

Research Report

Context, Skills and Social Progress: Evidence from Germany

Dorothea Blomeyer¹, Manfred Laucht¹, Friedhelm Pfeiffer,
Pia Pinger² and Karsten Reuß³

Mannheim, January 10, 2014

¹ Central Institute of Mental Health, Mannheim

² University of Bonn

³ The Association of German Engineers, Düsseldorf



ZEW

Zentrum für Europäische
Wirtschaftsforschung GmbH

Ansprechpartner

PD Dr. Friedhelm Pfeiffer

L 7, 1 · 68161 Mannheim

Postfach 10 34 43
68034 Mannheim

E-Mail pfeiffer@zew.de
Telefon +49 621-1235-150
Telefax +49 621-1235-225

Abstract: This study provides life-cycle evidence on the relationship between childhood investments (contexts), cognitive and non-cognitive skills, and life outcomes (social progress). From a policy perspective, societies are interested in generating high levels of social progress. We therefore investigate how Germany performs in terms of aggregate social progress and how individual life success is generated empirically through higher levels of skills and childhood rearing conditions. The empirical analysis is based on three different individual datasets that complement each other in the measurement of context, skills and social progress.

Our findings suggest that, compared to other countries, the aggregate level of social progress in Germany is high. Moreover we show that, at the individual level, skills provide an important link between childhood contexts and adult social progress. Based on factor modeling, our results indicate that environmental stimulation during childhood improves cognitive and mental skills and that environmental responsiveness positively affects mental skills, emotional skills and personality. Cognitive, mental and emotional skills in turn are all highly predictive of academic performance and skills and personality traits together drive societal engagement. Moreover, better cognitive and mental skills can help to cope with life burdens. We show that skills do not have a large direct effect on health, but that personality traits drive both health and health behaviors. Based on our findings, we derive policy recommendations and ideas for future research.

Keywords: Cognitive skills, non-cognitive skills, education, economic and social progress

JEL-classification: I12, I21, J13

Acknowledgements: This report was initiated and financially supported by the OECD-CERI international research project on education and social progress. Pia Pinger, Friedhelm Pfeiffer and Karsten Reuß gratefully acknowledge financial support from the project “Noncognitive Skills: Acquisition and Economic Consequences” funded by the Leibniz Association. Manfred Laucht thanks the German Research Foundation and the Federal Ministry of Education and Research for their support in conducting the Mannheim Study of Children at Risk. We thank Alisa Goegelein and Aline Schmidt for fine research assistance Winfried Pohlmeier and Holger Stichnoth for a number of very useful comments on an earlier draft of the paper. The views expressed in this article are those of the authors and do not necessarily reflect the views of the OECD, the Leibniz Association, the German Research Foundation or the Federal Ministry of Education and Research. The usual disclaimer applies.

1 Introduction and Overview

Societies strive for a high level of social progress and a large number of so-called social progress indices exist that rank countries along this dimension. At the same time, in many cases it remains unclear how social progress is actually formed except that it depends on good institutions, human actions and individual life successes. Human actions and life successes in turn are determined by skills and personality traits, whose formation starts in early childhood by context factors such as familial investments, education institutions and the community.

This study brings these different ideas together and provides initial evidence on the association between the environmental context and skill formation as well as between skills and social progress in Germany. To this end, we link macroeconomic evidence on social progress in Germany with microeconomic analyses of how individual life successes and the development of social progress at the aggregate level are determined by environmental context factors and human skill formation. Because longitudinal data on home environments, skill development and late-life outcomes do not exist for Germany, we base our analysis on different individual datasets that complement each other in the measurement of context, skills and social progress measures over the life-cycle.

During recent years, the effect of early-life conditions on late-life outcomes has become a focal point of research in economics, psychology, sociology, and related fields. In this literature, the formation of skills is an essential link between environmental conditions during childhood and adult outcomes that are part of social progress. First, important contributions in the economics literature show that the formation of cognitive skills, such as intelligence, memory power and reasoning, and non-cognitive skills, such as motivation, delay of gratification, persistence, resilience and personality traits, begins in early childhood and that cognitive and non-cognitive skills are formed in cumulative and synergetic processes all over the life span (Blomeyer et al., 2009, 2013; Heckman, 2007; Cunha and Heckman, 2007; Pfeiffer and Reuß, 2008; among others).

Families, schools, and the community together provide formal, non-formal and informal learning environments that are important for the formation of skills, while at the same time (preschool) skills and early family environment influence school outcomes (see also Fertig and Tamm, 2010; Todd and Wolpin, 2003, among others), as well as the quality and timing of teaching (see Becker et al., 2012, among others). The notion of “skills beget skills” (James Heckman) implies that skills formed early in life affect the accumulation of skills later in life and thus hints at the eminent role of the family and early life environment for the development of individual skills and social progress in a society. Non-cognitive skills and personality traits are often more important for life success than cognition and also more malleable throughout the life-cycle (Almlund et al., 2011, Heckman et al., 2006; Heckman et al., 2013, among others).

In our empirical analysis we focus on specific dimensions of environmental contexts and social progress. Environmental contexts comprise parental education, parental resources, parental personality traits, child care and education, child stimulation and the quality of parent-child interactions. Social progress comprises health (healthy lifestyles, health outcomes), societal engagement (civic participation, political participation and cultural engagement), family cohesion (teenage pregnancy, divorce and separation), subjective well-being (life satisfaction, happiness), trust and tolerance (interpersonal trust, tolerance and institutional trust), public safety (crime, bullying, traffic safety), and ecological behavior. Depending on the data, other aspects such as academic performance are included.

Our empirical analysis is based on microdata from Germany, which ideally complement each other in terms of measures and life-cycle coverage. The datasets are:

- Mannheim Study of Children at Risk (appr. MARS),
- Mother-Child Pilot Study (appr. MuKi),
- German Socio-Economic Panel (appr. SOEP).

MARS is an epidemiological cohort study that follows a carefully selected group of children from birth to adulthood. Children at risk are oversampled in the data. This is an advantage since the total sample covers the full range of early life adversity stemming from organic or psychosocial initial risks.

In addition, the data contain a unique set of psychological assessments on stage-specific competencies and the home environment in significant stages of development, among them the quality of mother child interaction in infancy (Blomeyer et al., 2009, Coneus et al., 2012, Laucht et al., 1997).

MuKi is part of the Socio-Economic Panel Study (SOEP), performed once in 2008 (Bartling et al., 2010). The sample contains roughly 300 mother-child pairs, who were visited by trained interviewers in their homes. Its innovative feature is that it employs experimental data of children and their mothers to explore the intergenerational relationship of impatience. However, the data also contain a large number of context and skill variables.

The SOEP provides a rich set of socio-economic data for a representative sample of the German population (Wagner et al., 2007). It contains information on age, family status, family background, life satisfaction, health, education, employment, hours of work and earnings, conducted annually. In recent waves, the SOEP additionally contains comprehensive self-ratings on personality, health and risk aversion, among others. The SOEP has been widely used in education and labour market research by the authors of this study, see for example, Eisenhauer and Pfeiffer (2008), Gernandt and Pfeiffer (2007), Pfeiffer and Seiberlich (2011), Piatek and Pinger (2010).

The three datasets complement each other with different strengths and weaknesses. MARS provides a deep look into the relation between context and skills during childhood based on psychological assessments. Among others, it contains unique observational data on parent-child interaction in infancy, on pre- as well as perinatal conditions and offers a rich longitudinal structure. According to the best of our knowledge MuKi is the only dataset that contains experimental measures of skills as measured once by children and their mothers.

Both of these data are not representative for the German population. Nevertheless, they provide insights into the basic structure of individual development and social progress that are not available with other data. The SOEP data represents the German population and allows us to study the relationships between context, skills and social progress in adulthood. SOEP provides a rich set of information on social progress on an annual basis.

To assess the relationship between context and skills and skills and social progress with the three German datasets the study utilizes the statistical approaches developed by Coneus et al. (2012). The basic idea is to first use factor analysis to condense the manifold information on contexts, skills, and social progress and to construct robust indicators. Instead of using the diverse original items available in the data, factor analysis helps to reduce measurement error and the dimensionality of the data. In a second step, regression analyses are performed to highlight the association between context and skills, and skills and social progress.

Our findings indicate that a beneficial socio-economic environment improves cognitive and mental skills throughout childhood. In particular, a responsive parent-child relationship during infancy and a stimulating home environment during toddlerhood and preschool age are very important for individual success and social progress. In addition, maternal personality traits such as patience foster the development of non-cognitive skills while the quality of the material environment mainly affects cognitive skills. Skills affect individual social progress in several ways. Cognitive, mental and emotional skills are all highly predictive of academic performance and skills and personality traits together drive societal engagement. Moreover, better cognitive and mental skills can help to cope with life burdens. We show that skills do not have a large direct effect on health, but that personality traits drive both health and health behaviors. Based on our findings, we derive policy recommendations and ideas future research.

The paper proceeds as follows. Section 2 provides an overview of the aggregate situation in Germany and summarizes macro evidence on social progress from different indicators in an international context. Section 3 elaborates our estimation framework and strategy. Section 4, 5 and 6 present the results for the three different datasets. Section 6 concludes with policy implications and possible directions for future research.

2 Social Progress in Germany – Evidence from Aggregates

This section discusses selected concepts of aggregate indicators of social progress and shortly summarizes the social progress situation in Germany. De-

spite a large number of available international rankings, one has to be careful drawing far reaching conclusions from these aggregates, since a unique definition of social progress is not available yet and the content of indicators differ between countries.

Germany is a western democratic society with an elaborated educational and welfare system and an aging population. The main reasons behind Germany's performance as a modern economy are a highly skilled work force in combination with contractual freedom, an extensive use of smart machines, openness and trade orientation. In Germany, households, firms and government invest steadily into research as well as vocational, academic education and life-long learning (see Borgloh et al., 2011, among others).

Today, people in Germany have invested on average 13 years into their formal education, an often used indicator available for world-wide comparisons of human capital (see Murin and Morrison (2009). Although average years in education is slightly higher in other OECD countries such as Great Britain or Japan (13.6, ditto), in Germany investment into training and qualification in adulthood seems to be especially high compared to international standards (Borgloh et al., 2011).

Traditionally, public policy is oriented towards redistribution and equality of opportunity. Therefore the level of inequality is moderate in Germany. However, as a result of ongoing globalization and social and technical change, Germany experienced an increase in wage inequality in the last twenty years (Gernandt and Pfeiffer, 2007, among others). Inequality in earnings and wages is still lower compared to countries such as Great Britain or the United States of America, although it is higher compared to the Scandinavian countries (Pfeiffer and Reuß, 2013, among others).

In terms of intergenerational mobility, Germany provides a moderate degree of equality of opportunity (Eisenhauer and Pfeiffer, 2008, among others). Intergenerational mobility is higher compared to Great Britain and the United States of America, and lower compared to the Scandinavian countries. During the last three decades, unemployment has been relatively high, especially among the low skilled. Today, overall unemployment rates are reasonably low (5.5 percent in the second quarter 2013 compared to the OECD average of 8

percent according to official OECD statistics), among others resulting from a higher degree of wage flexibility in the lower part of the wage distribution.

German students perform well in international achievement studies (PISA), especially in mathematics and natural sciences. However, PISA research suggests that inequality among students is high and performance in schools seems to depend relatively strongly on family background compared to other OECD countries (OECD, 2011, Wössmann and Hanushek, 2008, among others). Disconnectedness among young adults, a broader concept of performance that includes participation in the labour market and social relationship besides academic achievement, significantly depends on family background as well (Pfeiffer and Seiberlich, 2011, among others).

GDP per capita is one of the most frequently used indicators of a society's economic well-being. In 2012, Germany's GDP per capita was 42 thousand US\$ and thus on the threshold of the top third of all OECD countries. Arguably, GDP per capital is problematic as a performance indicator, because it simplifies complex interdependences and focuses on economic activities only. For example, it does not discriminate between economic activities with a negative or a positive impact on well-being or life quality and does not cover non-market activities or external effects.

As a consequence, multiple alternative indicators of economic well-being have emerged from governmental and supra-governmental initiatives (see e.g. the *Beyond GDP initiative* of the European Commission, (Beyond GDP, 2012)). The German Federal Bureau of Statistics regularly measures indicators on sustainability for ten years now ("Nachhaltigkeitsindikatoren", German Federal Statistical Office, 2012). The idea behind this biennial evaluation is the measurement of the success of political strategies that were implemented in order to improve the general life quality of the citizens and sustainable development. While some domains of social progress defined by the OECD-CERI research plan are directly or indirectly comprised in the indicators, others, such as subjective well-being, societal engagement and family cohesion, are not.

The Gallup-Healthways Well-Being Index measures subjective well-being all over the world (Gallup Healthways Well-Being Index, 2012). In 2008, the Well-Being Index was initially introduced in the USA and, in 2011, in Great-Britain and Germany. Each month, about 1,000 adults are surveyed in six domains:

life evaluation, health behavior, emotional and physical health, work environment and basic access, which relates to necessities crucial to well-being such as medicine, enough money for food or access to a doctor. A comparison of the three countries observed with the Well-Being Index shows that Germans have better health behavior, better basic access and better self-reported work environments but tend to rate their actual and future living-conditions less well than the Americans and the British.

Initiated in 1990, the Human Development Index (HDI) measures human development by combining social and economic development indicators (United Nations Development Programme, 2012). The HDI combines indicators of life expectancy and health, educational attainment, and income into one number. In 2012, Germany ranked 5 out of 187 countries and territories and was outperformed only by Norway, Australia, Sweden and The Netherlands.

The Progress Index (Center of Societal Progress in Frankfurt, 2011), developed in 1970, combines ecological and economic information on 22 countries. The countries included in the index are primarily European but also comprise Japan, South Korea, Australia, New Zealand, USA as well as Canada. The index focuses on similar aspects as the HDI: income, health and education. One additional indicator is the environment, which is represented by the countries' ecological footprint. The ecological footprint indicates the amount of land required to provide all the resource requirements and the amount of vegetated land needed to absorb all the CO₂ emissions (Rees and Wackernagel, 1996, among others). Among the 22 countries of the Progress Index, Germany is ranked number 5 in the 2011 report, behind Norway, Sweden, Switzerland and Japan, but ahead of the USA, France and Denmark.

The Happy Planet Index (HPI) adds the component of sustainability to the issue of well-being (The new economics foundation, 2009). The index comprises measures on life satisfaction, life expectancy and the ecological footprint for 143 countries. The highest HPI score is that of Costa Rica (76.1 out of 100). As well as reporting the highest life satisfaction in the world, Costa Ricans also have a relatively high average life expectancy - all this with an ecological footprint of only 2.3 global hectares, which is minor compared to the footprint of more developed Western countries. In fact, except for Vietnam, all of the top ten countries are in Latin America. Germany is ranked number 51 with a score

of 48.1 points out of 100 and it is mostly the ecological footprint that counter-weighs Germany's good scores in terms of life satisfaction and life expectancy.

The Legatum Prosperity Index (Legatum Institute, 2011) is composed of eight sub-indices and based on 89 different variables that affect wealth and personal well-being: economic growth, entrepreneurship and opportunity, governance, education, health, safety and security, personal freedom, and social capital. These sub-indices are more community-focused and put more weight on economic aspects. Germany is ranked number 15 of 110. The top three countries are Norway, Denmark and Australia.

A review of well-being indicators thus seems to reveal that Germany is among the leading countries in terms of economic well-being. While its good scores are mainly driven by Germany's economic performance, its modern government, education, health and research investments, the ecological footprint seems to be average at best.

In what follows, we focus on the relationship between context, skills and social progress over the life cycle and the methods of assessment. The analysis is based on individual data and intends to deepen the knowledge on the origins of skill formation and its consequences for social progress as defined by the OECD-CERI research plan. The focus thus shifts from aggregate indicators to mechanism and structures that links development from infancy to adulthood.

3 Empirical Strategies

Any comprehensive framework describing the relationship between learning contexts, skills and social progress is necessarily complex, involving dynamic and recursive interactions within and across diverse contexts (see OECD 2010, 2011). Both cognitive and non-cognitive skills seem to be important for economic and social progress (Borghans et al. 2008, Cunha and Heckman, 2007, Heckhausen and Heckhausen, 2008, Pfeiffer and Reuss, 2008, among others). The technology of skill formation developed by Cunha and Heckman (2007) provides an economic framework for addressing how skills are produced by educational investments and the environment. The framework is flexible enough to account for the cumulative and synergetic nature of skill formation, characterized by self-productivity ("skills begets skills") and dynamic comple-

mentarity - returns to investment later in life increase with the stock of skills acquired early in life.

To empirically assess the relationship between context and skills and skills and social progress we rely on the statistical approach developed by Coneus et al. (2012). Figure 3.1 provides a graphical representation of the impact of social environments on skills and of the impact of skills on social progress. As displayed by the figure, we first assess how cognitive and non-cognitive skills evolve in formal, non-formal and informal learning environments, including family, school and community (see relationship A in Figure 3.1). Second, we focus on the role that skills play in fostering measures of social progress in Germany (relationship B in Figure 3.1). Third, we develop policy recommendations for improving social progress.

Figure 3.1: Basic Framework



Source: Content adopted from OECD (2011).

To investigate how social contexts affect skills and social progress, we isolate relevant dimensions of social contexts and skills after controlling for the impact of multi-layered contexts and interactions. For instance, we assume that family, school and community contexts drive individuals' cognitive ability and personality traits, and that a combination of these skills shapes individual measures of social progress – e.g. health outcomes and civic engagement. Contexts comprise environmental factors (e.g. number of books at home, school class sizes and quality of recreational parks in the local community) and social interactions with parents, classmates, friends and neighbors. We investigate how such contexts affect skill development and how an individual's ability influences measures of social progress.

The statistical analysis proceeds in five steps. First, because our data contain a large number of measures for social contexts, skills and social progress, we use

factor analysis to condense this information into a smaller set of basic, orthogonal factors. Following Coneus et al. (2012), we extract each of the factors separately:

- *step one* will extract factors of the context variables,
- *step two* will extract factors of the skill variables,
- *step three* will extract factors of the social progress variables.

To make different types of scales comparable and to facilitate the analysis, all measures are standardized prior to factor analysis to have a mean of zero and standard deviation of one in order. Next, the minimum number of latent factors required to reflect the data is determined. Too few factors may not be able to capture all relevant information in the data, while too many factors may be highly correlated with each other and may thus not solve the problem of multiple measurements.

In a second instance, we then use maximum likelihood methods to estimate of a factor loadings matrix Ω that corresponds to a matrix of coefficients in the following equation:

$$z = \Omega \cdot f + e \quad (1)$$

with z being a vector of the variable measurements and Ω a constant $m \times n$ matrix of factor loadings ω_{mn} , with m measurements and n latent factors.

f is the vector of standardized and independent common factors with length n , and e the error term of independent specific factors, which we assume to be normally distributed. We identify the optimal number of factors by computing the number of eigenvalues of the correlation matrix greater than one (see e.g. Jöreskog, 1967).¹ Note that because each dataset contains different measures, the optimal number of factors may differ for all three datasets.

Third, we use orthomax-rotation to facilitate the subsequent interpretation of factors. Assuming the latent factors to be orthogonal, the rotation proceeds as:

¹ This criterion for factor selection is commonly known as the Kaiser criterion (Kaiser 1960).

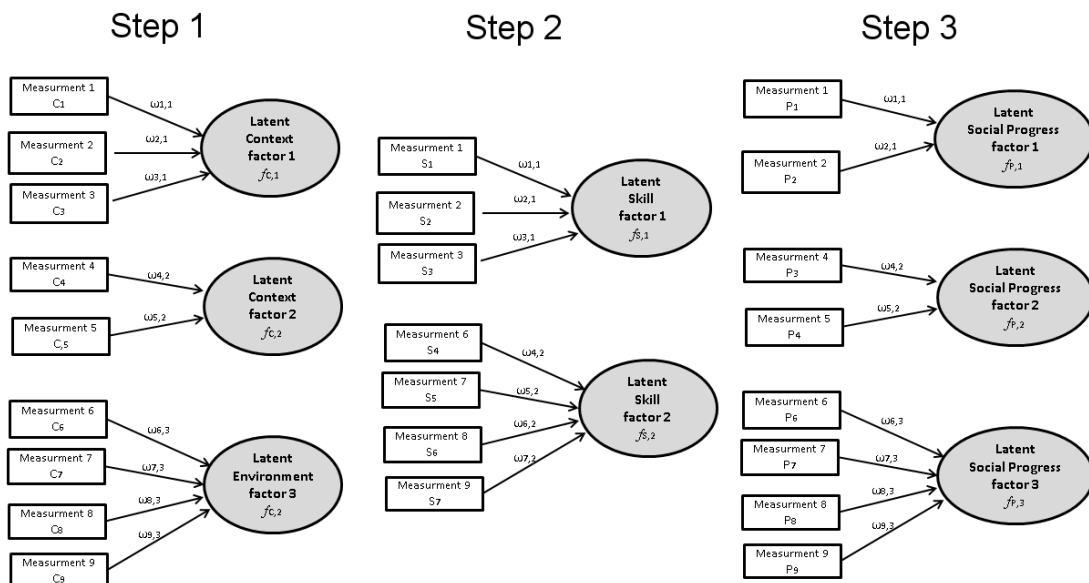
$$\max \sum_{q=1}^n \left\{ \sum_{j=1}^m (\omega_{jq})^4 - \frac{\gamma}{m} \left[\sum_{j=1}^m (\omega_{jq})^2 \right]^2 \right\} \quad (2)$$

with

$$\gamma = \frac{m(n-1)}{(m+n-2)} \quad (2')$$

Equation (2) states that the variance of the squared loadings ω_{mn} of the n factors on all the m measurements in the factor matrix Ω is maximized. This has the effect of differentiating the original measurements by the extracted factor. After the rotation, each factor tends to have either large or small loadings on a particular measurement. By specifying γ according to Equation (2'), we obtain common factors that are composed of a few variables, only (parsimax rotation). By means of an orthogonal transformation, we extract rotated factors that are uncorrelated (see Figure 3.2.)

Figure 3.2: Factor analysis



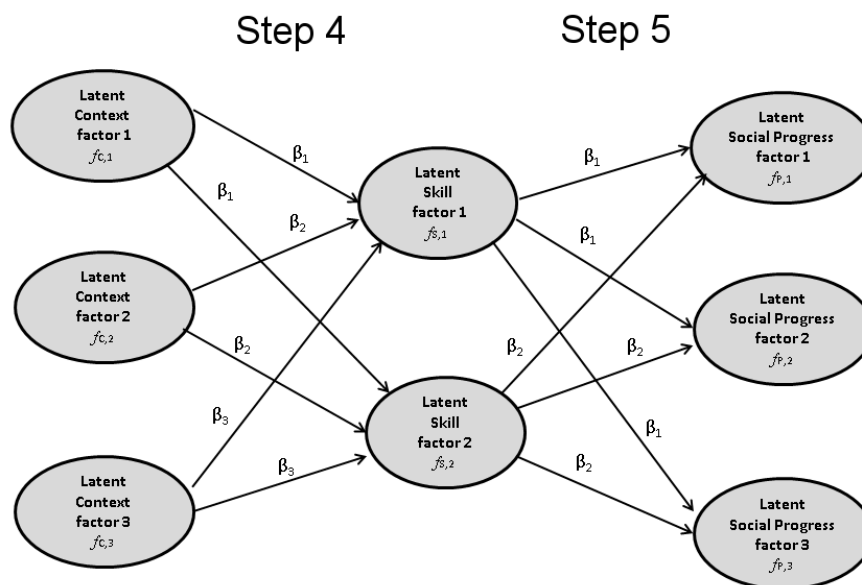
Steps four and five put the latent factors into regression models to assess the relationship between context and skills as well as between skills and social progress (see Figure 3.3):

- in *step four* latent context factors are regressed on latent skill factors,
- in *step five*, latent skill factors are regressed on latent social progress factors.

To assess the relationship between contexts and skills (*step four*), we estimate

- $f_{Sj} = \beta_0 + \beta_1 f_{C1} + \beta_2 f_{C2} + \dots + \beta_{n^c} f_{Cn^c} \quad (j=1,2,\dots, n^s) \quad (3)$
- with $\beta_0, \beta_1, \dots, \beta_{n^c}$ being the regression coefficients, n^c the number of context factors, n^s the number of skill factors, f_{S1}, f_{S2}, \dots the skill factors, f_{C1}, f_{C2}, \dots the context factors.

Figure 3.3: Regression analysis



To assess the relationship between skills and social progress (*step five*), we estimate

- $f_{Pj} = \beta_0 + \beta_1 f_{S1} + \beta_2 f_{S2} + \dots + \beta_{n^s} f_{Sn^s} \quad \text{with } j=1,2,\dots, n^p \quad (4)$
- In this specification, n^p is the number of social progress factors and f_{p1}, f_{p2}, \dots are the social progress factors. *Steps one to five* were conducted separately for all three datasets. If possible skill measures are only be used if they refer to later periods, than context measures and social

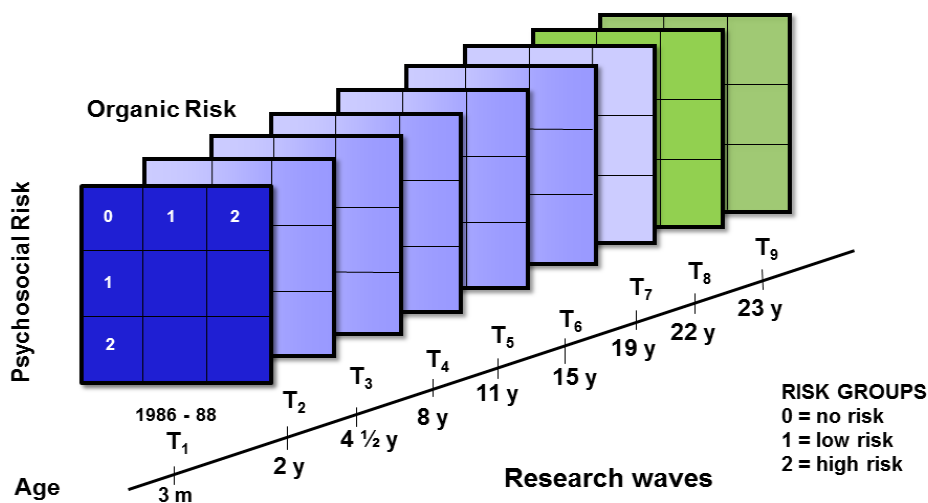
progress measures are only be used if they refer to later periods than skill measures. This way, reverse causality problems can be mitigated, such that context variables predict skills, and skills predict social progress.

4 Findings from the Mannheim Study of Children at Risk

4.1 Data Design

The Mannheim Study of Children at Risk (MARS), a longitudinal epidemiological cohort study following infants at risk from birth to adulthood, contains detailed data on psychometric skill measures and educational investments (Blomeyer et al., 2009, Coneus et al., 2012, Laucht et al., 1997, among others). The initial sample consists of 382 children (184 boys, 198 girls) born between February 1986 and February 1988. Infants were selected according to their degree of exposure to organic and psychosocial risks (see Figure 4.1).

Figure 4.1: Sample design in the Mannheim Study of Children at Risk



Source: Mannheim Study of Children at Risk

Organic risks reflect peri- and pre-natal complications, such as low birth weight or asphyxia, while psychosocial risks cover adversities that are, for example, related to low socio-economic environments, such as psychiatric disorders of the parents or early parenthood. Organic and psychosocial risks were

scaled into “no risk”, “moderate risk” and “high risk”. Children were assigned to one of the nine groups, all groups having approximately the same size.

The medical and psychological assessments of the research waves took place when the children were 3 months, 2, 4.5, 8, 11, 15, 18, 22 and 23 years old and are still going on. Participation rates between the research waves are high, despite the extensive survey procedure, comprising a large number of medical and psychological examinations. The sample amounts to up to 364 observations with oversamples of high-risk combinations and equal gender ratios in all subgroups. Since the MARS sample is restricted to first-born children with German-speaking parents from the Rhine-Neckar region, the socioeconomic background of the children and the family culture are not necessarily representative of the German population. It is however fair to say that the relationship between investments, medical and psychosocial risks, skill developments and social progress indicators share some universal principles.

4.2 Description of Variables

We start out by describing the organic and psychosocial risk ratings which were used for sample selection. A rating of organic risk was obtained from information provided by the maternal obstetrical and infant neonatal record. It is based on psychological and medical ratings of several pre-, peri- or neonatal complications including premature birth, EPH-gestosis of the mother, low birth weight, asphyxia, seizures, respiratory therapy, sepsis, etc. The variable *organic risk* denotes such organic risk factors. A rating of psychosocial risk was made based on the risk index developed by Rutter and Quinton (1977). It includes, among others, parental psychiatric disorders, broken home history, delinquency of a parent, early parenthood, low quality partnership, unwanted pregnancy, disease and unemployment. *Low psychosocial risk* denotes the absence of such psychosocial risk factors.

The context variables in MARS were assessed from infancy up to age eight, the skill measures were administered at the age of 11 and the social progress measures were collected at ages 22 and 23. The socio-emotional home environment of the children between the ages of 3 months and 8 years has been assessed by HOME-Score (Home Observation Measurement of the Environment, Bradley and Caldwell, 1980). Bradley and Caldwell (1980) find evidence for a strong link between cognitive abilities and the HOME as a relevant measure

for preparing and fostering abilities starting in early childhood. This study uses a modified version of the original HOME that was generated by a combination of parent interviews and direct observations. The composition of HOME items changes with age as other factors become relevant, consisting of 25 items at the age of 3 months, 87 at the age of 2 years, 95 at the age of 4.5 years and 59 items at the age of 8 years.

At the age of 3 months, videotaped information on the *mother-child interaction* was rated by means of the so-called MBS-MKI-S scale (“Mannheimer Beurteilungsskala”, see Esser et al., 1989). Maternal behavior is broken down into eight dimensions: emotion, tenderness, verbalization, verbal restrictions, congruity/authenticity, variability, reactivity/sensitivity and stimulation. Infant behavior is broken down into five dimensions: emotion/ facial expressions, verbalization, viewing direction, reactivity and the potential willingness to interact. Another important measure of early parental investments is the *duration of breastfeeding* which was administered when the children were two years of age. In the data, breastfeeding durations range from 0 to 104 weeks.

The HOME subscore *Mother-Child Interaction* was assessed once, at the age of three months, and captures a mother’s sensitivity towards the child, her vocalization, smooching, avoidance of punishment and aggression and her integration of the child during the interview. The subscore *conversation process with mother and child* evaluates factors such as clear speech, language, interest, praising or honesty of parents towards their 3-month old, 2-year old and 4.5-year old children (Bradly and Caldwell 1980). *Living Environment* consists of security, nursery, apartment appearance, yard quality or keeping pets.

The subscore *Stimulation of development and language* has 13 items that measure allowance of child play, speech quality towards child, quality of media or types of playing (e.g. songs, colors, numbers or letters). This variable concerns 2-year- and 4.5-year-old children. *Avoidance of Restriction and Punishment* is based on 7 items and describes the behavior of parents during their housework and during the interview, such as allowing the child to play, avoidance of punishment or offering interesting activities to the child. The *Emotional Climate* score measures how well parents integrate the child during the interview: examples are a tender interactions such as smooching, motivating

or praising the child and whether the parents showed compassion and avoided punishment or aggression.

Promotion of Maturation and Autonomy is measured by considering the child's capability to dress, tie shoes, tidy up or behave politely and the parents' contribution to their child's learning-progress. *Play Materials* are categorized in toys to drive, to paint, to read, to build, to cuddle, to puzzle, to learn with or to play music on. *Paternal Engagement* takes factors into consideration that describe the presence of a father or equivalent person. It evaluates, for example, the father's (or equivalent person's) engagement in outdoor activities, whether he sees the child at least 4 days a week or whether he attends meals or other social situations. The information is taken from the HOME by interview ratings that consist of 4 items for 8-year-old children.

Information on *emotional and verbal responsivity* was taken from the HOME interview (10 items for 8-year-olds) and observation of the interview situation. This variable evaluates whether the child has a clear daily routine and whether the parents praise, motivate and support the child. Information on *active stimulation* covers aspects such as reasonable TV use, hobbies, variety of leisure activities, playground use, and availability of a library card, museum visits or habits of travelling. *Material environment* describes the direct surroundings of the child including the appearance of the house/apartment, order and cleanliness, living space per person, noise level, child security and parental smoking habits.

Information on *activities promoting development* comprise activity-related factors such as visiting friends or relatives, taking the child to cultural events, business trips or journeys, or encouraging the child to engage in sport activities such as riding a bike or roller skating. *Promotion of social maturity* is measured by interview ratings of 8-year-olds. It evaluates the parents' support of social maturity, such as, for example, expecting the child to tidy up, to help in the household and to do homework, but also the reasonability of parental rules and their consistency. Information on *materials and experiences promoting development* include the availability of radio or cassette recorder, musical instruments, books, dictionaries, newspaper or activities such as visiting friends.

In addition, the quality of *neighborhood environment* is measured. The housing conditions in the neighborhood, the house type, the infrastructure quality as well as nearby disturbances of traffic, noise, industry and bars were rated. Information about *external childcare* at the age of 4.5 years was assessed retrospectively by means of an interview. The score comprises information on institutional childcare of the last 6, 12 and 18 months (in daily and weekly dimensions), kindergarten use and nanny care. The data contains information on several characteristics of the parents. The permanent income per capita in Euros was constructed from per capita income in each period.

MARS provides several psychometric measures of skills. The *IQ* (intelligence quotient), measuring cognitive abilities, was assessed with a battery of standardized tests, including, among others, the Culture Fair Test at the age of 11 years (Cattell, 1960). Each test consists of a variety of subtests such as numeracy, memory, receptive and expressive language skills. The *IQ* is measured in a verbal (*verbal IQ*) as well as in a nonverbal dimension (*nonverbal IQ*) from the age of two years onwards. The *MQ* (motor quotient), measuring motor abilities, has been assessed with the Body coordination test for children (KTK) (Kiphard and Shilling, 1974).

The data contain several measures of non-cognitive skills and personality traits. They were collected during a standardized parent interview and structured direct observations in four standardized settings both in familiar (home) and unfamiliar (laboratory) surroundings. Trained interviewers rated all children on 5-point scales of five temperamental dimensions adapted from the New York Longitudinal Study NYLS (Thomas et al., 1968). The eight measures employed in this study are as follows: *Activity* describes the frequency and intensity of motor behavior ranging from “being inactive and slow” to “being overactive and restless”. *Approach* describes the initial reaction to new stimuli (e.g. strangers, new food, or unfamiliar surroundings) ranging from “withdrawal” to “approach”. *Adaptability* denotes the length of time needed to get habituated to the new stimuli going from “very slow/not at all adapting” to “very quickly adapting”. *Mood* describes the general tendency of the child to be in good or bad temper ranging from “negative mood” to “positive mood”. *Persistence* refers to a child's ability to pursue a particular activity and its continuation in the face of obstacles varying from “very low” to “very high”.

At the ages of 22 and 23 years, multiple social progress-related variables were assessed by two questionnaires. Healthy lifestyles are measured by variables containing information on smoking, drinking and cannabis consumption. Health outcomes contain information on medical treatments, doctor visits and the self-perceived health. The drinking frequency per month and the average amount of alcohol consumed among 22- and 23-year-olds is summarized by a score of *alcohol consumption*. In addition, *alcohol dependency* of the individuals is measured by the AUDIT score (Alcohol Use Disorders Identification Test). This test consists of 10 questions that deal with alcohol consumption, alcohol dependency and alcohol-related problems. *Smoking frequency* is measured on a scale between 'never' and 'daily'. *Smoking dependency* is measured by the FTND score (Fragström Test of Nicotine Dependence). This test consists of six questions on the individual's smoking behavior.

The data also contain information on the *age at smoking onset*. *Frequency of cannabis use* is measured on a scale Likert-scale ranging from 'never' to 'nearly daily' during the last year.

With respect to health outcomes, the *self-perceived health* is measured on a 5-point scale between 'very good' and 'poor'. Information on the number of *doctor's visit and hospital stays* both for physical and mental health issues is available in the data as well as a variable containing the amount of *medications*, separately for physical and mental health problems. Further health outcome variables include *physical height*, the *BMI (body mass index)* and information on *chronic diseases*.

Family cohesion in the MARS was assessed by *teenage pregnancy* and the age at the birth of the first child for each individual. Also, the family status was reported ranging from "single" to "living together with unmarried partner" to "married". Subjective well-being and life satisfaction are measured by asking the young adults about the amount of life burdens they perceive. One score includes major life burdens such as the death of close relatives and unemployment. Another score contains information on minor life burdens such as "I had to hurry today" or "I was not able to finish my housework". A score on *resilience* eventually refers to the idea of an individual's tendency to cope with stress and adversity (see Schumacher et al., 2004, and Wagnild and Young, 1993).

4.3 Estimation of Latent Factors

This section discusses the results from the factor analysis applied to the context, skill and social progress variables described above. Table 4.1 lists all context variables in MARS and their corresponding factor loadings ω_{mn} with $m=32$ and $n=6$ (*step one*). The most relevant loadings of each factor are in bold. The first factor “Active stimulation at school age in the family” primarily loads on *Active stimulation* and *Activities promoting development* which are subscores of the HOME score at the age of 8 years. It is also correlated to other HOME subscores during school age.

Table 4.1: Context Factor Loadings in MARS

	1	2	3	4	5	6
Conversation process with mother and child (HOME, 3 months)	0.10	0.11	0.14	0.11	0.63	0.07
Mother-child interaction (HOME, 3 months)	0.23	0.20	0.12	0.07	0.34	0.12
Living environment (HOME, 3 months)	0.09	0.13	0.16	0.27	0.40	0.10
Organic risk	-0.15	0.12	0.11	0.05	-0.02	0.01
Psychosocial risk	-0.34	-0.04	-0.15	-0.36	-0.35	-0.14
Mother-child interaction (MBS-MKI-S scale)	0.12	0.05	0.00	0.12	0.39	-0.04
Permanent income	0.17	0.03	0.08	0.40	0.26	0.00
Conversation process with parents (HOME, 2 years)	0.17	0.40	0.20	0.01	0.29	0.16
Stimulation of development and language (HOME, 2 years)	0.14	0.94	0.21	0.15	0.15	0.06
Living environment (HOME, 2 years)	0.03	0.07	0.11	0.54	0.21	-0.01
Avoidance of restriction and punishment (HOME, 2 years)	0.11	0.41	0.23	0.15	0.19	0.84
Emotional climate (HOME, 2 years)	0.19	0.47	0.43	0.07	0.21	0.35
Promotion of maturation and autonomy (HOME, 2 years)	0.25	0.42	0.40	0.17	0.25	0.23
Play materials (HOME, 2 years)	0.25	0.25	0.10	0.25	0.39	0.14
Breastfeeding duration	0.13	0.06	0.08	-0.01	0.00	0.08
Conversation process with parents (HOME, 4,5 years)	0.20	0.14	0.58	0.13	0.28	0.03
Stimulation of development and language (HOME, 4,5 years)	0.14	0.93	0.21	0.14	0.16	0.15
Living environment (HOME, 4,5 years)	0.17	-0.01	0.18	0.70	0.09	0.00
Avoidance and restriction and punishment (HOME, 4,5 years)	0.17	0.18	0.60	0.26	0.13	0.07
Emotional climate (HOME, 4,5 years)	0.19	0.22	0.79	0.22	0.04	0.08
Promotion of maturation and autonomy (HOME, 4,5 years)	0.28	0.20	0.56	0.21	0.16	0.16
Play materials (HOME, 4,5 years)	0.36	0.09	0.26	0.42	0.33	0.05
External childcare	0.01	0.00	0.03	0.05	0.04	0.02
Paternal engagement (HOME, 8 years)	0.22	0.05	0.02	0.23	0.03	0.04
Emotional and verbal responsivity (HOME, 8 years)	0.60	0.10	0.31	0.09	0.20	0.01
Active stimulation (HOME, 8 years)	0.77	0.05	0.05	0.31	0.12	0.04
Material environment (HOME, 8 years)	0.46	0.11	0.06	0.37	0.19	0.16
Activities promoting development (HOME, 8 years)	0.70	0.11	0.16	0.23	0.15	0.05
Emotional climate (HOME, 8 years)	0.48	0.11	0.32	0.05	0.09	0.02
Promotion of social maturity (HOME, 8 years)	0.44	0.11	0.17	0.04	0.18	0.04
Materials and experiences promoting development (HOME, 8 years)	0.65	0.12	0.15	0.29	0.22	0.03
Neighbourhood environment	0.10	0.20	0.11	0.59	0.03	0.06

Source: Mannheim Study of Children at Risk. 360 observations. Own calculations.

The second factor “Active stimulation at toddlerhood and preschool age in the family” is also related to stimulating activities with the child but during the ages of 2 and 4.5 years. The third factor “Promotion of autonomy and emotional responsiveness at preschool age” is highly correlated with the emotional

climate and a harmonious parent-child relationship at the age of 4.5 years. In contrast to the first three factors, the fourth factor “Living environment during childhood” mainly loads on environmental variables. It is correlated with the living environment at home, including play materials, and the neighborhood environment. This indicates that neighborhood and living conditions at home are related and are more stable over time than active stimulation.

The fifth factor “Maternal responsiveness in the mother-child interaction at infancy” primarily loads on the conditions very early in life such as the quality of the conversation process with the mother at the age of three months, the very early living environment and the mother-child interaction as measured by the MBS-MKI-S scale. Hence, this factor covers the conditions during infancy. The sixth factor “Emotional responsiveness in toddlerhood” is correlated with avoidance of restricting and punishment and the emotional climate during toddlerhood. It covers similar aspects as the third factor but during an earlier stage of life. Some variables such as psychosocial risk or the permanent income are related to several factors but never dominate. Moreover, some environmental conditions tend to be stable over time, such as the living environment. Others tend to change relatively quickly as the child matures such as emotional climate and active stimulation, which load on different orthogonal factors.

Table 4.2 lists all skill variables of MARS and their corresponding factor loadings ω_{mn} with $m=8$ and $n=3$ (step two). All skill measures were administered at least 3 years after the context measures to mitigate simultaneity bias and reverse causality (see section 4.5).

Table 4.2: Skill Factor Loadings in MARS

	1	2	3
Nonverbal IQ	0.86	0.12	0.18
Verbal IQ	0.68	0.17	0.24
MQ	0.53	0.14	0.13
Activity	0.14	0.04	0.67
Approach	0.12	0.91	-0.08
Adaptability	0.21	0.61	0.16
Emotion	0.11	0.69	0.12
Persistence	0.40	0.16	0.70

Source: Mannheim Study of Children at Risk. 360 obs. Own calculations.

Results indicate that three factors are required to capture the variance of the skill measurements at the age of 11 years, which is in line with Coneus et al. (2012). The first factor is highly correlated with IQ, the second factor is highly correlated with persistence and activity, and the third factor is highly correlated with approach, adaptability and prevailing mood. Thus, non-cognitive skills comprise two dimensions, mental and emotional skills, while cognitive skills load onto a single factor. Mental skills are a mix of the optimal activity level and persistence, related also to cognitive skills. Emotional skills reflect adaptability, approach and emotion.

Table 4.3 displays social progress variables of MARS and their corresponding factor loadings ω_{mn} with $m=8$ and $n=3$ found by the factor analysis in *step three*. Variables were assessed more than 10 years after the skill measures were administered. Due to attrition, the number of observations reduces to 315.

Table 4.3: Social Progress Factor Loadings in MARS

	1	2	3	4	5	6	7
Alcohol consumption	0.15	0.75	-0.05	-0.06	0.05	-0.10	-0.04
Alcohol dependency	0.18	0.88	0.02	0.01	0.03	0.08	-0.04
Smoking frequency	0.97	0.18	-0.05	0.05	-0.08	0.02	-0.03
Smoking dependency	0.60	0.18	-0.09	0.02	-0.13	0.19	-0.10
Smoking starting age	-0.78	-0.19	-0.08	-0.08	0.13	-0.20	0.04
Cannabis frequency	0.23	0.39	-0.09	-0.05	-0.01	0.20	-0.12
Life burdens	0.24	0.14	0.05	0.27	-0.14	0.61	-0.07
Minor life burdens	0.03	0.01	0.12	0.02	-0.04	0.24	-0.09
Partnership	0.05	0.02	0.09	-0.04	-0.13	0.42	0.00
Resilience	-0.10	-0.12	-0.10	-0.12	0.09	-0.08	0.97
Height	0.02	0.19	-0.13	-0.01	0.12	-0.17	0.02
BMI	-0.01	-0.02	0.03	0.05	-0.21	0.06	0.04
Self-perceived health	-0.13	-0.10	-0.43	-0.05	0.11	-0.24	0.34
Doctor's visit physical/ hospital	0.01	-0.06	0.56	0.15	-0.07	0.37	0.05
Medication (physical)	-0.08	-0.05	0.77	0.08	0.00	-0.03	-0.04
Doctor's visit mental/hospital	0.04	-0.02	0.07	0.93	-0.12	0.09	-0.06
Medication (mental)	0.05	-0.06	0.07	0.76	-0.10	0.12	-0.06
Chronic disease	-0.04	-0.10	0.71	-0.05	0.04	0.06	-0.04
Teenage pregnancy	0.13	-0.08	-0.08	0.18	-0.04	0.32	0.03
Academic performance	-0.23	0.05	0.07	-0.11	0.63	-0.22	0.14
University student	-0.18	0.02	-0.03	-0.01	0.95	-0.06	0.16

Source: Mannheim Study of Children at Risk. 315 observations. Own calculations.

The first factor is closely related to smoking frequency, age at smoking onset and smoking dependency as measured by the FTND (*Fagerström Test for Nicotine Dependence*). The factor loading of age at onset is negative, since a younger age indicates higher dependence during young adulthood. The second factor comprises alcohol consumption and alcohol dependency measured by the AUDIT (Alcohol Use Disorders Identification Test).

Medication of physical diseases, chronic disease and doctor visits due to physical problems load onto the third factor, which can be summarized as “physical health”. The fourth factor complements the third with covering all mental health issues. The fifth factor is related to academic performance and the question whether individuals are still in tertiary education. Not surprisingly, this shows that individuals with higher educational degrees are more likely to enroll in higher education. The sixth factor mainly relates to the amount of major and minor difficulties in life but also stands in relationship to teenage pregnancy and low academic performance. These often go hand in hand with adversity during pre-adolescence. The seventh factor relates to resilience with a very high factor loading of 0.97. Resilience describes the ability to be able to cope with burdens in life and to recover from stress. With four out of seven factors addressing health, MARS is particularly rich in information about health. The other three factors are subjective well-being, academic achievement and family cohesion.

4.4 Regression results

We use OLS to assess the impact of context factors on skill factors (*step four*). Table 4.4 shows that cognitive skills at the age of 11 are primarily driven by active stimulation, the living environment, and the mother-child interaction during infancy. Increasing the active stimulation score by one standard deviation increases cognitive skills by 0.26 standard deviations.

Increasing maternal responsiveness in infancy by a standard deviation increases cognitive skills 11 years later by 0.16 standard deviations. This suggests that early-life conditions have long-run consequences for the skills during later periods, even after controlling for context variables of subsequent periods – some of which are closely related to the conditions early in life². Maternal responsiveness in the early mother-child interaction is the only context variable that significantly affects cognitive skills, and mental and emotional skills. Active stimulation at school age in the family is not only the context variable with the highest coefficient on cognitive skills, but also on mental skills with a

² Note that the context factors in our analysis are all orthogonal (independent) by construction.

coefficient of 0.3. The promotion of autonomy and emotional responsiveness at preschool age plays a large role for mental and emotional skills.

Table 4.4: The relationship between contexts and skills in MARS (regression coefficients)

	Cognitive skills	Emotional skills	Mental skills
Constant	-0.01	-0.07	0.14**
Active stimulation at school age in the family	0.26***	0.01	0.30***
Active stimulation at toddlerhood and preschool age in the family	0.00	-0.02	-0.07
Promotion of autonomy and emotional responsiveness at preschool age	-0.04	0.11**	0.14***
Living environment during childhood	0.18***	0.03	0.05
Maternal responsiveness in the mother child interaction at infancy	0.16***	0.10**	0.09*
Emotional responsiveness in toddlerhood	-0.10	-0.01	0.03

Source: Mannheim Study of Children at Risk. 360 observations. Own calculations.
 ***significant at 1% level, ** significant at 5 % level, * significant at 10 % level.

In *step five*, we look at the relationship between skills and social progress. All three types of skills determine the educational attainment 11 years later (table 4.5). The most important are cognitive skills, followed by mental and emotional skills. This result is in line with Blomeyer et al. (2013) and Coneus et al. (2012), among others.

Table 4.5: Skills and social progress in MARS (regression results)

	Smoking	Alcohol	Physical health problems	Mental health problems
Constant	0.04	-0.02	-0.02	0,00
Cognitive skills	-0.06	0.12*	0.09	0.02
Emotional skills	0.09*	-0.02	0.09	0.01
Mental skills	-0.13***	0.01	0.03	-0.06
	Academic achievement	Life burdens	Resilience	
Constant	-0.14***	0.07	-0.01	
Cognitive skills	0.41***	-0.16**	-0.01	
Emotional skills	0.18***	0.15**	0.11*	
Mental skills	0.32***	-0.2***	-0.01	

Source: Mannheim Study of Children at Risk. 315 observations. Own calculations.
 ***significant at 1% level, ** significant at 5 % level, * significant at 10 % level.

Mental and emotional skills are also important. Increasing both of them by one standard deviation enhances academic achievement by a total of 0.5 standard deviations in contrast to an increase of 0.41 standard deviations, if only cognitive skills are increased by one standard deviation. This confirms Bayer and Gollwitzer (2007), Duckworth and Seligman (2005), Gollwitzer

(1999), and Heckman (2007), among others that non-cognitive skills often outperform cognitive skills in predicting academic performance.

Besides academic performance, skills also affect the number of life burdens. Emotional skills deepen life burdens, while cognitive and mental skills seem to help ease difficulties in life. However, since the number of life burdens has been assessed by a questionnaire, individuals with higher emotional skills may simply perceive their problem to be more severe. Mental and physical health is not influenced by skills. This indicates that health captures another distinctive human capital dimension different from cognitive and non-cognitive skills. Mental skills can decrease problems associated with smoking. Apart from this, the effect of skills on smoking and drinking is not statistically significant.

4.5 Self- and Cross-productivities in Skill Formation

In MARS, skills have been assessed not only at the age of 11 years. Instead, psychometric assessments of cognitive (*IQ*) and motor abilities (*MQ*), have been conducted at infancy (3 months), toddlerhood (2 years), preschool age (4.5 years), elementary school age (8 years) and secondary school age (11 years), representing significant stages of child development (Blomeyer et al., 2009). This allows us to analyze the properties of self- and cross productivity defined by Cunha and Heckman (2007). To empirically assess the amount of self- and cross-productivities in MARS, a skill production function may be defined as:

$$S_t = f_t (S_{t-1}, C) \quad (5)$$

with S referring to a vector of skills and C to contexts. Assume that equation (5) can be represented in a Cobb-Douglas form and that S consists of three skills, defined as *IQ*, *MQ* and *Persistence*, there are three parameters characterizing self-productivity and six parameters characterizing cross-productivity for each t . Such a model has been estimated by Blomeyer et al. (2009) for four time periods. Since all variables have been transformed to their natural logarithms before estimation, the parameters can be interpreted as partial elasticities, see Table 4.6. The strength of the relationship differs between the three skills and changes in a way specific to the developmental stage. The results in the table indicate that self-productivity increases steadily. In early childhood, self-productivity is still small, and the environment is still more important. At

primary school age, the relationship between cumulative cognitive skills and the current *IQ* increases. Individual differences in the *IQ* seem to consolidate between the age of 4.5 and 8 years.

Table 4.6: Estimates of Self- and Cross-productivity

Skill	<i>IQ</i> (<i>t-1</i>)	<i>MQ</i> (<i>t-1</i>)	<i>Persistence</i> (<i>t-1</i>)
<i>t</i> = 11 years			
<i>IQ</i> (<i>t</i>)	0.89*	0.13*	0.10*
<i>MQ</i> (<i>t</i>)	0.34*	0.66*	-0,01
<i>Persistence</i> (<i>t</i>)	0.31*	0,03	0.31*
<i>t</i> = 8 years			
<i>IQ</i> (<i>t</i>)	0.84*	0.26*	0,07
<i>MQ</i> (<i>t</i>)	0	0.42*	0,01
<i>Persistence</i> (<i>t</i>)	0.27*	0.20*	0.29*
<i>t</i> = 4.5 years			
<i>IQ</i> (<i>t</i>)	0.53*	0.09*	0,02
<i>MQ</i> (<i>t</i>)	0.26*	0.72*	0.11*
<i>Persistence</i> (<i>t</i>)	0.61*	-0,04	0.18*
<i>t</i> = 2 years			
<i>IQ</i> (<i>t</i>)	0.23*	0,08	0.12*
<i>MQ</i> (<i>t</i>)	0,07	0.31*	0.15*
<i>Persistence</i> (<i>t</i>)	0.12*	0.13*	-0,08

MARS, 364 observations; Blomeyer et al. (2009)

regressions include a constant and are conducted for each ability; heteroscedastically robust standard errors;

* indicates significance at the 5 % level.

At the age of 8 years, the estimated self-productivity approaches 0.9, comparable to findings reported by Cunha et al. (2010). The results for cross motor skills, measured by *MQ* differ in terms of self-productivity. Self-productivity is higher compared to those for *IQ*. *MQ* seems to be even less malleable than *IQ* after early childhood. Self-productivity in *Persistence* shows a different pattern with lower values at all developmental stages. In other words, *Persistence* seems to remain more malleable during adolescence. Furthermore, there is strong evidence for synergies or cross-productivity, in early skill formation between *Persistence* and *IQ* and between *IQ* and *MQ*. In later childhood, cross-productivities decrease. Since the *IQ* seems to consolidate between the ages of 4.5 and 8 years, sufficient socio-emotional home resources in early childhood are particularly beneficial for human capital formation due to cross-productivity.

5 Findings from the Mother-Child Pilot Study

5.1 Data Design

The MuKi pilot study is part of the SOEP and was first assessed in 2008 (see Bartling et al., 2010). A total of 291 mothers with children aged between five and six years were interviewed. It includes child-based information that has been gathered by interviews with the mothers, behavioral experiments and standardized tests. Information about parental education, mother child interaction, leisure activities, emotional aspects and pregnancy is available. Cognitive measures include a figure-numbers test for the mothers, a Peabody Picture Vocabulary Test and a classification *IQ* test for the children. Personality characteristics were assessed through questionnaires, e.g. a simplified Big Five version where mothers report the personality of their children or a simplified self-efficacy scale for the mothers including measures on time preferences.

The data is unique in the sense that it offers cognitive and non-cognitive measures acquired in standardized test for both mothers and children and information on mother-child interaction. The MuKi is useful to provide further evidence on how cognitive ability and personality traits can be better developed in learning environments. A disadvantage of the MuKi pilot study is that some measures are based on self-reports and that information on social progress is restricted to primary school age.

5.2 Description of Variables

In order to collect information on the mother's cognitive skills, two *IQ* tests were conducted. The *figure/number* test measures the aspects of the mother's fluid intelligence by focusing on her cognitive performance in memorizing numbers and figures. The mother had to match numbers to a given configuration of figures in a computer-based test-situation within 30, 60 and 90 seconds. The result of the *maternal verbal IQ* test gives information on the mother's crystallized intelligence that describes culture-related cognitive skills. The verbal *IQ* is measured by the number of correct answers in computer-based word-test with 37 items. The mother had to distinguish between existent and non-existent terms of the German language.

In order to measure *maternal time preference*, a behavioral test was conducted that consisted of three sub-tests. In the first test, the mother was informed that every 7th mother (about 14% of all participating mothers) would win money. Each mother had to decide about her preferences in case of winning: she could choose between receiving 100 Euros immediately and receiving an amount higher than 100 Euros in 6 months. The second test consisted of the same scenario, except that the mother could choose between 100 Euros immediately and an amount higher than 100 Euros and also higher than the amount of the first test in 12 months. In the third test, the mother had to choose between 100 Euros in 6 months or an amount slightly higher than 100 Euros in 12 months. The actual winners were stated after the decision-process and received their preferred amount to the preferred point of time.

In the *Mother Questionnaire*, mothers have been asked about the family situation and the child's health, personality and surrounding, as well as about her personal socio-economic background, her education, life-satisfaction and self-reported personality traits. We generated the number of *siblings* of the child, the *breastfeeding-duration* in months, the child's *birth weight* measured in grams and the *birth week*, which indicates in which week of gestation. Mothers have also been asked about the supervision of the child and the frequency of different measures of supervision. *Supervision by father* indicates the amount of hours per week spent by the father supervising his child. *Supervision by relatives* measures the support of childcare in the household by the father, grandparents, siblings, or other relatives in hours per week. If the child is supervised at home by individuals who are not relatives, this counts as *private supervision*, which covers for example supervision by neighbors or nannies. *External supervision* refers to external childcare by child-minder or in kindergarten and is also measured in hours per week.

Alone at home describes the frequency of the child being alone in the household, measured on a scale with 4 categories (regularly, sometimes, rarely, never). *Periods without supervision* gives information on the amount of hours per week the child is without supervision by adults. The frequency of maternal activities with her child is described by *activities with child* and is measured in the 3 categories daily, weekly and never. Examples of the 11 items for such activities given in the questionnaire are going to the playground, doing excursions, visiting other families, going shopping, singing, doing handicraft, playing

games or going to the circus, the museum or the theatre. Context-variables of the mother's life situation are *family status*, *income*, *education of mother* and *books*.

Family status describes possible alternatives as, for example, living in a single-parent household, being married, being divorced or having a partner who lives in the household. *Income* refers to the household's per capita income. *Education of mother* measures the highest educational achievement of the mother concerning school and professional education. School education can for example be no school at all, basic school graduation, or high school graduation. Professional education can be university graduation or apprenticeship.

Books give information on the number of books in the household, measured in 7 categories between less than 10 and more than 1,000 books. On scales with 10 categories (between 'not at all' and 'absolutely') respondents were asked to rate individual *patience*, *risk seeking*, tendency to *impulsiveness* and *life satisfaction*. *Self-efficacy* is self-reported on hands of 4 items with 4 categories each (between 'I completely agree' and 'I don't agree at all') that ask about her trust in other people, her reliance on other people, her belief in destiny and the belief in having control over her life.

Child skill variables refer to skills and personality traits of the child, measured by intelligence and time preference tests and by mother ratings. Three cognitive tests were conducted in order to receive information on the cognitive skills of the child. The *IQ Classification test* and the *IQ Substitution test* are both sub-tests of the Culture Fair Intelligence Test (CFT). Both sub-tests consist of 12 items, and, in both tests, the child has to observe objects and figures with parental assistance. In the *IQ Classification test*, the child has to classify these objects and symbols and find out which ones do not match the other ones.

In the *IQ Substitution test*, the child has to insert objects and symbols into a given arrangement and find out which objects and symbols do and do not match the other ones. These sub-tests of CFT particularly measure the child's fluid intelligence, which describes the child's capability to understand complex relations and interactions in new situations. The third test is the *IQ Peabody Picture Vocabulary Test Revised (PPVT-R)*. This test contains 61 items concerning the relation between pictures and vocabulary. The child has to identify the

right object after hearing a word. This test aims to measure the culture- and education-related cognitive skills of the child.

The child's *time preference* is measured by an impatience test. In this test, the child has the choice to receive two gummy bears (candies) instead of one, if it is willing to wait with eating the first one until the mother has finished talking to the interviewer. In cases in which the child eats the first candy before the interview is finished, the child's waiting-time is measured and evaluated (Child Time Preference Test).

Each of the big five personality traits *extraversion*, *conscientiousness*, *agreeableness*, *openness* and *neuroticism* has been rated by three items each. *Extraversion* can be characterized by the child's tendency to positive emotions, and his/her interest in seeking out external stimulus and the company of others. *Conscientiousness* is a tendency to act dutifully and to think before actually acting. *Agreeableness* describes compassionate and cooperative behavior instead of being suspicious and antagonistic towards others. *Openness* indicates whether a child tends to be curious, adventurous and open for new experiences. *Neuroticism* describes a child's tendency to experience negative emotions, such as anger or anxiety.

All social progress measures are generated by mother ratings. The *body mass index (BMI)* gives information on the relationship between the child's weight and height. The variable *hospital* evaluates whether the child had to stay in hospital during the last year and measures the time of that stay. *Doctor* indicates if the child had to visit a medical doctor during the last 3 months. The mother is also asked to specify the child's diseases in a questionnaire that contains 10 items with possible diseases such as respiratory diseases, otitis media, neurodermatitis, or ametropia. This information was analyzed for the variable *sum diagnosis*. *Handicap* indicates whether or not the child is able to do what it wants relative to other children or if it suffers from physical limitations.

To find out about a child's *peer problems*, the mother is asked if her child has difficulties in socializing with other children, has few friends, suffers from attacks by other children, prefers playing alone or gets along better with adults. *Prosocial behavior* of the child contains aspects like the child's amicability, its willingness to share, or its helpfulness and kindness towards younger children. The mother is also asked about her child's tendency to cheat, steal and have

quarrels; *Behavioral problems* refers to these issues. *Emotional symptoms* describe psychosomatic health problems of the child. It indicates whether the child tends to worry easily, is unhappy, nervous or fearful. *Hyperactivity* displays the mother's opinion on her child being anxious, twitchy, distracted, not reflecting or unable to concentrate. Another aspect is the child's trait to have *trust in others*.

5.3 Estimation of Latent Factors

This section presents results from the factor analysis applied to the contexts, skill and social progress variables of MuKi. Table 5.1 contains all utilized context variables and their corresponding factor loadings ω_{mn} with $m=23$ and $n=10$ according to *step one* (see Section 3) of our statistical procedure.

Table 5.1: Context Factor Loadings in MuKi

	1	2	3	4	5	6	7	8	9	10
Mother IQ: figure/number	0,04	-0,05	0,10	0,00	0,14	0,00	0,03	0,32	-0,06	0,03
Mother verbal IQ	0,48	0,00	0,03	-0,02	-0,07	0,04	-0,01	0,54	0,11	0,03
Mother time preference	-0,30	0,06	0,04	-0,01	0,06	-0,13	-0,02	-0,08	0,15	-0,10
Siblings	-0,01	-0,04	0,06	-0,01	0,06	-0,02	-0,04	-0,29	0,07	0,07
Breastfeeding	0,37	0,19	0,00	0,08	-0,04	0,03	0,01	-0,02	0,13	-0,02
Birthweight	0,04	0,99	0,04	0,03	0,01	-0,05	0,01	-0,10	-0,07	-0,01
Supervision by father	0,11	-0,01	0,10	0,14	-0,07	0,03	0,20	0,00	0,00	0,14
Supervision by relatives	-0,05	-0,07	0,27	0,07	0,03	0,02	-0,17	0,09	-0,01	-0,14
Private supervision	0,06	0,03	0,23	0,03	0,01	-0,04	-0,03	-0,01	0,01	-0,03
External supervision	-0,06	-0,01	0,07	-0,01	0,99	0,03	-0,08	0,03	-0,04	0,07
Alone at home	0,09	-0,01	-0,14	0,13	0,15	-0,02	0,02	-0,12	0,00	-0,04
Periods without supervision	-0,21	0,06	0,95	-0,14	0,02	-0,01	0,11	-0,03	0,02	0,11
Activities with child	0,12	-0,03	0,02	0,98	0,01	0,10	0,06	0,05	0,05	0,04
Marital status	0,09	0,05	-0,15	0,03	-0,03	0,08	0,89	0,24	0,05	-0,12
Income	0,35	0,03	-0,02	0,05	-0,05	0,11	0,15	0,44	-0,12	-0,11
Education of mother	0,75	-0,01	0,00	0,10	0,09	-0,02	0,02	0,10	0,01	-0,14
Books	0,69	0,08	0,00	0,01	0,03	0,09	0,22	0,02	-0,08	0,14
Maternal self-efficacy	0,32	-0,02	-0,08	0,03	-0,01	0,22	-0,07	0,14	0,10	0,03
Maternal satisfaction	0,25	-0,07	-0,06	0,10	0,03	0,94	0,12	0,06	0,05	0,05
Maternal impulsivity	-0,14	0,08	-0,06	-0,02	-0,05	0,04	-0,06	0,05	-0,13	0,62
Maternal risk aversion	0,13	-0,01	-0,01	0,04	0,10	0,00	0,02	-0,12	0,07	0,42
Maternal patience	0,03	-0,03	0,02	0,04	-0,05	0,07	0,04	-0,19	0,81	-0,04
Birthweek	0,05	0,54	0,01	-0,04	-0,02	-0,02	0,02	0,08	0,02	0,05

Source: MuKi Pilot Study. 291 observations. Own calculations.

The most relevant loadings of each factor are in bold. Even though the number of variables is smaller than in MARS, the number of latent factors is higher. Reducing the number of factors does not form larger groups, but excludes

information. This may result from the fact that the context variables on MuKi do not only contain information on the parent-child interaction, but also information on the characteristics and skills of the mother.

The first latent factor “maternal education” sums up the educational attainment of the mother, the number of books in the apartment and the verbal *IQ* of the mother. “Birthweight” relates to the weight at birth in grams and the gestational age at birth (in weeks). The later the child is born, the more likely it is to be heavier. The factor “periods without supervision” proxies the amount and the quality of parental supervision, e.g. unattended TV use. “Activities with child”, “External supervision”, “Maternal satisfaction”, “Maternal status”, “Maternal patience” and “Maternal impulsivity” constitute separate factors. The maternal performance in the two *IQ* tests and the income load on another factor we call “Maternal *IQ*”.

Table 5.2 summarizes the skill variables from MuKi and their corresponding factor loadings ω_{mn} with $m=9$ and $n=3$ (*step two*).

Table 5.2: Skill Factor Loadings in MuKi

	1	2	3
IQ Classification test	0,72	0,14	0,05
IQ Substitution test	0,72	0,02	0,04
IQ Peabody test	0,62	0,19	0,15
Big 5: Extraversion	0,07	0,03	0,84
Big 5: Conscientiousness	0,04	0,79	0,04
Big 5: Agreeable	0,23	0,53	0,13
Big 5: Openness	0,15	0,54	0,38
Big 5: Neuroticism	-0,11	-0,21	-0,58
Time preference	0,02	0,13	0,14

Source: MuKi Pilot Study. 291 observations. Own calculations.

The results show that three factors are required to capture the variance of the skill measurements at the age of 6 years. They can be grouped into cognitive, mental and emotional skills. This result is in line with Coneus et al. (2012) and results presented in the previous section. The first factor is highly correlated with the three different *IQ* tests; the second factor is highly correlated with conscientiousness, agreeableness and openness; the third factor has high loadings of extraversion and neuroticism. As neuroticism describes a tendency

to experience negative emotional states, its loading on emotional skills is negative in contrast to the other loadings.

The Big Five measuring the personality of the child in Muki were assessed by asking questions to the mother. In contrast, MARS contains psychometric measures that were taken in standardized settings. Thus, the mental and emotional skill factors of this section cannot be directly compared to the non-cognitive skill factors from MARS. Nevertheless, conscientiousness that drives the mental skill factor in Muki as tendency to show self-discipline and to aim for achievement against measures or outside expectations seems to be related to persistence as an ability to pursue a particular activity and its continuation in the face of obstacles, which drives mental skills in MARS. Regarding emotional skills, neuroticism in Muki as a tendency to experience negative emotions corresponds to the inverse of prevailing mood in MARS.

Table 5.3 contains all social progress variables in Muki and their corresponding factor loadings ω_{mn} with $m=11$ and $n=4$ (*step three*). The first factor “behavioral problems” comprises behavioral problems, hyperactivity and prosocial behavior. The factor loading of “prosocial behavior” is negative as it reduces behavioral problems.

Table 5.3: Social Progress Factor Loadings in Muki

	1	2	3	4
BMI	0,21	0,18	0,14	-0,13
Handicap	0,08	0,05	0,09	0,33
Hospital	-0,04	0,00	-0,10	0,06
Doctor	-0,02	-0,04	-0,05	0,29
Sum diagnosis	0,11	0,06	-0,07	0,48
Peers problems	0,30	0,95	-0,05	0,03
Prosocial behaviour	-0,60	-0,14	0,08	0,04
Behavioural problems	0,59	0,14	0,12	0,23
Emotional symptoms	0,24	0,30	-0,03	0,26
Hyperactivity	0,59	0,26	-0,07	0,33
Trust in Others	-0,22	-0,06	0,95	0,18

Source: Muki Pilot Study. 291 observations. Own calculations.

The second factor is mainly composed of peer problems, but emotional symptoms and hyperactivity are also part of it. The third dimension of social pro-

gress is almost solely related to trust in others. The fourth factor “health problems” combines most of the health-related variables such as the amount of medical diagnosis, medical doctor visits and handicaps. Still, it relates to hyperactivity and emotional symptoms to a lesser degree, suggesting that health and behavior cannot be completely disentangled.

5.4 Regression Results

This section focuses on the relationships between contexts and skills and social progress. Context variables as well as skills were measured concurrently with the context variables at the age of 6. Simultaneity or reverse causality bias may therefore be possible. Many context variables do, however, relate to maternal characteristics like the IQ and personality characteristics that tend to be predetermined or stable over several last years. Thus, it is possible to estimate the effect of contexts on skills without a large bias. However, all variables on social progress were assessed at the age of 6 years just as the skill variables. Therefore, we only present a correlation matrix of latent skill and social progress factors and a regression of the context variables on social progress. Table 5.4 documents the coefficients of the regression of latent context factors on the skill factors (*step four*).

Table 5.4: The relationship between contexts and skills in MuKi (regression results)

	Cognitive skills	Mental skills	Emotional skills
Constant	0.00	0.00	0.00
Maternal Education	0.13**	0.10*	0.05
Birthweight	0.05	0.00	0.00
Periods without supervision	-0.06	-0.14**	0.08
Activities with child	0.17***	0.30***	0.04
External child care	-0.24***	0.11*	-0.02
Maternal Satisfaction	-0.08	0.26***	0.12*
Family status	-0.06	0.14**	-0.03
Maternal IQ	0.09*	0.00	0.03
Maternal Patience	0.20***	0.15***	0.16***
Maternal Impulsivity	-0.05	-0.03	0.15***

Source: Source: MuKi Pilot Study. 291 observations. Own calculations.

***significant at 1% level, ** significant at 5 % level, * significant at 10 % level.

We find that maternal personality traits play an important role for child outcomes. The most dominant factor is maternal patience with a significant coefficient on all three skills, confirming Kosse and Pfeiffer (2012, 2013). Maternal

education influences cognitive as well as mental skills, but does not affect emotional skills. On the other hand, the impulsivity of the mother seems to enhance the child's emotional skills. Maternal life satisfaction has a large coefficient on mental skills, a small one on emotional skills, but is insignificant for cognitive skills. Maternal IQ seems to be only weakly linked to the child IQ. Maternal personality may play a greater role at young age than maternal IQ.

Activities such as going to the playground, doing excursions or visiting other families, which are summed up in the score "Activities with the child", are significantly related to cognitive and mental skills. Interestingly, the amount of external childcare has a significantly negative impact on the cognitive skills of the child. We checked this result in other specifications, e.g. with a different number of latent factors or different sets of explaining variables, but it remains robust. It does not necessarily mean that external childcare has a negative impact on child outcomes. Mothers who make use of external childcare (for instance single parents) may have less support from their family and friends or lack time to take active care of the child.

As described above, skills and social progress in MuKi were administered at same time. The effect of skills on social progress therefore is not identified and *step five* has been omitted. We do however present results on the correlation between skills (Table 5.5) and social progress and coefficients that result from a regression of latent context factors on the social progress factors (Table 5.6). Behavioral problems and health problems are negatively correlated with mental skills (-0.56 and -0.22), suggesting that more mental skills relate to fewer problems. The same seems to be true for emotional skills and for peer problems, albeit to a smaller extent. On the other hand, emotional skills relate to a higher level of trust, as indicated by a correlation coefficient of 0.21. All in all, social progress tends to be closely related to mental skills.

Table 5.5: The relationship between skills and social progress in MuKi (correlation matrix)

	Behavioural Problems	Peer Problems	Trust	Health Problems
Cognitive Skills	0,03	-0,01	0,13	-0,15
Mental Skills	-0,56	-0,13	-0,08	-0,22
Emotional Skills	-0,11	-0,18	0,21	0,06

Source: MuKi Pilot Study. 291 observations. Own calculations.

Table 5.6 shows that the maternal personality traits are closely linked to a child's behavioral problems. Mothers with a high degree of satisfaction, education and patience positively influence the child's behavior. Besides, family status and activities with the child reduce child behavioral problems. Peer issues seem to be related to maternal characteristics, such as the family status and life satisfaction. A child's trust is correlated with external supervision activities, birth weight and maternal education. Health problems show a close relationship with maternal characteristics. "Activities with child" has a small coefficient when compared to the coefficient on maternal characteristics. This is presumably a result of the limited number of items describing the factor "activity with child".

Table 5.6: The relationship between contexts and social progress in MuKi (regression results)

	Behavioural Problem:Peer Problems	Trust	Health Problems
constant	0.00	0.00	0.00
Maternal Education	-0.25***	-0.06	0.16***
Birthweight	-0.01	0.01	0.13**
No supervision	0.10	0.00	-0.12**
Activities with child	-0.17**	-0.07	0.13**
External child care	0.01	-0.08	-0.11
Maternal Satisfaction	-0.29***	-0.10*	0.14
Family status	-0.13**	-0.12**	-0.08
Maternal IQ	-0.08	-0.04	-0.03
Maternal Patience	-0.13**	-0.01	-0.09
Maternal Impulsivity	-0.01	0.01	-0.22***
		0.04	0.16***

Source: MuKi Pilot Study. 291 observations. Own calculations.

***significant at 1% level, ** significant at 5 % level, * significant at 10 % level.

6 Socio-Economic Panel (SOEP)

6.1 Data Design

The SOEP is a nationally representative longitudinal dataset which has been surveying households and individuals older than 18 years on socio-economic issues since 1984 (see Wagner et al., 2007). In 2007, some 11,000 households comprising more than 20,000 persons were sampled by the SOEP. The SOEP includes data on cognitive measures for approximately 5,500 individuals.

Psychometric personality measures include the Locus of Control, risk aversion and the Big Five personality inventory. Environmental aspects during childhood have been collected by retrospective self-reports and include parental support, parental education and employment, neighborhood characteristics, among others. The information in the SOEP on social progress includes life satisfaction, labor market participation, income, smoking, drinking and health, among others. The SOEP is representative of the German population and includes a high number of observations. However, contexts are only administered retrospectively.

6.2 Description of Variables

The context measures in the SOEP data describe the retrospective view of 18- to 65-year-old adults on specific socio-economic issues of their youth. The variables *years with biological parents* and *number of years with both parents* indicate the number of years that the adult has lived with both of his/her (biological) parents. *Harmonious relationship with parents* is measured by the frequency of fighting or arguing with his/her parents at the age of 15.

Furthermore, individuals have been asked whether their *parents had shown interest in their performance*. Other evaluated aspects are *parental education* and *parental professional status*. *Parental education* indicates educational attainment of the respondent's parents (secondary school degree of mother and/or father and college degree of mother and/or father). *Parental professional status* contains information on whether his/her mother and/or father were white-collar workers or worked as civil servants. Other measures are indicators of whether an individual performed *sports in his/her youth* and participation in sport competitions, as well as if he/she has practiced *music in his/her youth*. The variable *in city during youth* refers to where the individual has lived until the age of 15.

The SOEP data on the adults' skills was collected in 2005, based on questions within the SOEP personality questionnaire and short cognitive tests (Computer-Assisted-Personal-Interviewing, CAPI). Information on *reciprocity* is generated by evaluating a six-item score. *Reciprocity* refers to an individual's tendency to respond to actions of other individuals with similar actions. Behavior characterized by *reciprocity* is based on the principle 'tit for tat'. The adult's disposition to behave reciprocally is measured by asking the participants, for

example, if they help individuals who helped them before or if they try to cause problems to those who acted unfairly. Another item of *reciprocity* is the disposition to aim for revenge in cases of injustice.

The variable *locus of control* defines the extent to which individuals believe that what happens to them in life is related to their own actions and decisions, or on the contrary to fate and luck. This variable is measured by evaluating a ten-item scale, such as if the individual thinks to have achieved what he/she deserved or if his/her achievements depend on sheer luck. Furthermore, the participants are asked if other people take crucial decisions in their life. The Big Five personality traits administered in the data are *conscientiousness*, *extraversion*, *agreeableness*, *openness* and *neuroticism*. The measures are the same as the ones described in the previous section on Muki.

The computer-based short cognitive tests were conducted in 2006. An individual's score in the *animals test* makes a statement on his/her crystallized intelligence, which describes particularly the individual's culture-related cognitive skills. In the *animals test*, the adult is asked to name as many animals as possible within 30, 60 and 90 seconds. The score in the *numerical entries test* refers to the individual's fluid intelligence by focusing on his/her cognitive performance in memorizing numbers and figures. The adult has to match numbers to a given configuration of figures within 30, 60 and 90 seconds.

The social progress variables on the SOEP data comprise the domains physical and mental health, health behavior, societal engagement and leisure time, subjective well-being, trust, environment and academic achievement. The social progress measures were assessed between 2007 and 2009, and at least one year after the skill measures.

Information on physical health is summarized in the variable *summary scale physical health*. Individuals are asked about the frequency of doing sports or exercise, the annual frequency of doctor visits, potential acute diseases, or about being less productive within the last 4 weeks due to physical and social limitations caused by the health condition. The *body mass index (BMI)* calculates the relation between an individual's weight and height.

Summary scale mental health summarizes information on the participant's mental health such as suffering from melancholy or having experienced a lack of energy and balanced feeling during the last four weeks. The participants are

asked about negative impacts of mental health problems such as being less careful due to emotional difficulties or being less productive. Different aspects of an adult's health behavior are measured by the variables *diet*, *alcohol consumption* and *amount of smoking*. *Diet* refers to whether the individual is following a health-conscious diet. In order to collect information on the individual's habits of consuming alcohol, the adults are asked about the amount of consumption of different sorts of alcohols such as mixed drinks, beer, wine or spirits. *Amount of smoking* informs on the consumption of cigarettes and other tobacco per day.

Items referring to *societal engagement* are volunteering or participating in local politics. Going to church and other religious events as well as going to the cinema, to pop concerts or cultural events, visiting expositions or theatre performances and doing sports or visiting sport events refer to the variables *sports and leisure* and *cultural events*. The variable *life satisfaction* is based to the subjective well-being of the adult. *Life satisfaction* is measured by the individual's score on items such as the frequency of being happy or sad in the last four weeks or their general satisfaction with life today or in five years. *Trust* is measured by evaluating the adult's score concerning his/her feeling towards strangers or the fear of being confronted with crime.

To find out whether the respondent can be considered as *environmentally conscious*, the individuals are asked if they are members of an environmental interest group or worried about environmental issues. Furthermore, the adult's *academic achievement* is taken into account. The individuals indicate whether they have completed an apprenticeship, a specialized vocational training, university or other courses of education.

6.3 Estimation of Latent Factors

This section presents the results of the factor analysis applied to the contexts, skill and social progress variables of the SOEP. Table 6.1 contains the chosen context variables from the SOEP and their corresponding factor loadings ω_{mn} with $m=9$ and $n=4$ according to *step one*. The most relevant loadings of each factor are in bold. As the number of context variables in SOEP is smaller than in MuKi and MARS, the number of latent factors is lower. The first factor "years with both parents" refers to the amount of years the individuals have lived with their parents.

Table 6.1: Context Factor Loadings in SOEP

	1	2	3	4
Years with biological parents	0,91	-0,01	0,02	0,19
Harmonious relationship with parents	0,31	-0,09	-0,06	0,57
Parents showed interest in performance	0,05	0,19	0,13	0,21
Sport in youth	0,05	0,20	0,15	-0,11
Music in youth	0,01	0,12	0,67	0,01
Parental education	-0,02	0,38	0,29	0,20
In city during youth	-0,05	0,34	0,00	-0,03
Number of years with both parents	0,90	0,00	0,03	0,12
Parents professional status	0,02	0,67	0,17	0,05

*Source: Socio-Economic Panel. 2715 observations.
Own calculations.*

The second factor “parental professional status” covers the academic and professional achievement of the parents. The third factor “music in youth” proxies some aspects of the home environment that might relate to the material environment. Factor four refers to the harmony in the relationship with the parents. As can be seen, sports in youth and the parental interest in performance also play a role for several latent factors, but are less pronounced in a particular one.

Table 6.2 presents the results of the factor analysis of the skill variables in SOEP (*step two*). In contrast to MARS and MuKi, four latent skill factors were found instead of three.

Table 6.2: Skill Factor Loadings in SOEP

	1	2	3	4
Reciprocity	-0,02	0,24	-0,08	0,00
Locus of control	-0,01	0,99	0,07	-0,07
Big5: Conscientiousness	-0,05	-0,06	0,27	0,21
Big5: Extraversion	0,01	0,00	0,04	0,76
Big5: Agreeableness	0,05	-0,07	0,99	0,05
Big5: Openness	0,07	0,00	0,12	0,48
Big5: Neuroticism	-0,01	0,19	0,00	-0,22
Cognitive: Animals test	0,96	-0,06	-0,03	0,06
Cognitive: Numerical ent	0,78	-0,02	0,01	0,04

*Source: Socio-Economic Panel. 2715 observations.
Own calculations.*

The main reason for this is the inclusion of the locus of control in the analysis. The locus of control (factor 2) seems to be distinct from other personality traits measured by the Big Five personality factors that split of in two dimensions “agreeableness” (factor 3) and “extraversion” (factor 4). Agreeableness and extraversion belong to two different latent factors with extraversion being more closely related to emotional skills.

The results of the factor analysis of the social progress variables (*step three*) are shown in Table 6.3. Results indicate that educational achievement may be closely linked to societal engagement and visiting cultural events as they constitute one latent factor. Life satisfaction and mental health relate to the same latent factor. The third latent factor summarizes physical health. With a factor loading of -0.37, BMI is also related, suggesting slimmer persons to have a better physical health. The fourth factor is also health-related but is more closely linked to individuals pursuing a healthy diet. The fifth factor is between the domains of health and societal engagement, comprising sports and leisure as well as alcohol consumption. To sum up, social progress factors in the SOEP are strongly related to the various health variables indicating the importance of health for social progress.

Table 6.3: Social Progress Factor Loadings in SOEP

	1	2	3	4	5
Summary scale physical health	0,05	0,09	0,76	-0,09	0,08
BMI	0,01	0,01	-0,37	-0,16	-0,22
Summary scale mental health	0,05	0,68	-0,10	0,02	0,12
Diet	0,24	0,06	0,05	0,74	0,00
Alcohol consumption	-0,17	-0,09	-0,14	0,20	-0,29
Amount of smoking	0,29	0,07	0,05	0,19	0,10
Societal engagement	0,49	0,10	-0,04	0,04	0,11
Life satisfaction	0,18	0,59	0,30	0,03	0,02
Trust	0,38	0,25	0,12	0,05	0,13
Environmental conscious	0,24	-0,10	-0,05	0,11	-0,01
Academic achievement	0,49	0,07	0,07	0,00	0,04
Sports and leisure	0,33	0,12	0,20	0,09	0,59
Cultural events	0,64	0,13	0,05	0,08	0,31

Source: Socio-Economic Panel. 2715 observations.

6.4 Regression Results

This section focuses on the relationship between contexts, skills and social progress (*step four* and *step five*) in the SOEP data. Because all context varia-

bles were assessed in retrospect, the skill variables in 2005 and 2006 and the social progress variables between 2007 and 2009, there should be no simultaneity or reverse causality bias present in the analysis. Table 6.4 shows the relationship between the latent context variables and the skill variables (*step four*). The duration of the time individuals have lived with their parents seems to have almost no effect on skills except for a weakly significant coefficient for extraversion and openness.

Table 6.4: The relationship between contexts and skills in SOEP (regression results)

	Cognitive skills	Locus of control	Big 5 Agreeableness	Big 5 Extraversion Openness
Constant	0,00	0,00	0,00	0,00
Years with both parents	0,00	0,01	-0,02	0.04*
Parental professional status	0.07***	0.07***	0,00	0.08***
Music in youth	0.04**	0,01	-0,01	0.06***
Harmonious relationship with parents	0.06***	0.04***	0.03**	0.08***

Source: Socio-Economic Panel. 2715 observations.
 ***significant at 1% level, ** significant at 5 % level, * significant at 10 % level.

The quality of the parent-child relationship in terms of harmony and absence of conflicts, however, seems to relate to cognitive and non-cognitive skills. In fact, it is the only context factor that may influence agreeableness. Context factors hardly influence agreeableness. Besides the harmony of the parent-child relationship, parental professional status is significantly related to all skill factors except agreeableness. “Music in youth” plays a role for cognitive skills and extraversion. Even though information on context variables is sparse, the results are in line with the previous analyses: parental education and a harmonious parent-child relationship both have important consequences for skill formation.

Table 6.5 displays results from regressions with factors of social progress and the skill factors in SOEP (*step five*). Extraversion/openness and the locus of control contribute to the higher level of satisfaction and mental health, more societal engagement and a healthier lifestyle. Cognitive skills enhance societal engagement, sports and leisure activities. The relationship of non-cognitive skills and social progress tends to be slightly stronger compared to cognitive skills. All social progress factors are related to skills. Health is associated with

non-cognitive, but not with cognitive skills. Societal engagement and life satisfaction are strongly related with skills levels.

Table 6.5: The relationship between skills and social progress in SOEP (regression results)

	Societal engagement	Satisfaction/ mental health	Physical health	Healthy diet	Sports and leisure
Constant	0,00	0,00	0,00	0,00	0,00
Cognitive skills	0.09***	0.05**	0.03	0.03	0.08**
Locus of control	0.16***	0.17***	0.13***	-0.04	0.02
Big 5: Agreeableness	0.04	0.14***	-0.01	0.19***	-0.14***
Big 5: Extraversion/openness	0.13***	0.22***	0.05**	0.09***	0.03

Source: Socio-Economic Panel. 2715 observations.
 ***significant at 1% level, ** significant at 5% level, * significant at 10% level.

7 Conclusions

This study combines macro evidence on the aggregate level of social progress in Germany with a microeconomic analysis of the development of social progress as determined by environmental context factors and human skill formation. The first part of the analysis is based on a review of a number of social progress indices for Germany, while the second part analyses three different datasets (MARS, MuKI, SOEP) that complement each other in terms of context, skill and social progress measures.

The microeconomic analysis describes the relationship between contexts skills and social progress over the entire life cycle on hands of three different datasets. The MARS data provide a unique look at the association between contexts and skills during (early) childhood, a critical period for human capital formation. The MuKi data contain innovative experimental skill measures of children and their mothers in Germany. Both of these datasets rely on relatively small samples that are not representative for the German population, but contain unique measures of environments and skills that make it possible to study the fundamental mechanisms behind the formation of skills and social progress. The SOEP data are representative of the German population and allow us to study the relationships between context, skills and social progress in adulthood.

Our findings suggest that, in comparison to other countries, Germany's average level of aggregate social progress is high. We complement this description of the aggregate situation with an analysis of micro data to investigate how skills and social progress are formed over the lifecycle. Factor analysis results in one latent factor for cognitive skills, but at least two for noncognitive skills, which we determine to be mental and emotional skills. Hence, heterogeneity in noncognitive skills is higher than in cognitive skills, which is plausible given the richness of human behavior. The most diverse domain of social progress in our data is health, with four out of seven latent factors in the MARS and three out of five in the SOEP. Aggregate indicators should therefore take into account that health is a highly multifaceted dimension of social progress. Other social progress factors in our data relate to subjective well-being, academic achievement, societal engagement, trust and family cohesion.

Our results imply that a beneficial socio-economic environment improves cognitive and mental skills throughout childhood. In particular, a responsive parent-child relationship during infancy and a stimulating home environment during toddlerhood and preschool age are vital for skill development. In addition, maternal personality traits such as patience are important for the formation of mental and emotional skills, while the quality of the material environment mainly fosters cognitive skill development. Skills affect social progress in several ways. Academic performance and societal engagement are mainly driven by cognitive and mental skills, while emotional skills and personality traits mostly affect health-related social progress and resilience. We also show that, to some extent, better skills can help to cope with life burdens.

Policy recommendations for fostering social progress via investments into the formation of skills have to be evaluated on efficiency and equity grounds. Equity considerations depend on societal preferences, but mostly foster the skill development of disadvantaged children. From an efficiency point of view, public policy should allocate scarce resources to those types investments that have the highest returns and that complement (not substitute) private investment. It turns out that from both equity and efficiency perspectives, early childhood investments yield the best outcomes for children who were born into an adverse environment, independent from the region they live in.

Effective social policies need to consider research on natural human development and on critical periods for skill formation over the life cycle. Research on the childhood-skill-multiplier and our results on the self- and cross-productivity of skills suggest that, given the current structure of the German educational and welfare system, improving the socio-emotional home environment and parent-child interaction during (early) childhood is an effective means for fostering cognitive, emotional and non-cognitive competencies, which should boost long-run social progress.

Lifelong data with detailed measures on home environments, skills, school investments and social progress variables do not exist for Germany. While the present study circumvents this problem by combining results on several datasets, it may also motivate the construction or usage of datasets that have elaborate information on childhood rearing conditions, skill measures and social context information over the entire lifecycle. Such data would allow for research on skill formation during childhood and its dynamic complementarities with school investments and social progress.

Future research should focus on studies that compare preventative and remedial interventions for the same group of individuals. In particular, research on interventions that compensate for early life adversity through high quality teaching during school age and adulthood is needed to derive policy implications for an institutional framework that promotes the development of skills and human capital. Such additional research should be designed to investigate the interdependencies between public and private skill investments and their respective contributions to social progress.

8 Literature

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