_C4_i + \beta_8 AGE_i + \beta_9 AGE_i^2 \\ & + \beta_{10} SEX_i + \beta_{11} WRKHRS_i + \varepsilon_i \end{aligned} \quad (21)$$

The dependent variable $NETINC_i$ denotes monthly net income for individual i, measured by 11 categories. I use this measure of net income, instead of the constructed variable $NETINC3_i$, to provide a better approximation of the true continuous distribution. Net income is explained by the number of books in parental households when respondents where around 14 years old. Similar to the previous regression (20), I construct dummy variables, $BOOKS\_M_i$ and $BOOKS\_H_i$, for the groups with a moderate, respectively a high amount of books. Individuals who belong to the group with a low number of books serve again as the reference group. Positive coefficients β_1 and β_2 will provide evidence for the hypothesis of a positive influence of the number of books on individual net income. $DEGREE\_Q_i$ and $DEGREE\_HQ_i$ represent dummy variables for qualified and highly

qualified individuals. Hence, parameters β_3 and β_4 measure the difference between net income of the corresponding group and the reference group of unqualified individuals. Both parameters are expected to be positive. In addition to the number of books and the highest educational level, I include respondent´s current occupation into the regression to control for the variation of net income that is caused by different occupations. Again, I introduce dummy variables for the constructed categories of occupations. The first category forms the reference group and is therefore left out of the regression equation. The interpretation of the coefficients β_5, β_6 and β_7 follows the same logic as in the case of the number of books and the highest educational level. The variable AGE_i serves as a proxy for the working experience of respondents. Older individuals are assumed to have more working experience and obtain a higher net income. The quadratic term, AGE_i^2, is included to verify whether the resulting marginal effect of age on net income is decreasing when individuals become older. The variable SEX_i controls for differences in net income between men and women. If the coefficient β_5 is negative, women will earn a lower monthly net income, holding all other variables constant. $WRKHRS_i$ controls for how many hours individuals work during a week. More working hours will result in a higher net income. Therefore the coefficient β_{11} is assumed to be positive. ε_i denotes the error term with the usual assumptions and captures the variation of net income that is not explained by the included variables.

The OLS regression is most likely not an appropriate method to analyze the given data. The ordinal scale of the dependent variables put the application of OLS regressions into question. Therefore, the interpretation of the results is not reliable. An ordered logit model is a more appropriate method to deal with ordinal scaled dependent variables. It is a non-linear model, which uses the maximum likelihood method to estimate the corresponding coefficients. I use an ordered logit regression to check how robust the findings from OLS regression (21) are. Therefore I use the variable $NETINC3_i$ as a dependent variable to reduce the number of categories. The variables $BOOKS3_i$, $DEGREE3_i$, $OCCUP4_i$, AGE_i, SEX_i and $WRKHRS_i$ serve as explanatory variables. The non-linear framework of the ordered logit model leads to a different interpretation of the estimation coefficients. Consequently, the quadratic age term is not included in this regression, because a

meaningful interpretation is impossible. Nevertheless, the sign of the resulting coefficients still indicates the direction of the effects.

4.2.4 Results

In this section I present estimated correlation coefficients, results from the analysis of contingency tables and estimates from the OLS regressions as well as the ordered logit model. I interpret the results and discuss how the findings coincide with economic theory and other empirical studies.

Correlation Coefficients

Spearman rank correlation coefficients provide a first insight into the general connection between all variables of interest (Table 10). Monthly net income is strongly correlated with the highest educational level, respondent´s current occupation, sex and working hours per week. The correlation between the number of books and net income appears to be weak. This indicates a weak overall dependence of net income on the number of books. The number of books is most correlated with the highest educational level and respondent´s occupation. A high correlation exists also between educational attainment and occupation. It points in the direction that the number of books has an influence on the highest educational level. As a consequence, educational attainment affects future net income. Part of this effect could be due to the choice of occupation. Furthermore, a negative correlation exists between sex and working hours. Women appear to spend less time working than men. However, correlation coefficients are not an appropriate measure for the connection between categorical variables and they provide no information on how variables exactly influence each other. Thus, the reported correlation coefficients offer a first overview of the relationship between the variables of interest, but the results should be interpreted cautiously.

Contingency tables and statistical tests

As a next step, I present contingency tables to account for the ordinal scale of the main variables. I examine the dependence of net income on highest educational attainment and the number of books as well as the dependence of highest educational level on the number of books. I use rearranged variables, where each variable consists of only three categories. Based on these contingency tables, I perform likelihood ratio tests of independence.

The contingency table for monthly net income and the number of books in a household shows that most individuals earn a moderate net income, independent of the number of books (Table 11). However, most individuals who belong to the highest net income group come from a family environment with a high number of books in their parental household. Hence, there seems to be at least a weak dependence between the number of books and net income. A likelihood ratio test of independence tests whether the distribution of net income is significantly different between different groups owning various numbers of books. The null hypothesis states that the distribution of net income is independent of the number of books. A p-value of around 0 indicates that the null hypothesis of independence can be rejected. According to this test, a significant dependence of net income on the number of books exists.

According to economic theory investment in human capital and individual earnings are linked through the level of education. As a check, I investigate the link between the number of books and the highest educational level of respondents, followed by an analysis of the link between the highest educational level and monthly net income. The contingency table for different levels of educational attainment and the number of books indicates that most unqualified individuals are located in the group with a low amount of books (Table 12). Qualified individuals tend to come from a family with a moderate number of books and most university graduates are children from a family environment with a high number of books. It seems that the probability of belonging to a higher education group increases by the amount of books in parental households. A likelihood ratio test of independence points in the same direction. A p-value of approximately 0 leads to a rejection of the null hypothesis of independence. The distribution of the highest educational level is therefore dependent on the number of books in the parental household.

The contingency table of net income and the highest educational level suggests that most individuals earn a moderate net income and can be considered as a qualified person (Table 13). Unqualified individuals most likely belong to the lowest net income group. Additionally, no individual from the unqualified education group is located in the highest net income group. The likelihood ratio test of independence computes a p-value of approximately 0. Therefore, the null hypothesis of independence between the highest educational level and net income can be rejected.

In short, likelihood ratio tests of independence suggest that net income, educational attainment and the number of books are dependent on each other. Contingency tables point in the direction of a positive relation in all three cases. However, the exact transmission channels remain still unclear.

Ordinary least square regression

The OLS estimation results for equation (20) confirm that the number of books significantly influences educational attainment (Table 14). Column 1 presents estimated coefficients for the group specific dummy variables. Individuals with a low number of books form the reference group obtain on average an educational level of 3.2. Compared to this group individuals with a moderate number of books have a significantly higher educational attainment. The same is true for individuals from a family environment with a high number of books. Their highest completed educational level is on average about 5.3, which corresponds to completing general high school. The group specific effects explain about 21 percent of the variation of educational attainment. Column 2 tests for differences in the educational attainment between men and women. The influence of the number of books on the highest educational level remains highly significant and the magnitude of the coefficients does not change drastically. The estimated difference of educational attainment between men and women is not significantly different from 0. The adjusted R^2 is the same in both regressions, therefore controlling for gender does not improve the explanation of educational attainment. Overall, the results provide evidence that the number of books is a determinant of educational attainment, but the estimated effects cannot be interpreted as a causal relationship.

The results of the OLS estimation for monthly net income point in the direction of an indirect effect of the number of books (Table 15). At first, monthly net income is regressed only on group specific dummy variables for the amount of books to examine a general correlation. Column 1 indicates that individuals who belong to the group with the highest number of books have a significantly higher net income than individuals from a family with a low amount of books. The difference in net income between these groups is about 293 euro. The net income of the group with a moderate number of books is not significantly different from individuals with a low number of books. Overall, the number of books explains only 2 percent of the variation of individual net income. The second regression uses only

educational attainment as an explanatory variable. Column 2 shows that qualified as well as highly qualified individuals earn a significantly higher net income than unqualified persons. The difference in net income between university graduates and individuals who completed only compulsory school is around 1066 euro. Education explains about 15 percet of the variation of net income. As a next step, I regress individual net income on the obtained residual from regression (20). This will show the effect of educational attainment on net income, independent of the number of books. Column 3 indicates that educational attainment has still a significantly positive influence on net income. The explained variation of net income decreases to 11 percent, which is only 4 percentage points lower compared to the explanatory power of the regression in column 2. Column 4 presents the results of a regression which includes the number of books as well as educational attainment as independent variables. Compared to column 2, the coefficients for the group specific dummy variables of different educational levels remain almost the same. On the other hand, the estimated coefficients for the number of books decrease and become insignificant, compared to the estimates in column 1. Additionally, the adjusted R^2 is nearly the same as in column 2. Hence, in the presence of the highest educational levels, the number of books does not provide additional explanation of individual net income. Column 5 includes additional control variables and therefore reports the estimation results from regression equation (21). Compared to column 4, the estimated difference in monthly net income between individuals with a high number of books and a low number of books increases and becomes significant. The coefficients for qualified and highly qualified individuals are still significantly positive. Individuals from occupation categories 3 and 4 have a significantly higher net income than individuals from category 1. Furthermore, women earn on average a 367 euro lower net income than men and one additional working hour per week raises monthly net income by 27 euro. The coefficients of AGE_i and AGE_i^2 are not significantly different from 0. The number of observations declines to 403, because working hours per week contain a large number of missing values. The adjusted R^2 rises to around 0.51. Hence, in the presence of all variables, about one half of the variation of net income is explained. The final regression excludes the quadratic age term from the equation. The resulting estimation coefficients are hardly changed compared to column 5, except that now the

coefficient of AGE_i becomes also significant, but the adjusted R^2 value remains almost unchanged.

The results reported in Table 15, together with the findings from Table 14, provide evidence of an indirect effect of the number of books on net income through the channel of educational attainment. Overall, the number of books has a positive influence on individual net income, but the effect appears to be weak. Only a small proportion of the variation of net income is explained by different amounts of books in the parental household. Nevertheless, the number of books has a significant positive influence on educational attainment and as a consequence a higher educational attainment raises monthly net income. Column 5 and 6 in Table 15 indicate that even a small direct effect of the number of books on net income remains after controlling for a variety of other factors.

Robustness checks for the OLS regressions show that the residuals of all regressions are not normally distributed.[25] Furthermore, evidence for heteroscedasticty exists.[26] Additionally, an OLS regression is not a preferable method for dependent variables with an ordinal scale. I perform an ordered logit regression for equation (21) to account for these methodological problems and to verify how reliable OLS estimates are.

Ordered logit regression

The estimation results of the ordered logit regression for monthly net income are in accordance with the findings from the OLS regressions (Table 16). The interpretation of the resulting coefficients is not straightforward, because coefficients report odds ratios in logarithmic form. One has to apply the exponential function to obtain the odds ratio between an explanatory variable and the dependent variable. A positive coefficient indicates a positive relationship between variables and is associated with an odds ratio higher than 1. Table 9 reports significant coefficients for all variables. For example, the coefficient of the highest educational level is 1.207 and therefore indicates a significantly positive influence on net income. The corresponding odds ratio is 3.34. Thus, holding everything else constant, a one unit increase in the highest educational attainment corresponds to a 3.34 times higher odds of belonging to net income group “high”, than net income groups “low” and “middle”

[25] A Shapiro-Wilk test rejects the null hypothesis of normally distributed residuals for all regressions.
[26] A Breusch-Pagan test leads to a rejection of the assumption of homoscedasticity for all regressions.

taken together. A crucial assumption of the ordered logit model for the interpretation of the coefficients is the proportional odds assumption. As a consequence of this assumption, a one unit increase in the highest educational level is also associated with a 3.34 times higher odds of belonging to net income groups “high” and “middle” together, than net income group “low”. Hence, the resulting interpretation is the same for all reference groups of the dependent variable. Following this interpretation, a higher net income is more likely for male individuals who have a higher educational level, come from a family environment with a higher amount of books in their household, have more working experience and spend more time at work during a week.

4.2.5 Discussion of the results

Although OLS regressions and the ordered logit model lead to different interpretations of the resulting coefficients, the overall implications are the same for both estimation techniques. Thus, the results from the ordered logit regression do not change the findings from the OLS regressions. All significant explanatory variables of the OLS estimation report a significant coefficient in the ordered logit regression as well. Furthermore, the sign of the estimates is also in accordance in both regressions. The results from Table 14 show that the number of books has a significant and positive influence on the highest educational degree of individuals. The number of books is also positively related to monthly net income, although the overall effect appears to be weak. The findings from columns 2-4 in Table 15 support the hypothesis that the number of books has an indirect effect on net income, through educational attainment. Nevertheless, column 6 in Table 15 and the results from the ordered logit regression provide some evidence that the amount of books has at least a small direct effect on net income.

If the number of books appropriately reflects early childhood investment of parents, one can infer that this investment has a significantly positive effect on individual net income. Regarding the role of parental characteristics, it follows that children from a parental environment which enhances educational performance are more likely to attain a higher educational level. As a consequence, these children earn a higher income. These empirical findings for Austria are in accordance with economic theory presented in section 2. These economic models consider an indirect effect of investment in children on individual earnings. Higher investment raises human capital, which transforms into higher adult income.

Additionally, parental characteristics determine the level of investment in children and the productivity of the human capital production process. Furthermore, the empirical findings for Austria are consistent with the empirical literature. First, education is a main determinant of income as the human capital earnings function by Mincer (1974) suggests. Second, since the number of books is most likely a proxy for investment in cognitive skills, such as reading skills, the empirical findings for Austria enhance a more important role of cognitive skills for educational attainment than for income. This is in accordance with Cunha & Heckman (2008). Their simulation results suggest that early investment in cognitive skills especially influence educational success and not so much future earnings.

4.3 A Critical Assessment of the Empirics

Although the empirical study for Austria delivers some useful insights into the connection between early childhood investments and individual earnings, it is not free from methodological issues.

First, the data from the ISSP 2009 entails some concerns. The proportion of missing values is relatively large and some variables are measured in categories. Additionally, further information on non-cognitive skills, parental education, parental income as well as the evolution of skills over time would be helpful for an extensive analysis of the development of children.

Second, according to economic theory, initial ability is a determinant of investment decisions of parents as well as individual earnings. In my empirical study for Austria, initial ability is omitted from the regression, which raises concerns about endogeneity. If parental investment and net income are affected by initial ability, the estimation results cannot be interpreted as a causal effect. Since initial ability is unobservable and hard to measure, it is a challenging task to control for it and reveal a causal relationship between early childhood investment and individual earnings. The estimates of the OLS regressions are most likely biased, because of these methodological issues.

Third, the empirical estimations and the resulting implications rely on certain assumptions. An OLS regression assumes normally distributed residuals and homoscedasticity. Both assumptions are violated according to statistical tests. This raises concerns about the correct specification of the resulting inference statistics.

Forth, the main assumption for conclusions about the relationship between early childhood investment and individual earnings is that the number of books in parental households when respondents were 14 years old is an appropriate proxy for early childhood investment. The number of books is most likely a bad predictor of early childhood education. Therefore, additional measures could improve the validity of the analysis. For example, child care time during the early years in life (ages 0-5) are an essential investment in the development of children.[27] Additionally, the number of books mainly reflects investment in cognitive skills, but economic theory also considers non-cognitive skills as an important determinant of adult outcomes. Nevertheless, the number of books in parental households has the advantage of including information on parental characteristics. In addition, it is a comparable measure. Hence, a possible extension of the empirical analysis is to compare the relationship of parental characteristics, educational attainment and income between different countries and welfare states.[28]

5 Conclusion

The above exposition provides several hypotheses about the effects of early childhood education on individual earnings. From the theoretical perspective, the period of childhood is essential for future economic success, because during this time individuals acquire essential human capital. Especially the first years in life are important for the development of cognitive and also non-cognitive skills. Most importantly, Cunha & Heckman (2007) emphasize that investment during early childhood determines the success of future investment. Hence, investment during the early years in life lay the basis for particular adult outcomes, such as individual earnings. Furthermore, the efficiency of investment in children depends crucially on parental characteristics. The empirical literature provides evidence for these results. My empirical analysis for Austria supports these findings as well. A family environment which encourages educational success has a positive influence on educational attainment and as a consequence, higher educational attainment leads to higher individual net income. Nevertheless, further research is necessary to confirm these findings and to

[27] Morchio (2013) analyzes parental decisions on child care time by using the American Heritage Time Use Survey (AHTUS).

[28] Jerim & Micklewright (2012) analyze the influence of parental background on child outcomes for a variety of countries by using the number of books as a measure for parental background.

improve the analysis of the role of early childhood for individual earnings in a more accurate way.

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Appendix

A.1 Figures

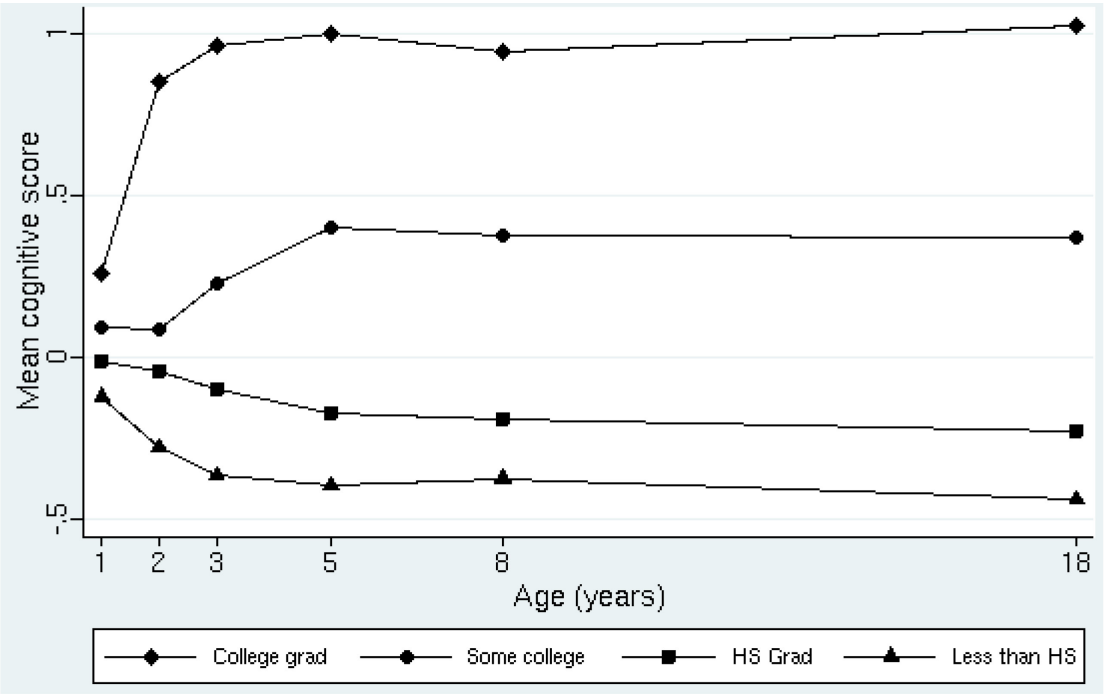

Figure 1. Trend in mean cognitive score by maternal education.

Source: http://jenni.uchicago.edu/tech-skill/webappendix.pdf

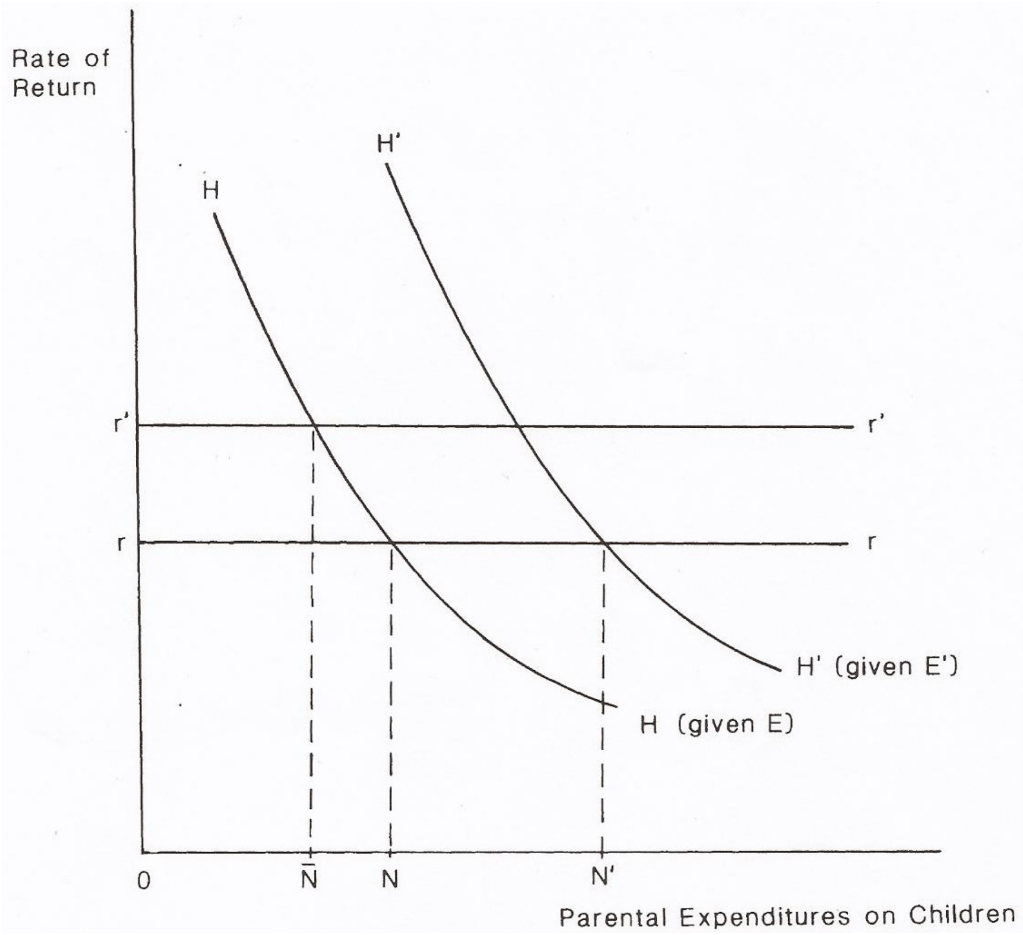

Figure 2. Rates of Return as a function of parental expenditures on children. It shows the demand and supply curve in perfect capital markets and how an exogenous change of the market interest rate, respectively initial endowment, affects optimal parental expenditures.

Source: Becker & Tomes (1986), p.8.

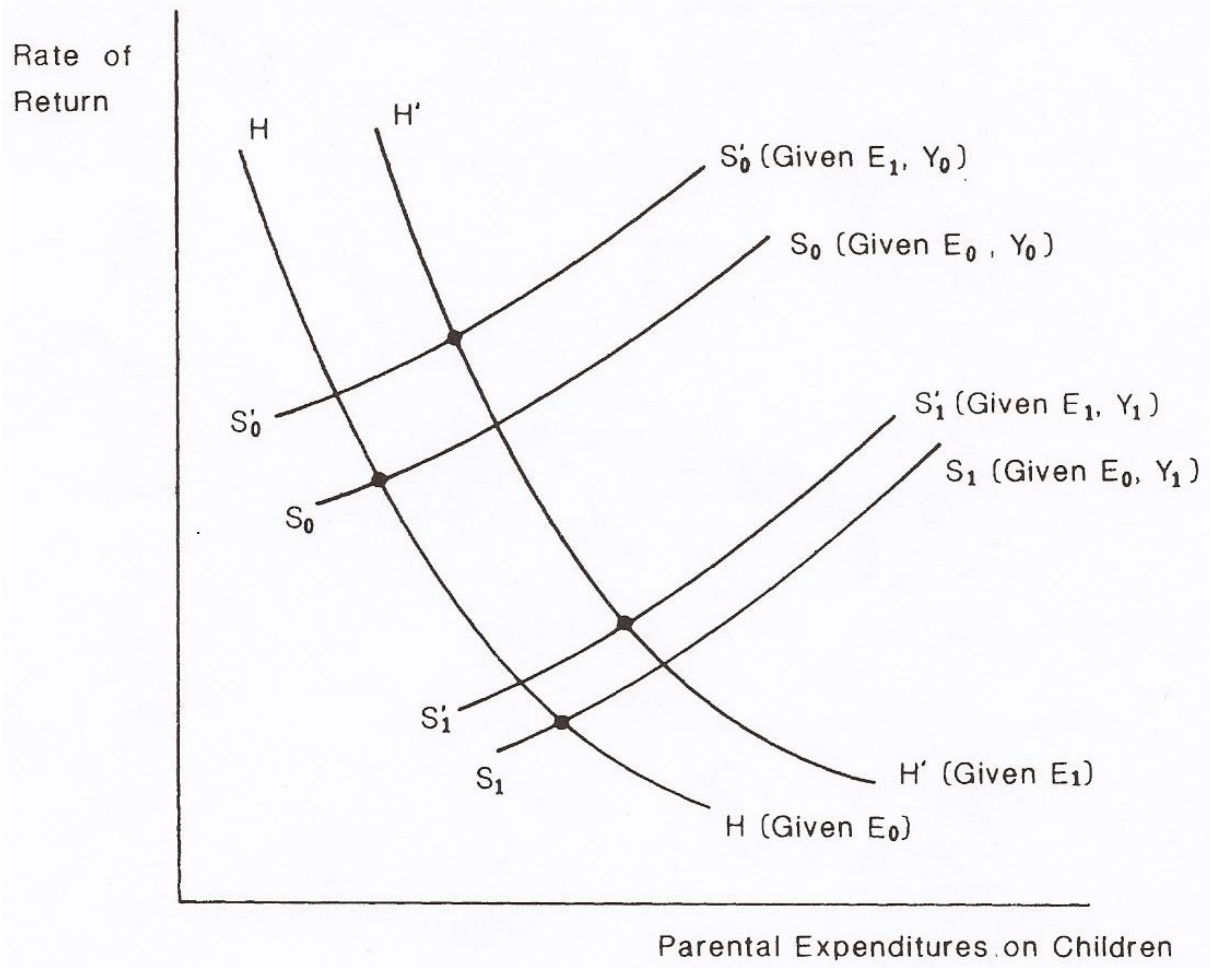

Figure 3. Rates of return on parental expenditures on children. It shows the market equilibrium with capital constraints and how an exogenous change of parental income and initial endowment affects the intersection between demand and supply curve.

Source: Becker & Tomes (1986), p.12.

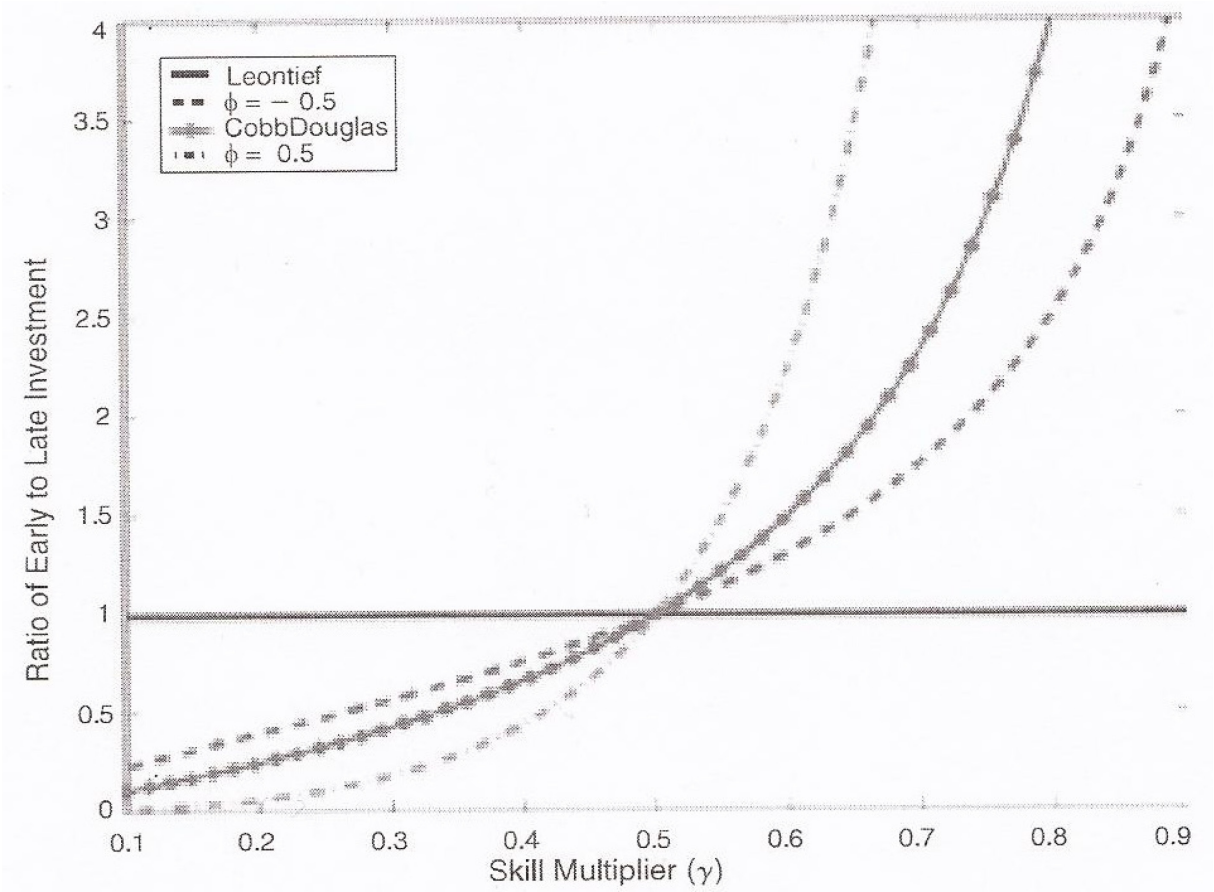

Figure 4. The optimal ratio of early to late investment as a function of the skill multiplier for different values of the degree of complimentarity. The market interest rate is assumed to be fixed at $r = 0$.

Source: Cunha & Heckman (2007), p. 40.

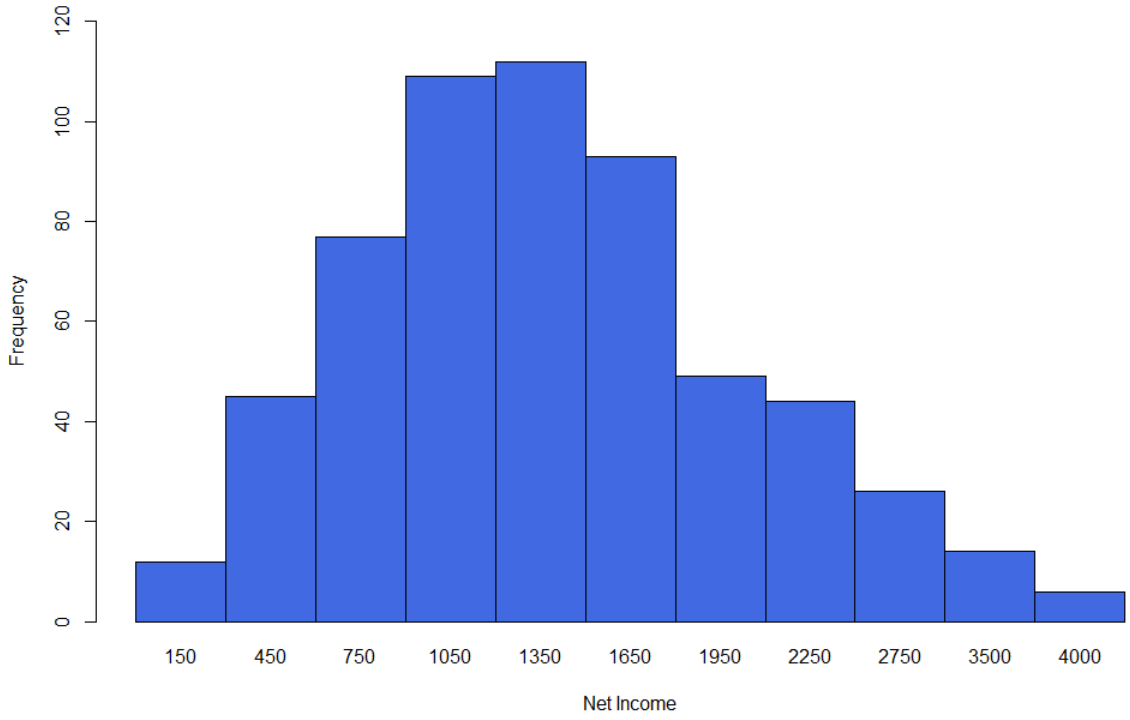

Figure 5. Absolute frequencies for different net income groups using a subsample of the ISSP (2009) for Austria. Observations with no own net income are excluded.

Source: own calculations

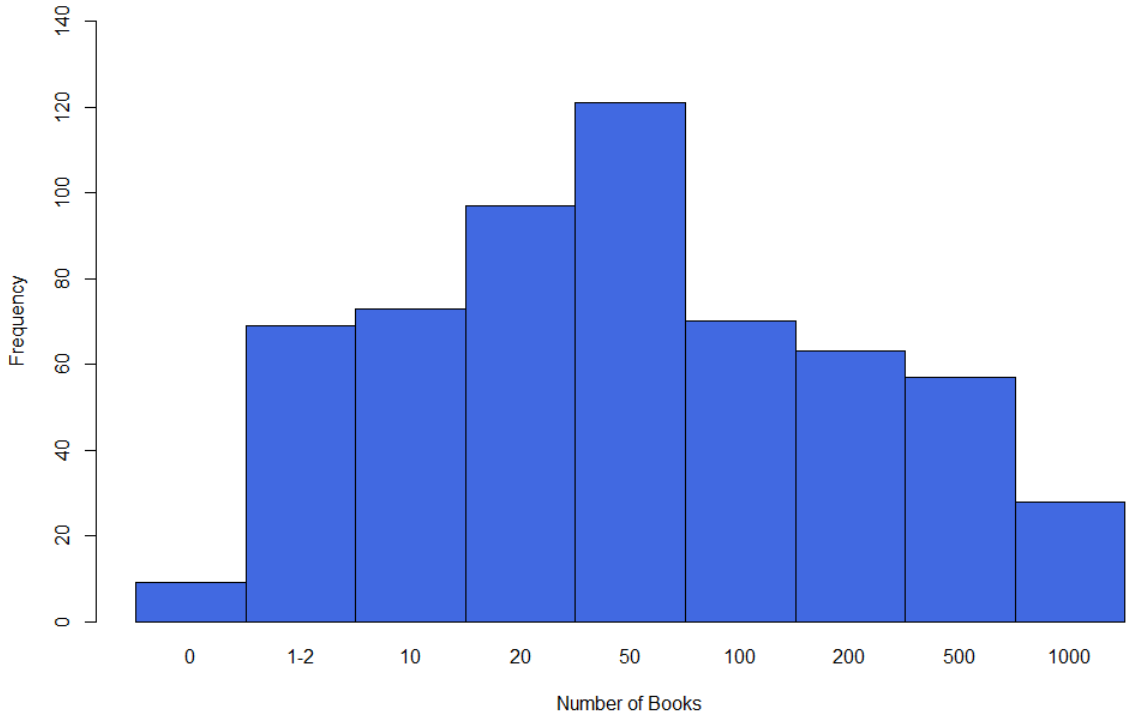

Figure 6. Absolute frequencies for all different categories of the number of books. Calculation is based on a subsample of the ISSP (2009) for Austria.

Source: own calculations

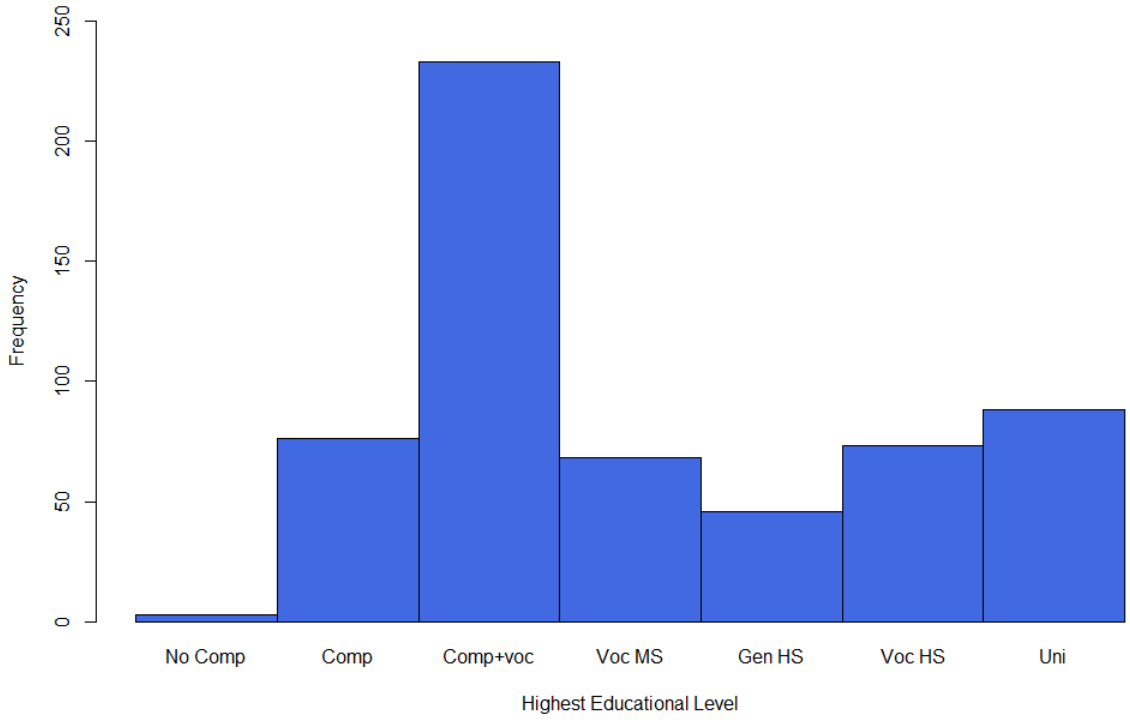

Figure 7. Absolute frequencies for all different categories of the highest completed educational level. Calculation is based on a subsample of the ISSP (2009) for Austria

Source: own calculations

A.2 Tables

Table 1

Percentage impact from a 10% increase of investment in different periods on two different outcomes

Log earnings at age 23 – 28			Probability of graduating from high school		
Total percentage impact	Percentage impact exclusively through cognitive skills	Percentage impact exclusively through noncognitive skills	Total percentage impact	Percentage impact exclusively through cognitive skills	Percentage impact exclusively through noncognitive skills
	Period 1			Period 1	
0.2487 (0.0302)	0.1247 (0.0151)	0.1240 (0.0150)	0.6441 (0.0789)	0.5480 (0.0672)	0.0961 (0.0118)
	Period 2			Period 2	
0.3065 (0.0358)	0.0445 (0.0052)	0.2620 (0.0306)	0.3980 (0.0466)	0.1951 (0.0229)	0.2029 (0.0238)
	Period 3			Period 3	
0.2090 (0.0230)	0.0540 (0.0059)	0.1550 (0.0170)	0.3565 (0.0389)	0.2366 (0.0258)	0.1198 (0.0131)

Source: Cunha & Heckman (2010), p.20.

Table 2

Classification of the number of books in a household when the respondent was 14 years old according to the ISSP 2009

Variabe name: ***BOOKS***	
Value	Category
1	None
2	1-2
3	Around 10
4	Around 20
5	Around 50
6	Around 100
7	Around 200
8	Around 500
9	1000 or more

Source: ISSP 2009

Table 3

Classification of monthly net income of respondents according to ISSP 2009

Variable name: ***NETINC***	
Value	Category
0	No own income, not in paid work
150	Up to 300 EUR per month
450	301-600 EUR
750	601-900 EUR
1050	901-1200 EUR
1350	1201-1500 EUR
1650	1501-1800 EUR
1950	1801-2100 EUR
2250	2101-2500 EUR
2750	2501-3000 EUR
3500	3001-4000 EUR
4000	More than 4000 EUR per month

Source: ISSP 2009

Table 4

Classification of the highest educational level of respondents according to ISSP 2009

Variable name: ***DEGREE***	
Value	Category
1	No formal schooling
2	Compulsory school
3	Compulsory school plus vocational training
4	Vocational middle school
5	General high school
6	Vocational high school
7	University

Source: ISSP 2009

Table 5

Classification of monthly net income into three categories

Variable name: ***NETINC3***	
Category name	Associated subcategories
Low	150, 450, 750, 1050 euro
Middle	1350, 1650, 1950, 2250 euro
High	2250, 2750, 3500, 4000 euro

Source: own calculations

Table 6

Classification of the number of books into three categories

Variable name: **BOOKS3**	
Category name	Associated subcategories
Low	0, 1-2, around 10
Middle	around 20, around 50, around 100
High	around 200, around 500, around 1000 and more

Source: own calculations

Table 7

Classification of the highest educational level into three categories

Variablename: ***DEGREE3***	
Category name	Associated subcategories
Unqualified	No formal schooling, compulsory school
Qualified	Compulsory school+vocational training, vocational middle school, general high school, vocational high school
Highly qualified	University

Source: own calculations

Table 8

Classification of respondent´s current occupation into four categories

Variable name: ***OCCUP4***	
Category name	Associated subcategories
Category 1	Personal service, sale and elementary occupations
Category 2	Office workers, skilled agricultural workers, craft and trade workers, plant and machine operators and assemblers
Category 3	Technicians
Category 4	Legislators, senior officials, managers and professionals

Source: own calculations

Table 9

Summary Statistics

Variable	Mean	Median	Standard deviation	Max	Min
NETINC	1428	1350	724	4000	150
BOOKS	5	5	2	9	1
DEGREE	4.1	3	1.7	7	1
OCCUP4	2.3	2	1	4	1
SEX	1.5	1	0.5	2	1
AGE	46	46	16.2	88	16
WRKHRS	38	40	10.5	80	8

Source: ISSP 2009, own calculations

Table 10

Cross correlation table reporting spearman´s rank correlation coefficients

Variables	1	2	3	4	5	6	7
1. NETINC	–						
2. BOOKS	0.15	–					
3. DEGREE	0.36	0.50	–				
4. OCCUP4	0.48	0.30	0.53	–			
5. AGE	0.15	-0.17	-0.03	0.15	–		
6. SEX	-0.36	0.10	0.07	-0.20	-0.03	–	
7. WRKHRS	0.53	0.03	-0.02	0.25	0.01	-0.39	–

Source: ISSP 2009, own calculations

Table 11

Contingency Table containing the frequency of net income groups in relation to the number of books

	Net income		
Number of Books	Low	Middle	High
Low	68	79	4
Middle	123	147	18
High	52	72	24

Source: ISSP 2009, own calculations

Table 12

Contingency table containing the frequency of highest educational levels in relation to the number of books

	Degree		
Number of Books	Low	Middle	High
Low	45	98	8
Middle	26	233	29
High	8	89	51

Source: ISSP 2009, own calculations

Table 13

Contingency table containing the frequency of net income groups in relation to the highest educational level

	Net income		
Degree	Low	Middle	High
Low	63	16	0
Middle	162	232	26
High	18	50	20

Source: ISSP 2009, own calculations

Table 14

OLS estimation results of the effect of the number of books on the highest educational level of respondents

	Dependent variable: ***DEGREE***	
	(1)	(2)
BOOKS_M	0.790***	0.773***
	(0.152)	(0.153)
BOOKS_H	2.139***	2.120***
	(0.175)	(0.176)
SEX		0.126
		(0.126)
Constant	3.179***	3.004***
	(0.123)	(0.213)
Observations	587	587
R^2	0.209	0.210
Adjusted R^2	0.206	0.206

Note: Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01
Source: ISSP 2009, own calculations

Table 15

OLS estimation results of the effect of the number of books and the highest educational level on monthly net income

	Dependent variable: ***NETINC***					
	(1)	(2)	(3)	(4)	(5)	(6)
BOOKS_M	73.596			-63.548	59.269	59.320
	(72.015)			(69.307)	(67.701)	(67.465)
BOOKS_H	292.923***			9.168	183.117**	183.208**
	(82.907)			(82.697)	(80.450)	(79.954)
DEGREE_Q		527.232***		540.557***	489.356***	489.153***
		(81.790)		(84.800)	(92.881)	(91.034)
DEGREE_HQ		1,065.744***		1,061.386***	666.893***	666.699***
		(103.369)		(110.728)	(124.370)	(123.047)
Res			159.371***			
			(18.707)			
OCCUP_C2					73.731	73.689
					(68.657)	(68.469)
OCCUP_C3					215.030**	215.009**
					(83.977)	(83.850)
OCCUP_C4					350.319***	350.243***
					(97.021)	(96.667)
AGE					16.387	16.561***
					(15.486)	(2.263)
AGE^2					0.002	
					(0.197)	
SEX					-367.140***	-367.138***
					(55.827)	(55.756)
WRKHRS					27.148***	27.148***
					(2.607)	(2.603)
Constant	1,317.550***	890.506***	1,427.513***	910.492***	-299.634	-302.561
	(58.330)	(75.037)	(28.211)	(80.306)	(324.732)	(198.002)
Observations	587	587	587	587	403	403
R^2	0.023	0.154	0.110	0.157	0.522	0.522
Adjusted R^2	0.020	0.151	0.109	0.151	0.509	0.510

Note: Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01
Source: ISSP 2009, own calculations

Table 16

Ordered logit regression estimates of the effect of the number of books and the highest educational level on monthly net income

	Dependent variable: ***NETINC3***
DEGREE3	1.207***
	(0.295)
BOOKS3	0.407**
	(0.188)
OCCUP4	0.427***
	(0.142)
AGE	0.049***
	(0.011)
SEX	-1.493***
	(0.264)
WRKHRS	0.112***
	(0.014)
Observations	403
Log Likelihood	-248.771

Note: Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01
Source: ISSP 2009, own calculations

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Abstract (English)

The first years in life are important for the production of certain skills and abilities of individuals. This thesis examines the role of early childhood education for the later success in socio-economic life. The first part presents two economic models from Becker & Tomes (1986) and from Cunha & Heckman (2007). The basic assumptions as well as predictions from the theoretical models will be presented and discussed. The second part of this thesis consists of an empirical analysis for the special case of Austria by using data from the International Social Survey Programme 2009. The empirical study investigates the role of early investment in children for future economic outcomes, like individual net income. According to economic theory, early childhood education lays the basis for certain achievements in future life. My empirical analysis provides evidence for the connection between parental characteristics, investment in education, educational attainment and net income.

Abstract (Deutsch)

Den ersten Lebensjahren kommt eine besondere Bedeutung zu für die Entwicklung einer Reihe von individuellen Fähigkeiten. Diese Arbeit untersucht die Rolle von frühkindlicher Erziehung für die weitere Entwicklung von Individuen und deren zukünftigen Erfolg im sozialen und wirtschaftlichen Leben. Im ersten Abschnitt dieser Arbeit werden zwei ökonomische Modelle präsentiert. Es handelt sich dabei um die Modelle von Becker & Tomes (1986) und Cunha & Heckman (2007). Die grundlegenden Annahmen und die daraus resultierenden Ableitungen für die zentrale Fragestellung werden dargestellt und diskutiert. Der zweite Abschnitt in dieser Arbeit besteht aus einer empirischen Untersuchung für Österreich. Dafür werden Daten des International Social Survey Programme 2009 verwendet. Die empirische Studie untersucht die Rolle von Investitionen in Bildung im frühkindlichen Alter für zukünftige wirtschaftliche Größen, wie etwa das individuelle Nettoeinkommen. Die ökonomischen Modelle prognostizieren, dass frühkindliche Erziehung die Basis für den späteren Erfolg im sozialen und ökonomischen Leben legt. Meine empirische Untersuchung für Österreich liefert Ergebnisse, die einen Zusammenhang zwischen elterlichen Charakteristika, Investitionen in Bildung, dem Bildungsabschluss und dem Nettoeinkommen nahe legen.

Curriculum Vitae

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