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Swedish evidence on the impact of cognitive and non-cognitive ability on earnings
– an extended pre-market factor approach

Johnny Zetterberg

WORKING PAPER 2005:16

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Postal address: P.O. Box 513, 751 20 Uppsala
Visiting address: Kyrkogårdsgatan 6, Uppsala
Phone: +46 18 471 70 70
Fax: +46 18 471 70 71
ifau@ifau.uu.se
www.ifau.se

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ISSN 1651-1166

Swedish evidence on the impact of cognitive and non-cognitive ability on earnings – an extended pre-market factor approach*

by

Johnny Zetterberg**

June 21, 2005

Abstract

This paper investigates the impact on earnings of non-cognitive ability, measured in terms of individuals' 'self-esteem' on earnings. Starting with the pre-market factor approach suggested by Neal & Johnson (1996) a main finding is that measures of relative self-esteem along with cognitive ability are positively correlated with earnings. The analysis also reveals that the returns to cognitive and non-cognitive ability vary over the earnings-distribution: the returns are larger at higher levels of earnings than at low levels. While qualitatively robust, the effects decrease in magnitude when an extended version of the pre-market factor model is used.

Keywords: Incentive-influencing preferences, cognitive and non-cognitive ability, relative and absolute self-esteem, earnings distribution.
JEL codes: J31, M54.

* This research was supported by a grant from FAS (Forskningsrådet, Arbetsliv och Socialvetenskap). Jesper Antelius has done excellent research assistance. Comments on earlier drafts of the paper from Sten Johansson, Anna Larsson, Erik Mellander, Anna Sjögren, Björn Öckert, seminar participants at IFAU and FIEF are gratefully acknowledged.
** IFAU, P.O. Box 513, SE-751 20 Uppsala, Sweden, +46 18 471 70 82, johnny.zetterberg@ifau.uu.se.

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1 Introduction

Differences in wages/earnings are in general explained by differences in educational attainment, along with experience, age, gender, ethnicity, and family background. At the same time, it is an empirical fact that there are considerable wage (earnings) differentials across individuals with similar education. To the extent that these differences vary systematically they indicate that employers are willing to pay wages exceeding those motivated by 'the equilibrium skill premium'. Apparently, there are individuals with qualities or 'abilities' that other individuals do not posses that are appreciated by the employer. This observation gives rise to the issue of what qualifications which actually are valued in the labour market.

An obvious ability-factor is individual ability in terms of the intelligence quotient (IQ) that is assumed to indicate individual productivity and thereby is a wage determinant. A positive relationship between the individual's cognitive ability and earnings is also supported by several empirical studies.[1] However, the concept of 'ability' includes several other dimensions than the individual's cognitive ability. These other dimensions will henceforth be denoted 'non-cognitive ability'. Heckman & Rubinstein (2001) conclude that in real life there are a number of examples "of high-IQ people who failed to achieve success in life because they lacked self-discipline and low-IQ people who succeeded by virtue of persistence, reliability, and self-discipline." It also has been verified that in connection with firms' recruitment of labour, non-cognitive individual characteristics such as attitudes, motivation and communicative skill may be ranked far higher than formal educational attainment (years of schooling) or theoretical attainments.

In recent years, a growing economic literature has emphasized the relationship between the individual's non-cognitive ability (psychological capital) and labour market outcomes. The main hypotheses is that the individual wage (productivity) is influenced by his/her motivation, reliability, perseverance, view of life, social skills etc. Empirically support for measures of personal traits that vary with earnings/wages are reported in, for instance, Goldsmith et al (1997) and Murnane et al (2001). They find that the individual's self-esteem co-varies positively with future earnings whereas more odd findings are

[1] For references, see Section 2 in the present paper.

reported in Duncan & Tifone (1998) who find a positive relationship between earnings and individuals whose home was clean.[2]

This paper is related to the above literature, using Swedish data in order to analyse the importance of cognitive and non-cognitive factors, respectively, for individual earnings. For obvious reasons it is not possible to capture the overall characteristics of the individual in one single measure. Similar to previous studies the point is rather to investigate whether or not there is any empirical support for the idea that the individual's personal traits do matter for the labour market outcome, in addition to cognitive ability. The focus of this paper is on measures of non-cognitive ability that are expected to capture the individual's 'self-esteem'. Firstly, this personal trait is included within a theoretical framework in order to substantiate the empirical analysis. The framework is based on Bowles et al (2001a, 2001b) who use a principal-agent-model to explain wage differentials across individuals. The main message is that individual traits in terms of 'incentive-enhancing preferences' make it possible for the employer to induce higher effort from the employee at a lower cost. Profit-maximizing agents in competitive markets may therefore find it valuable to reward such preferences. Using this framework it is shown that self-esteem is a personal trait that is an incentive-enhancing preference and hence may be valuable to the employer. [3]

Secondly, in the empirical part of the paper, the influence of cognitive and non-cognitive factors is investigated by estimating earnings equations for males and females, respectively. The empirical analysis is also extended to investigate whether or not the influence of cognitive and non-cognitive variables on earnings varies over the earnings distribution. The investigation uses longi-

[2] Another example of odd finding is found in Bowles et al (2001a). They report evidence from British data on how personal traits in terms of 'Aggression' and 'Withdrawal', respectively, affect future earnings. For females, these traits in general vary negatively with earnings. However, a decomposition of the data by gender in high-status job, and low-status job, show that while earnings of males vary positively with Aggression and negatively with Withdrawal, the opposite relationship holds true for females!

[3] Other approaches are of course possible. For instance, it is possible to explain wage differences across individuals with similar educational attainment by means of a schooling model with heterogenous characteristics in terms of different productivity-related cognitive and non-cognitive abilities. But the limitation of such an approach is that it presumes that different personal traits reflect differences in individual productivity and thereby excludes personal traits that give rise to wage dispersion but still are not necessarily related to productivity, for instance the importance of having a clean home. Benabou & Tirole (2002) and Sjögren & Sällström (2004) use another approach and model personal traits as a result of different social interactions.

tudinal data on individuals mainly born in 1967, based on interviews and questionnaires from early school age (12–13 years of age). This data has then been matched with register data on earnings from the time the individual left compulsory schools until he/she was about 34 years old. The data also enables us to deal with problems of potential endogeniety discussed in the literature that are related to the causality between the individual's earnings and non-cognitive ability. This problem may be overcome by using data on the non-cognitive ability of the individual before entering the labour market as an instrument. This 'pre-market factor' approach suggested by Neal & Johnson (1996) would allow us to use OLS since earnings variations are explained by variables that can be taken to be predetermined. This approach implies that traditional human capital variables such as schooling and labour market experience are excluded from the analysis.

Compared to the original pre-market factor approach the present paper extends the empirical analysis in two important directions. Firstly, measuring cognitive and non-cognitive variables during childhood does not necessarily mean that they can be taken to be predetermined. Personal traits such as self-esteem in particular, are likely to be dependent both on genes and environmental factors that the individual is exposed to during adolescence. Moreover, the outcomes of IQ-tests might be sensitive to the individual's maturity (age) when the test was performed. Hence, there are reasons for using measures of cognitive and non-cognitive ability that are adjusted for such underlying factors. The importance of such factors is an empirical matter though and is therefore highlighted by comparing and contrasting estimates of such 'adjusted' measures to their corresponding 'unadjusted' measures.

Secondly, the analysis highlights a potential error of measurement in the self-esteem measure that may arise since self-esteem measured during childhood does not necessarily reflect the individual's self-esteem when grown-up. It is argued that a key factor to handle this potential measurement error is the individual's human capital since self-esteem when grown-up is likely to be dependent on the accumulation of human capital before entering the labour market while at the same time the self-esteem of the individual is important for the investment in human capital made during adolescence. The importance of this error of measurements is highlighted by introducing human capital variables as controls in the earnings equations. This extension constitutes a considerable departure from the original pre-market factor approach.

Consistent with previous studies, a main finding of the paper is first that the unadjusted measures of cognitive ability and non-cognitive ability are positively correlated with earnings. However, when the adjusted measures are used in the estimations and when human capital controls are introduced the findings reveal lower estimates of the returns to different abilities. Another finding is that the return to ability varies over the earnings distribution: the return is considerably larger at higher levels of earnings than at low levels. But when human capital controls are introduced into the analysis the conclusion is instead that the returns to cognitive and non-cognitive abilities tend to be completely equalised over the income distribution. In general these results apply to both males and females.

The outline of the paper is as follows. Section 2 provides a short survey of the literature to Section 3 which provides a theoretical model of the individual's self-esteem in terms of a simple principal-agent-framework. This framework is intended to serve as a general basis for the empirical analysis in the subsequent sections. Section 4 discusses the empirical approach used while Section 5 provides a description of the data and empirical results. Section 6 concludes the paper.

2 A brief review of the literature

The type of skill most commonly believed to explain wage differentials across individuals with similar education is the individual's cognitive ability in terms of the intelligence quotient (IQ).[4] The cognitive ability is fairly stable over the life cycle: it evolves into early adolescence and then remains more or less constant.[5] This does not necessarily mean that measures intended to capture the individual's cognitive ability are unaffected by investments in human capital. If anything, there is evidence that previous schooling and work experience indeed

[4] Cognitive ability or intelligence quotient (IQ) is often used as a summary measure of individual reasoning ability, verbal ability and spatial ability. Psychologists also use three additional categories of variables in classifying individual characteristics: vocational preferences, psychomotor abilities and personality variables. Vocational preferences concern individual ranking of occupations while psychomotor abilities involve individual physical strength and skill, reaction time, flexibility etc. Personality variables intend to capture the individual's perception and behaviour among other individuals. For references, see Hartog (2001).

[5] For references, see Heckman (2000).

influence achievement scores.[6] Hence, an important empirical issue is how to measure the variable used to capture cognitive ability. To fulfil the requirement of exogeniety in estimating the influence of cognitive ability on the outcome of educational attainments and/or earnings, the measure used must not be contaminated by schooling (besides compulsory schooling) or other investments in human capital. The most commonly used measures of cognitive ability in empirical studies are test scores from different kinds of IQ-tests, grades in math/readings or AFQT.[7] The evidence suggests that measures of cognitive ability from early ages in general are strongly positively correlated with the success in the labour market during adulthood – measured in terms of earnings and/or employment.[8]

In a controversial study – *The Bell curve* – Herrnstein & Murray (1994) even argue that individual IQ more or less is the universal determinant of economic and social success. However, this study has been strongly criticised on empirical grounds and in light of findings from previous research.[9] For instance, Neal & Johnson (1996) report evidence that the sample used by Herrnstein & Murray implies that the measure of individual IQ used – AFQT test scores – is likely to be endogenous in their analysis. Furthermore, the study's main conclusion is in stark contrast to the results in another influential study by Jencks (1979). Jencks analysis concerns the importance of individual IQ as well as schooling, family background and individual non-cognitive ability. The main conclusion is that no single factor dominates the others and that the relative importance of each factor differs across samples and outcomes.

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[6] See Carneiro & Heckman (2003).

[7] It is mostly studies using US data that have used information from the Armed Forces Qualification Test (AFQT) that exists in an older (1980) and a more recent version (1989). The recent version is based on four out of ten different tests that the US army uses as a means of assigning recruits to military positions. The AFQT-measure summarises the results from the four tests that involve paragraph comprehension, arithmetic reasoning, word knowledge and mathematics knowledge. In the older version (1980) the measure is slightly differently defined, see Neal & Johnson (1996). According to these authors the AFQT-measure should not be interpreted as a test of individual innate ability but as a test of individual achievement and learned skill.

[8] See Connolly et al (1992) Blackburn & Neumark (1993), Cameron & Heckman (1993), Murnane et al (1995), Neal & Johnson (1996), Currie & Thomas (2001) and Zax & Rees (2002). Some older studies report a non-existing or only weak relationship between intellectual capacity and future earnings. See Zax & Rees (2002) for references.

[9] See for instance Manski & Goldberger (1995), Korenman & Winship (1995), Neal & Johnson (1996).

In a survey article Bowles et al (2001a) argue that the literature's strong focus on individual cognitive ability (IQ) as an explanation for wage differentials is likely to have been governed by the availability of data on cognitive performance scores from different kinds of tests. In turn, this seems to have crowded out other complementary hypotheses on, for instance, the role of individual non-cognitive characteristics for the economic outcome.

There is a small but growing economic literature focusing on the relationship between the individual non-cognitive ability (psychological capital) – which is a comprehensive term for personal traits such as self-esteem, attitudes to work, social skills etc - and the labour market outcome. In one strand of this literature the main hypothesis is based on theories of social psychologists on the individual's general outlook on life – her/his 'locus of control'. This is assumed to play a crucial role for the individual's conception of life and self-esteem, respectively, and thereby for the future outcome in the labour market. In this context one distinguishes between individuals who are 'externalisers' and 'internalisers', respectively.

Externalisers believe that their life to a large extent is controlled by outside forces and consequently that the prospects of taking responsibility for their own life position are limited. On the other hand, internalisers are individuals who believe that they have a large influence on their own position in life and that the outcome is due to their own actions. In other words, the latter category of individuals is assumed to have a higher degree of 'locus of control' that in turn strengthens their intrinsic value and thereby their self-esteem. Therefore, individuals with high self-confidence are assumed to be more productive. They are more likely to efficiently make use of their creative potential in their work by being more open-minded to a wider range of solutions to problems and by having a large ability to co-operate. They also use their time more efficiently since they need less direction from their employers. [10]

Bowles et al (2001a, 2001b) develop and generalise some of these ideas within a simple principal-agent-model in order to explain individual wage differentials. Individual personal traits may be of relevance for earnings in a labour market which is characterised by persistent 'disequilibrium rents' due to technological shocks or other shocks and where all conditions in the labour contracts are not completely enforceable. Individuals with certain personal traits – which are not necessarily related to individual productive skills – have

[10] For references see Goldsmith et al (1997) and Murnane et al (2001).

larger ability than others to identify, capture and take advantages of such disequilibrium rents. This concerns for example individuals who exhibit a higher degree of independence and/or believe that their own actions efficiently influence the outcome (internalisers), in contrast to more fatalistic individuals (externalisers) and/or individuals who are more impatient by nature.

For firms with limited possibilities to monitor their employees the effort of the employees is endogenously determined since effort cannot in general be regulated in the labour contract. The contract may then rather be an agreement in which the employee accepts the employer's authority during the hours of work and the employer can use this authority to secure a certain flow of labour services. In order for employers to be able to exercise and enforce such a contract they firstly have to pay a wage that exceeds the alternatives, and secondly, to threat to terminate the labour contract if it is not fulfilled.

In such a situation there may be reasons for the employer to take into account the individual's traits if these exert an influence on costs to secure the labour force services. In particular, this concerns personal traits or 'incentive-influencing' preferences that make it possible for the employer to affect the costs of labour effort. Incentive-influencing preferences that will lead an employee to work harder are valuable for the employer even though they do not contribute directly to production. Profit-maximising firms may therefore be motivated to reward such preferences.

3 A simple framework

Following Bowles et al (2001a, 2001b), consider an individual possessing a given potential capacity who supplies labour services to a firm in terms of working hours (h) and a certain effort level (e), where $0 \leq e \leq 1$. The employer can decide upon the number of hours worked but effort cannot be regulated in the contractual agreement. Moreover, the employer has an imperfect measure of effort that indicates the probability $\tau(e)$ that the employee has 'shirked'. Employees who by a certain probability (q) are detected "shirking' are directly dismissed and replaced by a new identical employee while those who get fired take the next best alternative in terms of the unemployment benefit and job

search.[11] The termination probability is assumed to be determined by the function $\tau(e) = q - e^{\gamma}$ where γ is a parameter, $\gamma \in]0,1]$ implying $\tau'(e) < 0$, $\tau''(e) \leq 0$.

The relationship between the employer and the employee is modelled as an infinitely repeated game. First, in order to maximise profit the employer chooses to hire *h* employees each one of which works for one hour at a wage *w*. The wage is set taking in account of the fact that higher wages can induce the employee to supply a higher effort since the cost of losing the job increases with the wage. In the next step, the employee chooses the level of effort that maximises the present value of expected utility conditional on the expectation of the terminal probability function $\tau(e)$.

If the individual's utility function $u(w,e)$ is strictly increasing and concave in wages (*w*) while strictly decreasing in labour effort (*e*), the discounted value of being employed, $v(e)$, can be written as

$v(e) = \dfrac{u(w,e) + (1-\tau(e))v(e)^{*} + \tau(e)z^{*}}{(1+\rho)}$ where $v(e)^{*}$ and z^{*}, respectively, are values of the value function and the alternatives in the next period, and ρ denotes the subjective discount rate. In steady state the value function can be written as:

$$v(e) = z + \frac{u(w,e) - \rho z}{(\rho + \tau(e))} \tag{1}$$

Equation (1) says that the value of employment is determined by the value of the alternative income, *z*, and the 'employment rents' that is the present value of the excess of holding a job over the next best alternative.

In the next step the employee chooses the level of effort that maximizes the value of $v(e)$. The first order condition $v_e = 0$ implies that:

$$u_e = (v - z)\tau_e \tag{2}$$

[11] Compare Shapiro & Stiglitz (1984).

In equilibrium the marginal subjective cost of effort is equal to the marginal subjective revenue in terms of employment rent times the marginal effect of increased effort on the probability of losing the job.
From the equilibrium condition the employee's reaction function is solved in terms of $e = e(w, z)$. The impact of incentive-influencing preferences on the employee's reaction function is described by introducing a parameter, α, in the utility function and the value function, respectively. Hence, the value function can be written as $v(e, \alpha)$. The influence of preferences on effort channelled by the reaction function is then determined by totally differentiating the first order condition ($v_e = 0$). Rearranging, we obtain:

$$\frac{de}{d\alpha} = -\frac{v_{e\alpha}}{v_{ee}} \quad \text{where } v_{ee} < 0 \tag{3}$$

and

$$sign\ \frac{de}{d\alpha} = -sign\ v_{e\alpha}$$

Hence, the impact of incentive-influencing preferences on the employee's reaction function and thereby on effort are due to the nature of the preferences. Personal traits that are incentive-enhancing i.e., $v_{e\alpha} > 0$, increase the marginal effect of the present value of holding a job, meaning that the reaction function, all other things equal, shifts upwards. Analogously, $v_{e\alpha} < 0$ implies personal traits that have a contrary effect on effort and consequently on the reaction function.

3.1 Examples of incentive-influencing incentives

Of course, there are different personal traits that more or less plausibly can be classified as incentive-enhancing and incentive-dampening, respectively. Personal traits that may be valuable to the employer are, for instance, reliability, company loyalty and staying power. An example of incentive-enhancing preferences is a reduction in the individual's subjective discount rate which indicates that the individual is forward looking and likely to remain in the company while a high rate discount rate indicates the opposite.

The value of incentive-enhancing preferences may vary due to the nature of the employer's problem of authority. In organizations with limited ability to monitor the employees, preferences such as reliability are highly esteemed while in organizations with favourable monitoring conditions, the employer might rather value the foreman's ability to interact with others, i.e. of being 'good with people'.

The previous discussion on the classification of individuals into internalisers and externalisers, respectively, implied that self-esteem might differ across individuals. Contrary to externalisers internalisers expect that their own actions have a large impact on the outcome of their lives. Formally, the impact of such a trait on the employee's reaction function can be determined by first writing the terminal probability as $\tau(e,m)$ where m is a measure of the individual's self-esteem. Furthermore, it is assumed that $\tau_{em} < 0$, since individuals with high self-esteem also value high personal efficacy and therefore expect that their effort have a relatively large influence on the terminal probability τ. This also means that persons with high self-esteem expect that they could retain their jobs conditional on their own labour effort i.e. $\tau_m \leq 0$. The first order condition (2) is then modified as follows:

$$v_e = \frac{u_e - (v-z)\tau_e}{\rho + \tau} \tag{2'}$$

Differentiating the reaction function with respect to m gives:

$$v_{em} = \frac{-(u_e - (v-z)\tau_e)\tau_m - (v-z)\tau_{em}(\rho+\tau)}{(\rho+\tau)^2} > 0 \tag{4}$$

by account of the first order condition (2') and $\tau_{em} < 0$.

Hence, self-esteem is a personal trait that is incentive-enhancing. This is due to the fact that self-esteem decreases the value of the terminal probability, τ_e, which increases the marginal subjective revenue of effort and thereby increases the employee's desired level of effort. More intuitively, self-esteem increases the extent to which effort reduces the probability of losing one's job.

4 Results from previous studies and some empirical issues

The following section investigates whether there is empirical support for the hypothesis that non-cognitive ability in terms of self-esteem has an impact on individual earnings. The conventional view is that individual psychological factors or non-cognitive variables are difficult to measure.[12] In particular, there are two kinds of measurement problems that have been discussed in the literature.

Firstly, measures based on subjective interpersonal comparisons of graded answers might be meaningless since individuals may perceive a given scale differently. As a result, two individuals with identical reactions to a certain statement may respond differently; for instance, the first person chooses 'Agree' while the second person picks 'Strongly agree'. However, Goldsmith et al (1997) argue that modifying the graded responses to more distinctly dichotomous alternatives can reduce this kind of measurement error.[13] This is also stressed by Bertrand & Mullainathan (2001) who show that if measurement errors are sufficiently small, subjective measures, such as indicators of the individual's attitude, can be used as explanatory variables in predicting outcomes.

Secondly, there is a potential problem of endogeniety. Contrary to IQ that is formed early in life, non-cognitive ability (skill) evolves over the life cycle. In an empirical analysis this means that variables measuring individual self-esteem after labour market entry can be misleading since self-esteem could be influenced by previous outcomes in the labour market. Estimates of earnings equations where self-esteem is included as a determinant may then lead to endogeniety problems. Goldsmith et al (1997) report evidence that indicators of self-esteem measured late in life are endogenous in earnings equations.

A pre-market factor approach according to Neal & Johnson (1996) avoids at least partly this problem by using childhood measures of individual cognitive ability and non-cognitive ability. Such an approach also means excluding factors that reflect the individual's choices and chances of getting education.

[12] See for instance Heckman & Rubinstein (2001).
[13] For example, alternatives such as 'strongly positive, positive, negative, strongly negative' are modified to the alternatives 'positive, negative'.

This implies, for instance, that variables related to family background are not included in the estimations since family background is an important determinant of education. Neither should years of completed education, work experience, occupation, residence, marital status etc be included as controls in the estimated equation since they are all, more or less, due to individual choices and therefore reflect mechanisms by which the productive capacity has an impact on the future labour market outcome. Hence, this approach suggests an empirical analysis that merely uses variables that are strictly exogenous and/or determined before labour market entry i.e. pre-market-factors.

The few studies following Jencks (1979) that have investigated the possibility of a causal relationship between psychological capital and future earnings have more or less taken into consideration these measurement problems in the empirical analysis. In Goldsmith et al (1997) and Murnane et al (2001) the measure of the individual's self-esteem is based on a sample of questions in NSLYS that capture the individual's perceived 'locus of control'. Murnane et al (2001) include a variable that measures the individual's self-esteem during adolescence with the motivation that this personal trait 'might be positively correlated with two kinds of skills relevant to employers a decade later: the ability to work productively in groups and perseverance in the face of adversity.' Both of these studies find a positive co-variation between self-esteem during adolescence and earnings at grown-up ages.

However, it may be argued that the problem of endogeneity is only partly overcome by the approach suggested by Neal & Johnson when this approach is implemented as, for instance, in Murnane et al (2001). For analysing ethnical wage discrimination, which is the purpose of Neal & Johnsons' study, ability measured during the teenage years may certainly be considered as a 'pre-market factor' since it has then not been affected by expectations or actual experiences of discriminations in the labour market. But as pointed out by Carneiro et al (2005), Neal & Johnson have not specified any "explicit criterion for determining which factors are 'premarket' and which are not." This is an important issue because a pre-market factor approach that simply uses determinants measured before the individual enters the labour market relies on implicit conditions that might not be justified.

Firstly, the approach means that the individual's self-esteem is assumed to be exogenous during childhood. It is not obvious how the individual's self-esteem is formed during the years s/he is growing up but it is most likely that self-esteem is dependent on both genes and environment. For instance, it is

likely that there is a positive interaction between the individual's intelligence and certain personal traits, such as self-esteem. This would mean that the individual's 'locus of control' increases with the ability to grasp the complex context of reality.[14] Further, sociologists/social psychologists stress that the progress of the individual's cognitive and non-cognitive ability is dependent on how successful parents, relatives, friends etc are in communicating and explaining the reality for the individual during early ages and adolescence.[15] Social environments that provide the individual with an intrinsic basic security regarding how 'the real world' works should therefore provide children with greater ability to develop their 'locus of control'. The nature of the 'immaterial investments' that provides this basic security is then equivalent with the context into which the individual is born and is thus related to the family background. It is therefore likely that the basic security is positively connected to family resources in terms of income, wealth, education, time etc. For the empirical analysis these observations justify the use of measures of the individual's self-esteem that are adjusted for the intelligence and family background of the individual (see below).

Secondly, the 'simple' pre-market factor approach implicitly assumes that self-esteem measured in adolescence captures the impact of self-esteem during adulthood on earnings, even though there is much to suggest that non-cognitive ability is changed over the life cycle. There are theoretical grounds for believing that non-cognitive ability affects the individual's choice (direction) of human capital investment and the progress of his/her psychological capital stock and, hence, the self-esteem at grown-up ages (see Sjögren & Sällström (2004)). Formally, this may be written as $A_G = f(A_C, , H(A_C, ,Z))$ where A_G and A_C denote non-cognitive ability (self-esteem) when grown-up and during childhood, respectively, while H is the individual's human capital and Z is a vector of other determinants of human capital. On the other hand, theory provides no guidelines as to what extent the non-cognitive ability in childhood remains and is transmitted to the self-esteem at grown-up ages. Since the data in this study does not allow any comparison of measures of self-esteem at different ages it is an open issue whether measures of self-esteem at early ages reflect the stock of psychological capital at grown-up ages. In other words,

[14] Compare Benabou & Tirole (2002) who assume that an individual's self-confidence is positively related to talent.
[15] See for instance Eriksson & Jonsson (1993) and references therein.

there is a potential measurement error of the self-esteem measure that has to be taken accounted of in the empirical analysis.

This measurement error can be handled in at least two ways. The first (trivial) way, which provides an interpretation of what has been done in the previous literature (for instance in Murnane et al (2001)), is just to assume that non-cognitive ability in grow-up ages is a linear transformation of non-cognitive ability during childhood according to $A_G = a+\beta*A_C + \varepsilon$ where β is a parameter and ε is the error term. However, as long as data on non-cognitive ability are not available at different ages this relationship is not empirically testable. In such circumstances it is natural to make the additional assumptions that the parameter β is equal to one and the error is identically zero. In other words, there would be a 'one-to-one-correspondence' between the individual's self-esteem in childhood and self-esteem when grown-up. But the relationship also involves the implicit assumption that the individual's human capital does not affect the self-esteem when grown-up, which is contradicted by the theory mentioned above. This means that the individual's human capital is an omitted variable.

An alternative starting-point is therefore that self-esteem when grown-up is dependent on the accumulation of human capital before the individual enters the labour market. This also makes it possible to test, in a strict sense, the theoretical implication of this paper i.e. self-esteem as an incentive enhancer at given skills. To do so it is necessary to distinguish the impact of self-esteem at grown-up ages on earnings from its potential general influence on the accumulation of human capital. This could be done by including variables that capture the individual's human capital in the earnings equation. If the estimated coefficient value of the self-esteem variable is affected by the inclusion of human capital variables this indicates that the assumption of a 'one-to-one-correspondence' between the individual's self-esteem at different ages is not a reasonable approximation. So, in light of this, there are reasons to modify the 'simple' pre-market factor approach by including traditional human capital variables as controls in the empirical analysis.

Analogous to, for instance, Carneiro et al (2005) who use an age-corrected AFQT-measure for cognitive ability there are also reasons for taking into account age difference across individuals that may affect an IQ-measure based on results from an intelligence test during adolescence. The data on intelligence and self-esteem used in this study are based on information from individuals who during the school year 1979/80 went to sixth grade in compulsory school.

Even though most of the pupils were born 1967 there is still some age dispersion among them that may affect the intelligence measure. There are at least two kinds of influences.

Firstly, there are age-group differences among the pupils due to the fact that some of the individuals started compulsory school earlier or later than the regular school starting age which was 7 at the time. On the one hand, there are individuals who were advised (by their parents) to start school earlier as they were regarded as sufficiently mature for school or talented enough to manage an earlier school start. On the other hand, there are individuals whose school start was delayed by opposite reasons.

Secondly, there is a literature suggesting that individuals born earlier within the calendar year perform better in school than class-mates born later in the year, simply because they are older when they start school.[16] For instance, in the Swedish educational system the school start is based on the calendar year when the individual is born which means that there can be an age-difference of nearly one year between the individuals in a class. In light of the fact that the IQ-tests were performed when the children were about 13 years old and there is a progress of the intelligence of an individual up to 15–16 years of age, one year is a quite big age-difference that might affect the outcome of the IQ-test and therefore should be considered in the estimations.

In the empirical analysis this is taken into account by means of an age-corrected IQ-measure ($\overline{IQ}$) which is the standardised residual from the regression of the IQ-test on the individual's age and quarter of birth. Such an 'adjusted' IQ-measure should purge potential age-effects from the estimate of IQ on earnings. In a similar way we define an adjusted measure of self-esteem ($\overline{Esteem}$). The measure is the standardised residual from the regression of the defined self-esteem measures (see below) on the individual's IQ, family background and the age-variables mentioned above that are included as controls for the same reasons as for the IQ-measure. By controlling for IQ and family background we do at least to some extent take into account that the unadjusted measure of self-esteem might also capture the individual's

[16] In fact researchers, for instance Neal & Johnson (1996), have used this variation in ages to create an instrument for education in order to investigate the influence of schooling on the individuals' IQ. In general this research reports findings that indicate a positive relationship between schooling and IQ (see Winship & Korenman (1997)). For a recent study on Swedish data and a review of the school-start literature, see Fredriksson & Öckert (2004).

performance in school and reflect parental investment in their children. The adjusted measure should therefore better reflect the individual's actual self-esteem.

We also explore the presence of possible complementarities between cognitive and non-cognitive ability by including interactions between the IQ-variable and the self-esteem variables. Even though the above cited observation by Heckman & Rubinstein indicates that intelligence and personal traits might be substitutes this is for obvious reasons an open empirical issue.

5 Data and empirical results

Using Swedish data, this section reports evidence for males and females on how measures of individual cognitive and non-cognitive abilities co-vary with earnings. The econometric analysis is mainly based on the above mentioned pre-market-factor approach by Neal & Johnson (op cit): variation in adults' earnings is explained by predetermined cognitive and non-cognitive variables. However, for reasons discussed in the previous section the analysis is also extended by using adjusted measures of cognitive and non-cognitive abilities and by the introduction of controls for individual's skill.

The data are based on a representative longitudinal survey of individuals mainly born in 1967, carried out by the Educational department at the University of Gothenburg. Henceforth, the data will be referred to as 'the Gothenburg-data'.[17] The Gothenburg-data originates from a sample of pupils in a total of 437 classes in the 6th grade of compulsory school during the school year 1979/80, i.e. when the pupils were 12–13 years old. The data include information on results from different IQ-tests, the individual's own perception of his/her social study environment (e.g. independence in relation to classmates, parents, teachers etc), study ambitions, home environment, future plans with respect to education and occupation etc. This information has then been complemented by different register data from Statistics Sweden[18] on earnings, nationality, socio-economic information, employment status etc up to

[17] See Härnqvist (1998) for a detailed description of the data.
[18] Register data from RAMS, LOUISE, LUCAS, Education register (Utbildningsregistret), Census80 and Census90.

the year 2001 when the individuals were about 34 years old.[19] All in all, the data contains information on approximately 9000 individuals, but due to missing values on some variables and after exclusion of individuals without earnings in 2001 the sample is reduced to 6681 individuals out of which 3277 are females.

The dependent variable in the analysis is log real earnings (in 1990 prices). The earnings variable is a sum of wages, firm income (excluding capital income), sick benefits and unemployment benefits. The earnings components are based on register data from the Tax authorities and are hence measured with high precision. Unfortunately there are no data on individual hours worked which implies that potential effects of labour supply cannot be taken into account. To some extent this limitation is remedied by estimating the equations under earnings restrictions assumed to correspond to full-time employment.[20] Quantile regressions are also carried out to provide estimates from different part of the earnings distribution.

The IQ-variable used is based on three cognitive variables indicating verbal, spatial and reasoning ability. These variables have weighted together with equal weights to produce one single (unadjusted) measure of the intelligence quotient.

Based on the responses with respect to social study environment, measures of individual self-esteem have been defined in terms of 'relative self-esteem' and 'absolute self-esteem', respectively. The underlying questions are similar to those in NSLSY and the design of the measures on self-esteem are similar to those used in Goldsmith et al (1997) and Murnane et al (2001). The measure of individual relative self-esteem intends to capture the individual's view on his/her own ability in a social context. The measure is an index and based on two questions that indicate the individual's own perception of his/her relatively capacity in the class and potential highest capacity, respectively. The questions were formulated as follows: *Q1: Suppose that the most successful pupil in your class is given the number 9 and the least successful is given the number 1 in a range of 1-9, which number would you then assign to yourself? Q2: If you*

[19] The data contains relatively few individuals with immigrant-background which reflects the general situation during the years of 1979–80 with proportionately few pupils with immigrant-background compared to the school conditions nowadays.

[20] Antelius & Björklund (2000) compare estimations based on hourly wages and earnings, respectively, as the dependent variable, and find that given "appropriate" earnings restrictions the differences in the obtained estimates can by and large be disregarded.

really make an effort to do your best, which of the numbers would you then reach? The numbers from these two questions have been summed and then normalised by division by the maximum possible sum. This provides an index between 0 and 1 where 1 denotes the maximum value of relative self-esteem.

The measure of individual absolute self-esteem is generated from two 'yes' or 'no' questions: *Q1: Do you believe that you are successful in your school-work? Q2: Do you frequently think that you would like to do better in your school-work?* The answers on these questions have been ranked in the following way: The highest ranking is assigned to responding 'yes' to both questions; the second highest ranking is assigned to responding 'yes' to the first question and 'no' to the second; the third highest ranking is assigned to responding 'no' to the first question and 'yes' to the second, while responding 'no' to both questions is assigned the lowest rank. The sum of the obtained responses has then been normalised to the [0,1] interval.

In the following regression analysis the estimates of these 'unadjusted' measures of the intelligence quotient (IQ), absolute self-esteem (Absesteem) and relative self-esteem (Relesteem), respectively, are contrasted and compared to the result obtained for corresponding adjusted measures - $\overline{IQ}$, $\overline{Absesteem}$ and $\overline{\mathrm{Re}lesteem}$, respectively - defined according to the procedures discussed in the previous section.

Table 1 provides descriptive statistics. The different measures of cognitive ability are on average somewhat higher for females than for males; in particular, this is true for verbal ability. On the other hand, the measures of non-cognitive ability are on average somewhat higher for males. Not surprisingly, real earnings are higher on average for males than for females, reflecting that females work part-time to a larger extent than males.

One way to control for this difference is to estimate the equations under earnings restrictions that correspond to full-time work. In the following it is therefore assumed that a full-time worker can be identified by individuals who in 2001 had real earnings that amounted to at least one standard deviation of the real earnings in the original sample. Among males this means that those who have real earnings lower than 120 000 SEK have been excluded and among females those with real earnings below 80 000 SEK have been left out of the estimation.[21]

[21] In nominal terms these real earnings correspond to about 154 000 SEK for males and 102 000 SEK for females, respectively.

Table 1 Summary statistics, ability-variables and earnings.

Variables	Male		Female	
	Average	Standard Deviation	Average	Standard Deviation
Cognitive ability				
IQ	114.9	28.8	116.2	28.3
Verbal	113.1	29.0	116.9	30.2
Spatial	118.7	37.3	118.3	34.5
Reasoning	112.9	41.5	113.4	39.3
Non-cognitive ability				
Self-esteem				
absolute	.673	.317	.653	.309
relative	.703	.172	.694	.164
Earnings				
real earnings (SEK)	212 169	119 927	147 683	79 483
log real earnings	12.111	.698	11.735	.730
Number of observations	3 404		3 277	

Notes: The IQ-measure is an average of verbal, spatial and reasoning ability-measures. The measures of the cognitive variables could take values in the interval of 0-200 (maximum). The values of the non-cognitive variables are in the interval of 0-1. Real income in 2001 is measured in the year of 1990 prices.

5.1 Estimation results

Table 2 reports results - based on the simple pre-market factor approach - from estimating the impact of unadjusted measures of cognitive and non-cognitive ability on male earnings (columns 1–4) and female earnings (columns 5–8),

respectively. In order to facilitate the interpretations of the estimated coefficients all skill-variables have been standardised such that they have zero mean and unit standard deviation. Since the dependent variable is log real earnings the estimates can be interpreted in terms of percentage changes in earnings when the explanatory variables change by one standard deviation. For instance, in the first column of *Table 2*, the positive estimate of the IQ-variable indicates on average almost 10 percent higher earnings for male individuals who have one standard deviation higher IQ. In column 2 the positive estimate indicates that individual psychological capital in terms of relative self-esteem is also rewarded in the Swedish labour market. The estimate indicates that earnings are 7–8 percent higher for males who have one standard deviation higher relative self-esteem. However, as shown in columns 3 and 4, the size of the estimate of relative esteem is considerably reduced when the IQ-variable is included in the estimations. This implies that the measure of relative self-esteem at least to some extent is correlated with the measure of individual cognitive ability. The estimates of the interactions (column 4) also reveal that relative self-esteem and IQ seem to be complementary i.e. the impact on earnings of high IQ is strengthened by having high relative self-esteem.

Columns 5–8 report corresponding estimates for females and show by and large similar magnitudes and patterns as for males. Women with one standard deviation higher IQ get on average 8 percent higher earnings (column 5) whereas females with a relatively high level of relative self-esteem are rewarded by 6–7 percent higher earnings (column 6). The influences of the IQ-variable and relative self-esteem on earnings are also reduced when both cognitive and non-cognitive variables are included in the estimations. Moreover, just like for men, relative self-esteem and IQ are complementary. But in contrast to males, there is a negative interaction between IQ and absolute self-esteem indicating that they are substitutes i.e. for females the impact of high IQ on earnings is reduced by low absolute self-esteem. *Table A1* in the Appendix reports corresponding estimates using the unrestricted sample. The results are largely similar to the findings in *Table 2,* the main difference being that the estimates of absolute self-esteem in the male earnings equation are statistically significant throughout.

However, as noted above it can be argued that the individual's cognitive and non-cognitive ability are not exogenous during adolescence and therefore there are reasons for using adjusted measures of these variables. The adjusted

Table 2 Estimation results from unadjusted measures, males and females. Dependent variable: 2001 log real earnings. Restricted sample.

	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IQ	.096**		.076**	.074**	.081**		.066**	.065**
	(.006)		(.006)	(.006)	(.006)		(.006)	(.007)
Absesteem		.006	.004	.006		-.003	-.001	-.001
		(.006)	(.006)	(.006)		(.006)	(.006)	(.007)
Relesteem		.076**	.044**	.050**		.066**	.036**	.040**
		(.006)	(.006)	(.007)		(.007)	(.007)	(.008)
IQ*Absesteem				-.002				-.013**
				(.006)				(.006)
IQ*Relesteem				.025**				.022**
				(.006)				(.006)
Absesteem *Relesteem				.004				.005
				(.006)				(.007)
Constants	12.29	12.29	12.29	12.28	11.95	11.95	11.95	11.94
	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)	(.007)
F-value	282.4	99.1	75.3	56.8	185.5	55.0	68.1	35.5
R^2	.089	.060	.106	.113	.061	.038	.070	.075
Number of observations	3011	3011	3011	3011	2810	2810	2810	2810

Notes: * and ** denote statistical significance at 10 %-level and 5%-level, respectively. The IQ-measure is an average of verbal, spatial and reasoning ability-measures. This measure can take on values in the interval of 0–200 (maximum). The values of the non-cognitive variables, Absesteem and Relesteem, are defined on the closed interval 0–1.

variables used are based on the estimation results reported in *Table A2* in the Appendix. The findings are consistent with those reported in Fredriksson & Öckert (2004) and indicate that IQ varies negatively with delayed school start and positively with the date of birth during the year. For females there are negative age-effects also in the estimated esteem equations. For both males and females IQ and family background (in terms of permanent family income) have positive impacts on self-esteem.

We have further argued that to solely use a measure of self-esteem from adolescence as a proxy for the self-esteem when grown-up may give rise to error of measurement and that, therefore, there are reasons for including human capital variables in the earnings equation. The latter are supposed to capture part of the influence of childhood cognitive and non-cognitive ability on the human capital accumulation of the individual, in order to isolate the incentive-enhancing impact of self-esteem on grown-up earnings.

Using this extended pre-market factor approach *Table 3* reports estimates for males based on the adjusted measures, with and without human capital controls. As shown in column (1) the estimate of the adjusted IQ-measure hardly deviates from the estimate of the unadjusted measure in *Table 2*, column (1). On the contrary, there is a considerable reduction in the estimate of the adjusted relative self-esteem measure which has been halved compared to the estimate based on the unadjusted measure (column 2 in *Table 2*). This implies that part of the positive co-variation between the unadjusted measure and earnings reported in *Table 2* can be attributed to the individual's cognitive ability.

In columns 5-8 though, that report estimates with controls for human capital variables, the magnitude of the estimate of the IQ-variable is reduced by nearly half and the estimate of relative esteem is lowered by an additional third. Hence, not controlling for the fact that part of the cognitive and non-cognitive ability measured in childhood also has an impact on the human capital accumulation of the individual tends to exaggerate the impact of self-esteem as an incentive-enhancer on earnings. The estimates of the interactions (columns 4 and 8, respectively), on the other hand, are by and large unchanged.

Table 4 reports estimates for females when using adjusted measures of IQ and self-esteem, respectively, and reveal a similar pattern as for males. The estimate of the adjusted IQ-measure is of similar magnitude as the estimate of the unadjusted measure whereas the size of the estimate of the adjusted relative self-esteem measure is reduced by more than half. Similar to the case with the

Table 3 Estimation results from adjusted measures with and without controls for schooling andexperience, males. Dependent variable: 2001 log real earnings. Restricted sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{IQ}$	.091**		.091**	.090**	.048**		.050**	.049**
	(.006)		(.006)	(.006)	(.006)		(.006)	(.006)
$\overline{Absesteem}$		.002	.002	.003		- .001	- .001	-.001
		(.006)	(.005)	(.006)		(.005)	(.005)	(.006)
$\overline{\text{Re}\,lesteem}$		.036**	.036**	.041**		.021**	.024**	.028**
		(.006)	(.007)	(.007)		(.005)	(.005)	(.006)
$\overline{IQ}$ * $\overline{Absesteem}$				-.005				-.005
				(.006)				(.006)
$\overline{IQ}$ * $\overline{\text{Re}\,lesteem}$				.024**				.019**
				(.006)				(.005)
$\overline{Absesteem}$ * $\overline{\text{Re}\,lesteem}$				.001				.001
				(.005)				(.005)
Constants	12.29	12.29	12.29	12.29	12.29	12.29	12.29	12.29
	(.006)	(.006)	(.006)	(.006)	(.005)	(.005)	(.005)	(.005)
Controls for schooling and experience	no	no	no	no	yes	yes	yes	yes
F-value	252.1	20.60	96.6	49.6	168.9	105.7	104.1	66.4
R^2	.081	.013	.094	.099	.185	.171	.190	.193

Notes: * and ** denote statistical significance at 10 %-level and 5%-level, respectively. $\overline{IQ}$ is the standardised residual from the regression of the unadjusted IQ-score on the individual's age and quarter of birth reported in *Table A3* in the Appendix. $\overline{Absesteem}$ and $\overline{\text{Re}\,lesteem}$, respectively, are the standardised residual from the regression of the unadjusted measures of Absolute self-esteem and Relative self-esteem on the individual's age, quarter of birth, intelligence and family background, see Table A3 in the Appendix. The number of observations is 3009.

Table 4 Estimation results from adjusted measures with and without controls for schooling and experience, females. Dependent variable: 2001 log real earnings. Restricted sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{IQ}$	.079**		.079**	.078**	.052**		.053**	.052**
	(.006)		(.006)	(.006)	(.006)		(.007)	(.007)
$\overline{Absesteem}$		-.001	-.001	-.002		- .002	- .001	-.002
		(.006)	(.006)	(.007)		(.006)	(.006)	(.007)
$\overline{\text{Re}lesteem}$		.031**	.030**	.033**		.016**	.020**	.022**
		(.006)	(.006)	(.007)		(.007)	(.006)	(.007)
$\overline{IQ}$ * $\overline{Absesteem}$				-.012*				-.011*
				(.007)				(.006)
$\overline{IQ}$ * $\overline{\text{Re}lesteem}$				.016**				.013**
				(.007)				(.006)
$\overline{Absesteem}$ * $\overline{\text{Re}lesteem}$				.002				.001
				(.006)				(.006)
Constants	11.95	11.95	11.95	11.95	11.95	11.95	11.95	11.95
	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)	(.005)
Controls for schooling and experience	No	No	No	No	yes	yes	yes	yes
F-value	172.8	12.2	62.6	32.1	104.1	52.3	65.3	41.7
R^2	.057	.008	.065	.068	.115	.097	.118	.120

Notes: * and ** denote statistical significance at 10 %-level and 5%-level, respectively. The number of observations is 2805. For notation, see *Table 3*.

unadjusted measures, the estimates of the interactions indicate that IQ and absolute self-esteem are substitutes while IQ and relative self-esteem are complements although this relationship now is somewhat weaker. The substitutability and complementarity relationships are not affected to any appreciable extent by including human capital variables in the estimations (column 8). Note that the estimates of IQ for females have been reduced to a lesser extent than for males after the inclusion of human capital variables whereas the reduction in the estimates of relative self-esteem is of similar magnitude for both males and females.

All in all the estimates based on the simple pre-market factor approach are reduced considerably when they are adjusted for age-effects, intelligence and family background and when we take into account that part of the childhood cognitive and non-cognitive ability is manifested in human capital accumulation. However, these considerations do not change the result that psychological factors seem to matter for wage formation in the Swedish labour market. For both males and females the estimates indicate that an individual with one standard deviation higher relative self-esteem on average obtains at least 2–2,5 percentage higher earnings.

It is not obvious how these percentage numbers should be related to the magnitude of the return on other human capital factors such as schooling since the choice of education is determined by, for instance, intelligence and self-esteem. One can get some idea of the magnitudes by relating the estimates reported in columns (7) in *Table 3* and *Table 4*, respectively, to the (unreported) estimates of the schooling variable used as control in these estimations. The estimations show that the return to one standard deviation higher number of years of schooling is about 13 percent for males and 8 percent for females.[22]

[22] These numbers correspond to a yearly returns to education of 4,7 percentage for males and 3,1 percentage for females. These results are in line with the findings reported in Kjellström (1999) who, using similar data, finds that the yearly return to education is slightly more than 4 percent (for males) when using IQ-tests as controls in the estimations.

5.2 Estimations results from quantile regressions

An alternative or complementary approach to imposing earnings restrictions in accounting for the influence of part-time working on the estimates, is to estimate quantile regressions that provide different estimates for different parts of the earnings distribution. Following Buchinsky (1998) the quantile regression model assumes that the conditional quantile of the random variable y is linear in the regressor vector x such that the coefficient vector $b(\theta)$ is given by the solution to

$$\min\left[\sum_{i:y_i \geq x_i b(\theta)} \theta \left| y_i - x_i b(\theta) \right| + \sum_{i:y_i < x_i b(\theta)} (1-\theta) \left| y_i - x_i b(\theta) \right|\right] \quad (5)$$

Contrary to OLS, which essentially amounts to estimating the marginal effect of x on the mean of y, quantile regression implies estimating the marginal effect of x at various points in the distribution of y. For example, in this paper the focus is to estimate the impact of cognitive and non-cognitive variables (x) on log earnings (y) at the bottom of the earnings distribution (for instance the twenty-fifth percentile) and at the top of the distribution (for instance the seventy-fifth percentile). The obtained coefficient estimates are interpreted as the estimated returns to cognitive and non-cognitive individual characteristics at the θth quantile of the log earnings distribution.

Table 5 reports estimated coefficient values of cognitive and non-cognitive variables based on the adjusted measures at the twenty-fifth, the fiftieth and the seventy-fifth percentiles for males and females, respectively. Columns (1) and (3) report estimates without controls for the individual's human capital and show a similar pattern for both males and females. There is a positive impact of individual IQ on earnings and the impact is larger at high earnings levels than at low levels. In fact, there is a statistically significant difference between the seventy-fifth percentile and the fiftieth and the twenty-fifth percentiles, respectively.[23] This means that at the seventy-fifth percentile one standard deviation of higher IQ provides a return that is 2–4 percent larger than at the fiftieth and twenty-fifth percentiles.

[23] The significance test of different coefficient estimates across the quantiles has been performed by applying the iqreg command described in STATA.

Table 5 Estimation results, quantile regressions, males and females. Dependent variable: 2001 log real earnings.

	Males		Females	
	(1)	(2)	(3)	(4)
Q25				
$\overline{IQ}$	065**	.036**	.058**	.054**
	(.009)	(.008)	(.014)	(.018)
$\overline{Absesteem}$	.015	.013	.009	.017
	(.009)	(.008)	(.014)	(.013)
$\overline{\text{Re}lesteem}$	.012	.023**	.012	.007
	(.009)	(.009)	(.014)	(.016)
Q50				
$\overline{IQ}$	.073**	.037**	.077**	.052**
	(.007)	(.006)	(.008)	(.009)
$\overline{Absesteem}$	.007	.003	.009	.009
	(.008)	(.007)	(.007)	(.007)
$\overline{\text{Re}lesteem}$	.020**	.018**	.025**	.009
	(.006)	(.006)	(.009)	(.009)
Q75				
$\overline{IQ}$	.111**	.059**	.095**	.067**
	(.009)	(.008)	(.008)	(.009)
$\overline{Absesteem}$	.007	-.001	.003	.002
	(.009)	(.006)	(.007)	(.008)
$\overline{\text{Re}lesteem}$	.037**	.025**	.038**	.025**
	(.008)	(.007)	(.006)	(.008)
Controls	no	yes	no	yes
Pseudo-R^2				
Q25	.012	.095	.006	.058
Q50	.023	.090	.017	.056
Q75	.048	.112	.039	.079

Notes: The numbers in parentheses are bootstrap standard errors. ** and * denote statistical significance at 5%-level and 10%-level, respectively. The estimates of constants are not reported. The number of observations is 3400 for males and 3272 for females. Controls include schooling and experience. Notations are given in *Table 3.*

The impact of non-cognitive variables on earnings also varies across different earnings levels. Absolute self-esteem matters for male earnings at the twenty-fifth percentile but not at higher earnings levels, while this individual trait is of no importance at all for female earnings. The impact of relative self-esteem is increasing with the level of earnings. For individuals at the fiftieth and seventy-fifth percentile one standard deviation of higher relative self-esteem implies 2–4 percent higher earnings compared to the lowest percentile. This difference is statistically significant throughout for males but for females only across the highest and the lowest earnings levels.

However, when including controls for individual's human capital in the estimations the pattern is changed considerably (see columns 2 and 4). The magnitude of the IQ-estimates for males are almost halved at all income levels whereas for females the estimates are reduces mostly at higher income levels and to a lesser extent. For females the differences across the income levels are not statistically significant. For males in the twenty-fifth percentile the relative importance of absolute self-esteem and relative self-esteem are reversed compare to when there are no controls for human capital. As a result, the return to relative self-esteem is completely equalized over the income distribution. For females, on the other hand, the estimates of relative self-esteem change such that their impact remains only at the highest income level.

Table A3 in the Appendix reports corresponding estimates using unadjusted measures of the variables and reveals similar results and pattern. Columns (1) and (3) report estimates emanating from the simple pre-market factor approach which are fairly close to the estimates reported in the corresponding columns in *Table 5*. The most important difference when using unadjusted measures is on the one hand that the size of the IQ-estimates are somewhat lower, while, on the other hand, the estimates of relative self-esteem are somewhat higher which is in accordance with the fact that the unadjusted variables are correlated. Hence, when using the extended pre-market factor approach the overall conclusion is that the differences in return to both cognitive and non-cognitive abilities tend to be equalised over the income distribution. This result is mainly due to the inclusion of human capital controls in the estimations and highlights the importance of the measurement error implying that ability measured during childhood does not completely reflect the adult's ability.

Table 6, finally, reports estimates with and without human capital controls for the presence of complementarities between the intelligence variable and the two self-esteem variables at different income levels. Irrespective of gender the

Table 6 Estimates of complementarities across cognitive and non-cognitive ability, quantile regressions, males and females. Dependent variable: 2001 log real earnings.

	Males		Females	
	(1)	(2)	(3)	(4)
Q25				
$\overline{IQ} * \overline{Absesteem}$	.007	.001	-.053**	-.046**
	(.009)	(.009)	(.017)	(.012)
$\overline{IQ} * \overline{\text{Re}lesteem}$	.010	.020**	.013	.024
	(.009)	(.009)	(.016)	(.015)
$\overline{Absesteem} * \overline{\text{Re}lesteem}$	.003	.007	-.009	-.003
	(.010)	(.006)	(.014)	(.011)
Q50				
$\overline{IQ} * \overline{Absesteem}$	-.001	.004	-.012	-.018**
	(.007)	(.006)	(.009)	(.007)
$\overline{IQ} * \overline{\text{Re}lesteem}$	.023**	.016**	.016*	.015
	(.007)	(.006)	(.009)	(.009)
$\overline{Absesteem} * \overline{\text{Re}lesteem}$	.004	-.002	-.001	-.003
	(.006)	(.005)	(.008)	(.007)
Q75				
$\overline{IQ} * \overline{Absesteem}$	.003	-.002	-.008	-.008
	(.008)	(.007)	(.008)	(.008)
$\overline{IQ} * \overline{\text{Re}lesteem}$	.024**	.020**	.020**	.014**
	(.008)	(.007)	(.006)	(.006)
$\overline{Absesteem} * \overline{\text{Re}lesteem}$	.002	.013*	-.001	-.008
	(.007)	(.007)	(.006)	(.006)
Controls	no	yes	no	yes
Pseudo-R^2				
Q25	.012	.096	.008	.060
Q50	.025	.091	.017	.056
Q75	.051	.114	.040	.081

Notes: The numbers in parentheses are bootstrap standard errors. ** and * denote statistical significance at 5%-level and 10%-level, respectively. Notations are given in *Table 3* The estimates of the single variables are not reported but are of similar magnitudes as those reported in *Table5*. The number of observations is 3400 for males and 3272 for females. Controls include schooling and experience. Notations are given in *Table 3*.

estimates indicate that IQ and relative self-esteem are complements. The previous noted observation that intelligence and absolute self-esteem for females are substitutes seems primarily to be true in the lower tail of the income distribution (see columns 3 and 4). *Table A4* in the Appendix reports corresponding estimates when using the unadjusted measures of cognitive and non-cognitive ability and the findings imply similar conclusions.

6 Concluding remarks

An important empirical issue is explaining and understanding the sources of earnings differences across individuals with similar education. In addition to degrees and other formal qualifications it is apparent that certain individuals, unlike others, have productive capacities that are positively valued by the employer. One such capacity is individual cognitive ability measured by IQ-tests. Another capacity is non-cognitive skills such as motivation, reliability, self-confidence, social skills etc. The present paper uses Swedish data to investigate whether individual personal traits besides individual cognitive ability are determinants of earnings.

The starting-point for the empirical analysis is a simple principal-agent framework where employer and employees form incomplete contracts and the employee's labour effort is endogenous. The model predicts that individuals with incentive-enhancing preferences, for instance self-esteem, exert relatively higher effort (productivity). Individuals with such a trait are therefore valuable to the employer who is prepared to pay them higher wages.

The empirical analysis – based on both the (simple) pre-market-factor approach suggested by Neal & Johnson (1996) and an extended approach - is focused on investigating whether measures that are assumed to reflect individual relative and absolute self-esteem during adolescence vary with earnings when grown up.

Starting with the simple pre-market-factor approach we find that cognitive ability (IQ) of individuals when they are 12–13 years old has a positive impact on earnings in adult ages. For both males and females the estimates indicate that an individual with one standard deviation higher cognitive ability on average obtains 8–10 percent higher earnings. For males this estimate is of similar magnitude to the one reported in Zax & Rees (2002) (11 percent) but

lower than the estimates reported in Neal & Johnson (1996) (18 percent) and Murnane et al (2001) (19 percent).[24]

The findings also show that earnings for both males and females vary positively with individual non-cognitive ability, in particular with individual relative self-esteem. Individuals with one standard deviation higher relative self-esteem earnings have on average 7–8 percent higher earnings. This finding is consistent with Murnane et al (2001) who (using a similar measure) report that individual self-esteem in early ages is positively related to wages obtained when grown-up (27–28 years old). Their study reveals that a corresponding change of self-esteem implies about a 4 percent higher hourly wage when controlling for individual cognitive ability. Similar to the present study they also find that the impact of self-esteem on earnings is very sensible to the inclusion of other skill-measures in the estimated model. This implies that various skill measures might be correlated and this paper presents evidence that supports this hypothesis.

Compared to the original analysis, the extended version of the pre-market factor approach contains two new features. Firstly, the measures of the cognitive and non-cognitive variables are not assumed exogenous just because they are measured during childhood and before labour market entry. In particular, the individual's self-esteem is likely to be determined by intelligence and family background. Secondly, the analysis takes account of the potential error of measurement that may arise because self-esteem measured in childhood not necessarily reflects the individual's self-esteem when grown-up. There are theoretical arguments indicating that self-esteem during adolescence is important for the human capital accumulation that in turn does have an influence on self-esteem when grown-up. A similar argument can be made with respect to IQ-tests; even though the individual's intelligence is permanented relatively early in life there is a literature suggesting that results from IQ-tests during childhood may be affected by age-effects related to early or delayed year of school-start and the date of birth within the year of regular school-start. These considerations suggest using adjusted measures of cognitive and non-cognitive variables in the analysis as well as including controls for the

[24] One possible explanation for the (on average) higher estimate of the US studies is that the individuals in those studies are somewhat older than the individuals considered in the present study. Another explanation is that earnings differentials in general are more equalised in the Swedish labour market.

individual's human capital. Of these, the latter constitutes a considerable departure from the original (simple) pre-market factor approach.

When using this extended pre-market factor approach the results are in general changed considerably with respect to magnitudes. In particular, the estimate of the adjusted relative self-esteem measure is more than halved compared to the estimate of the unadjusted measure. This means that the unadjusted measure of relative self-esteem used in this study includes parts that may be attributed to the individual's cognitive ability. When, next, human capital controls are introduced the magnitude of the estimate of the IQ-variable is reduced by nearly half while the estimate of relative esteem is lowered by an additional third. Hence, ability measured in childhood does not completely reflect the ability when grown-up the latter is also dependent on the individual's human capital accumulation. This means that not controlling for human capital will exaggerate the impact of self-esteem as an incentive-enhancer on earnings.

We also find some evidence on significant interactions between cognitive and non-cognitive ability implying that intelligence and relative self-esteem in general are complements whereas, for females, IQ and absolute self-esteem are substitutes.

This paper also reports evidence that the returns to cognitive and non-cognitive ability vary over the earnings distribution. When using the simple pre-market factor approach the estimates indicate that the returns in general are considerably larger at high earnings levels than at low earnings levels, i.e. differences in cognitive and non-cognitive ability explain earnings- and wage dispersion to a larger extent at high earnings levels than at low earnings levels. When applying the extended pre-market factor approach the pattern is changed and the overall conclusion is rather that the differences in return to both cognitive and non-cognitive abilities tend to be completely equalised over the earnings distribution. This result is especially marked when human capital controls are introduced, which again highlights the importance of the measurement error arising because ability measured during childhood does not completely reflect the adult's ability.

Contrary to the previous literature the present study has involved separate analyses for males and females. Comparisons by gender have revealed by and large nearly identical findings for females and males. The over all conclusions are therefore that there is hardly any significant gender differences with respect to the returns to cognitive ability and non-cognitive ability.

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Appendix

Table A1 Estimation results from unadjusted measures, males and females. Dependent variable: 2001 log real earnings.

	Males				Females			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IQ	.100**		.083**	.081**	.111**		.086**	.086**
	(.012)		(.014)	(.014)	(.013)		(.014)	(.014)
Absesteem		.027**	.024*	.029**		.021	.024*	.019
		(.013)	(.013)	(.013)		(.014)	(.014)	(.014)
Relesteem		.065**	.029**	.036**		.086**	.048**	.049**
		(.013)	(.014)	(.015)		(.014)	(.015)	(.015)
IQ*Absesteem				.010				-.016
				(.014)				(.014)
IQ*Relesteem				.018				.033**
				(.013)				(.014)
Absesteem				.006				-.022
*Relesteem				(.013)				(.017)
Constants	12.11	12.11	12.11	12.10	11.74	11.74	11.74	11.73
	(.012)	(.012)	(.012)	(.013)	(.013)	(.013)	(.013)	(.014)
F-value	65.7	21.6	27.1	14.0	77.7	24.8	30.5	19.6
R^2	.021	.013	.024	.025	.023	.018	.029	.032

Notes: * and ** denote statistical significance at 10 %-level and 5%-level, respectively. The number of observations is 3402 for males and 3277 for females. For notations, see *Table 2.*

Table A2 Estimations of determinants of IQ, absolute and relative self-esteem.

	Males			Females		
Dep. variable	IQ	Absesteem	Relesteem	IQ	Absesteem	Relesteem
Age	-.919**	-.019	-.055	-.967**	-.259**	-.357**
	(.080)	(.089)	(.088)	(.113)	(.096)	(.106)
Bornq	-.032**	-.007	-.038**	-.058**	-.025	-.030**
	(.015)	(.015)	(.014)	(.016)	(.016)	(.015)
IQ		.173**	.420**		.136**	.413**
		(.017)	(.017)		(.018)	(.017)
Permanent		3.45**	4.24**		2.42**	3.07**
family income		(1.10)	(1.02)		(1.10)	(1.01)
Constants	31.34	-.754	1.86	33.02	8.80	12.12
	(2.70)	(3.02)	(3.00)	(3.83)	(3.24)	(3.59)
F-value	73.4	32.5	196.9	48.8	24.9	166.1
R^2	.039	.035	.195	.033	.027	.195

Notes: * and ** denote statistical significance at 10 %-level and 5%-level, respectively. The age of the individuals (Age) in the sample is in the range of 33–36 years. Bornq denotes the quarter of birth of the individual and the variable takes the values of 1(early birth date) to 4 (late birth date). Permanent family income is the average parental income of the individual during the period 1987–1998. The number of observations is 3400 for males and 3272 for females. For notations, see *Table 2.*

Table A3 Estimation results, quantile regressions, males and females. Dependent variable: 2001 log real earnings.

	Males			Females		
	(1)	(2)	(3)	(4)	(5)	(6)
Q25						
IQ	.060**	.031**	.072**	.053**	.046**	.055
	(.009)	(.009)	(.011)	(.016)	(.017)	(.039)
Absesteem	.015*	.012*	.017	.010	.020	.010
	(.009)	(.007)	(.013)	(.015)	(.013)	(.037)
Relesteem	.017*	.024**	.022	.019	.009	.044
	(.010)	(.010)	(.014)	(.017)	(.016)	(.043)
Q50						
IQ	.063**	.031**	.067**	.064**	.046**	.063**
	(.008)	(.006)	(.010)	(.007)	(.008)	(.010)
Absesteem	.009	.003	.010	.009	.010	.006
	(.008)	(.006)	(.009)	(.007)	(.007)	(.008)
Relesteem	.028**	.022**	.027**	.034**	.015	.030**
	(.007)	(.007)	(.010)	(.011)	(.011)	(.011)
Q75						
IQ	.093**	.050**	.096**	.081**	.056**	.076**
	(.009)	(.008)	(.008)	(.007)	(.009)	(.010)
Absesteem	.007	-.002	.006	.002	.004	.006
	(.009)	(.007)	(.008)	(.007)	(.008)	(.008)
Relesteem	.046**	.032**	.044**	.045**	.028**	.039**
	(.008)	(.008)	(.008)	(.006)	(.007)	(.007)
Controls	no	yes	no	no	yes	no
Pseudo-R^2						
Q25	.014	.096	.004	.006	.058	.001
Q50	.026	.091	.008	.018	.057	.004
Q75	.054	.114	.024	.043	.081	.012

Notes: The numbers in parentheses are bootstrap standard errors. ** and * denote statistical significance at 5%-level and 10%-level, respectively. The estimates of the constants are not reported. Controls include schooling and experience. Columns (3) and (6) report estimates for the whole sample including individuals with zero-incomes (n=3606 for males and n=3660 for females) and they show a quite similar pattern as for the sample including individuals with positive incomes (columns (1) and (4). However, since the standard errors of the estimates at the twenty-fifth percentile are relatively large, in particular for females, there are just a few of the differences that are statistically significant across different income levels.

Table A4 Estimates of complementarities across cognitive and non-cognitive ability, quantile regressions, males and females. Dependent variable: 2001 log real earnings.

	Males		Females	
	(1)	(2)	(3)	(4)
Q25				
IQ*Absesteem	-.004	-.002	-.053**	-.048**
	(.051)	(.008)	(.016)	(.015)
IQ*Relesteem	.002	.016**	.024	.028**
	(.012)	(.008)	(.013)	(.013)
Absesteem* Relesteem	-.002	.010	.002	-001
	(.029)	(.009)	(.016)	(.015)
Q50				
IQ*Absesteem	-.004	.006	-.011	-.010
	(.008)	(.007)	(.010)	(.018)
IQ*Relesteem	.023**	.015**	.028**	.025*
	(.008)	(.006)	(.010)	(.014)
Absesteem* Relesteem	.012	-.001	.001	.001
	(.008)	(.005)	(.010)	(.012)
Q75				
IQ*Absesteem	.010	-.004	-.007	-.003
	(.009)	(.008)	(.007)	(.008)
IQ*Relesteem	.016**	.025**	.030**	.020**
	(.007)	(.009)	(.006)	(.006)
Absesteem* Relesteem	.006	.012	-.001	-.005
	(.010)	(.008)	(.008)	(.007)
Controls	no	yes	no	yes
Pseudo-R^2				
Q25	.014	.097	.008	.060
Q50	.028	.093	.020	.058
Q75	.056	.117	.046	.083

Notes: The numbers in parentheses are bootstrap standard errors. ** and * denote statistical significance at 5%-level and 10%-level, respectively. The number of observations is 3402 for males and 3277 for females. Controls include schooling and experience. For notations, see *Table 2.*

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