

SGH WARSAW SCHOOL OF ECONOMICS

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Cognitive and non-cognitive skills in the labour market

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1. Introduction

The understanding of the determinants of economic success and well-being of individuals is one of the most important goals of labour economics and economics in general. Human capital plays a central role in all analyses of differences in life outcomes. The standard measures of human capital are educational attainment and work experience but they are incomplete proxy of individual skills. The large impact of cognitive skills on economic and social outcomes has long been recognised (Herrnstein & Murray, 1994; Leuven et al., 2004; Murnane et al., 1995). As evidence grows that also non-cognitive skills are important predictors of life outcomes, economists became increasingly interested in incorporating non-cognitive skills into the economic analysis of individual outcomes (Almlund et al., 2011; Borghans et al., 2008). These new results on the role of different types of skills also drew my research attention.

Although it is difficult to draw a sharp line between cognitive and non-cognitive skills (Almlund et al., 2011), the term “non-cognitive skills” is used by economists for a wide range of personal qualities, which are believed to be distinct from skills measured by IQ tests and achievement tests, such as personality traits, motivation or interests. Some psychologists disapprove of the term “non-cognitive” as it implies that there are aspects of mental functioning devoid of cognition while in fact all are based on some kind of information processing and cognition (Duckworth & Yeager, 2015). Therefore, alternative terms have emerged, including soft skills, socio-emotional skills and character skills, but none became so familiar and widely accepted as non-cognitive skills. In this thesis, I use the term non-cognitive skills interchangeably with personality traits. The measures of non-cognitive skills used throughout all the articles in this thesis are two personality scales: grit and the Big Five personality inventory referred to by Kautz et al. (2014, p. 9) as “the longitude and latitude of non-cognitive skills, by which all more narrowly defined skills may be categorized”.

2. Theoretical and empirical background

Many aspects of choice behaviour are studied in neoclassical economic models, behavioural economics, and psychology; thus, there are attempts to relate economic preferences and personality traits. Earlier results suggested that both concepts predict important life outcomes but they are only weakly related (Becker et al., 2012). Recently, evidence is growing that economic preferences and psychological concepts of personality overlap substantially where standard economic preference parameters are mostly associated with non-cognitive skills while the quality of decisions made is related to cognitive skills (Heckman et al., 2019). Further research on a wide range of preferences and skills could lead to a unified set of determinants of human behaviour.

In the analysis of wage determination the dominant framework is the human capital model (Becker, 1964) where human capital consists of skills that contribute to production. Non-cognitive skills may enhance worker’s productivity and act as traditional measures of human capital such as years of

schooling or experience. They can also stand in for compensating wage differentials (Blau & Kahn, 2017). Behavioural models offer a framework for considering the relationship between non-cognitive skills and wages beyond the productivity factors (Bowles et al., 2001). First, they assume that employers value incentive-enhancing preferences of workers which allow to lower the costs of labour contract enforcement. Second, they stress that some non-cognitive skills facilitate benefiting from labour market disequilibria e.g. by decisions to migrate in case of spatial disequilibria or by enhancing job search effort.

At the same time, the recent economic literature has suggested that cognitive skills and selected non-cognitive skills, particularly social skills, are complements (Deming, 2017; Weinberger, 2014). Complementarity is understood here as an additional premium for having high levels of both types of skills at the same time. Deming (2017) developed a team production model in which workers are assumed to exploit their comparative advantage by "trading tasks". According to this model, workers with high social skill levels have lower coordination costs when trading tasks, and are able to work with others more efficiently because they can specialise in their most productive tasks. There are also reasons to expect complementarity of emotional stability and cognitive skills. Bénabou & Tirole's (2002) work on motivation assumes that ability and effort are complements. As individuals have imperfect knowledge of their own abilities, higher levels of self-confidence may be expected to lead to higher levels of motivation and effort. Accordingly, the less self-confident an individual is, the lower his or her level of effort is expected to be; and, thus, the lower his or her use of skills and returns to cognitive skills are likely to be.

Non-cognitive skills are rarely investigated in the context of the overeducation phenomenon. Overeducation arises when qualifications of a worker are higher than qualifications required by his or her job. It might have serious consequences both for individuals and the society. The literature provides consistent evidence that overeducation is associated with wage penalties (Caroleo & Pastore, 2018; Rubb, 2003) and job dissatisfaction (Green & Zhu, 2010; Verhaest & Omey, 2006). Non-cognitive skills influence the probability of becoming overeducated (Blázquez & Budría, 2012). The mechanism behind this relationship can be potentially explained by an extended job search model (Caliendo et al., 2015). Unlike standard job search models in which unemployed individuals have perfect information about the payoffs of their search effort, it assumes that each individual has a subjective belief about the payoffs to job search which depends on individual non-cognitive skills. Empirical evidence supports the predictions of the model that the number of job applications and the reservation wage depend on non-cognitive skills (Caliendo et al., 2015; McGee, 2015). These results suggest that workers with certain non-cognitive skills have wider choice of job offers and that they might accept positions with requirements below their qualifications less often. If the skills related to the probability of being overeducated are also productivity enhancing, accounting for the heterogeneity of skills among workers with the same level of education would partially explain overeducation wage penalty.

3. Aim and research questions

Although this literature is continuously growing, there are still many gaps in knowledge to be addressed and this thesis aims at contributing to filling them. First, the empirical importance of non-cognitive skills compared to cognitive skills for a wide range of policy-relevant outcomes still needs to be established. Second, our understanding of the complementarities between cognitive and non-cognitive skills in the wage determination process is limited to one type of non-cognitive skills: social skills. Third, the mechanisms behind the overeducation wage penalty have not yet been fully understood and the role of skills heterogeneity not fully investigated. Finally, to the best of my knowledge there are no studies investigating the role of non-cognitive skills in the Polish labour market.

To sum up, cognitive and non-cognitive skills are an increasingly important area of research of labour and education economics, with many questions unanswered. It is the aim of this thesis which consists of a collection of three articles to contribute to this new research strand. In particular, the main objective is to verify the hypothesis that non-cognitive skills are a significant determinant of important life outcomes, with a focus on wages. To this end, this thesis answers three research questions in three separate chapters:

RQ1: Do non-cognitive skills explain the variation in selected life outcomes additionally to traditional measures of human capital such as educational attainment, work experience and cognitive skills?

RQ2: Is there complementarity of cognitive and non-cognitive skills with respect to wage premia?

RQ3: Do the differences in cognitive and non-cognitive skills among workers with the same level of education explain the overeducation wage penalty?

4. Data and methods

4.1. Data

All the papers collected in this thesis use microdata from the Polish Follow-up Study to the Programme for International Assessment of Adult Competencies (postPIAAC). This is a survey, representative of the Polish working-age population, with well-established measures of cognitive and non-cognitive skills. This dataset combines information for Poland from the international PIAAC study coordinated by OECD and conducted in 2011-2012 with the country follow-up conducted by the Educational Research Institute in 2014-2015. The main goal of postPIAAC was to collect additional background information on PIAAC respondents in Poland not available in the international study. The sample of postPIAAC are PIAAC respondents who live in Poland during the fieldwork of postPIAAC. The unique feature of the PIAAC dataset is that it includes direct measures of cognitive skills: literacy, numeracy and problem solving in technology-rich environments. The postPIAAC study contains self-report scales

of personality: Big Five Inventory - Short (BFI-S) (Gerlitz & Schupp, 2005; John et al., 1991) and the short Grit scale (Grit-S) (Duckworth & Quinn, 2009).

4.2. Psychological scales

The Big Five model originated from the lexical approach which assumes that personality characteristics are encoded in language. Personality psychologists working on the analysis of personality-describing adjectives gathered from dictionaries, concluded that personality traits can be organised into a five-factor structure (Almlund et al., 2011). The Big Five which is the most widely accepted taxonomy distinguishes the following dimensions: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (the opposite of emotional stability) (McCrae & Costa Jr, 1999). Conscientious individuals tend to be organised, responsible, and hardworking. Neuroticism is characterised by emotional instability, vulnerability to stress, and a lack of self-confidence. Neuroticism is strongly correlated with other psychological constructs: locus of control, self-esteem, and generalised self-efficacy (Judge et al., 2002). Agreeableness is defined as the tendency to act in a cooperative, unselfish manner while open individuals are typically curious, imaginative, and have a wide range of interests. Extraversion is defined as the tendency to orient one's interests and energies towards the outer world of people and things, and is characterised by having a positive affect and high levels of sociability.

Although the Big Five taxonomy is probably the most widely used personality framework, new research on personality traits is emerging nowadays. The trait termed "grit" deserves special attention, as a relatively new construct that quickly attracted attention of researchers and policy makers. Grit is defined as perseverance and a passion for pursuing long-term goals (Duckworth et al., 2007). Grit is not part of the Big Five framework, but grit and conscientiousness correlate strongly (e.g. Duckworth & Quinn, 2009; Ivcevic & Brackett, 2014).

4.3. Methods

The relationships between non-cognitive skills and life outcomes are analysed using linear regression as comparability over models is very important for the purposes of this study. First, this approach allows us to compare the effect estimates between analyses of different outcomes. Second, it overcomes the problem of incomparable coefficients in models with different independent variables (Mood, 2010). Sensitivity analyses using non-linear models when appropriate are performed and the results are qualitatively similar to the linear models in terms of the sign and the significance of the relationship between non-cognitive skills and life outcomes. To assess the incremental validity of grit after controlling for the Big Five we compare nested specifications checking whether grit explains incremental variance and whether the relationship of the Big Five traits with the outcomes changes after adjusting for grit.

The analysis of complementarity between cognitive and non-cognitive skills uses OLS estimation as there is no evidence of a sample selection problem in estimating the wage equation for women or for men when estimating Heckman's selection model.

In order to examine the role of cognitive and non-cognitive skills in the overeducation wage penalty, the last analysis compares the estimates from two specifications: without and with these characteristics. A modification of Mincerian wage equation with a dummy for overeducation is estimated. In terms of methodological approach, I use propensity score matching (PSM) methods where being overeducated is considered the treatment.

The analyses are not without limitations. The data did not allow to rule out endogeneity concerns as the non-cognitive skills and life outcomes measures are contemporaneous. Yet, it can inspire potential further studies using better data and more advanced methods to establish pure causal effects. Moreover, the evidence gathered on the stability of personality traits over time (Cobb-Clark & Schurer, 2012) and on very limited or temporary impact of a major work-related life event such as an involuntary job loss on personality (Anger et al., 2017; Preuss & Hennecke, 2018) gives reasons to expect the observed relationships with wages to be causal.

5. Results

The articles collected in this thesis investigate different aspects of the role of cognitive and non-cognitive skills in predicting micro-economic behaviour. Overall, the conducted studies warrant a conclusion that cognitive and non-cognitive skills explain individual differences in many life outcomes. The effects of skills are also observed when traditional measures of human capital, such as educational attainment and work experience, are taken into account. Below I summarise and discuss the answers to the three research questions.

5.1. Personality, cognitive skills and life outcomes

The article presented as the second chapter of the thesis investigates the relationships between cognitive skills, personality traits and eight life outcomes: educational attainment, labour market participation, employability, wages, job satisfaction, health, trust and life satisfaction. After controlling for sociodemographic characteristics and cognitive skills, Big Five traits are incrementally predictive of all life outcomes except for employability.

Big Five traits explain differences in subjective outcomes such as health, life satisfaction or trust better than cognitive skills while for educational attainment or wages the relationships are comparable or smaller, but non-negligible, for non-cognitive skills. Only educational attainment is more strongly related to cognitive skills, while for wages, the explanatory power of personality and cognitive skills is similar.

The effects of particular traits are largely in agreement with the results of previous studies conducted mostly in the United States and Western Europe. Conscientiousness is positively related to most of the outcomes analysed while Neuroticism has a negative relationship. Extraverted individuals are less likely to attain higher levels of education. They are also more satisfied with their life and job and feel healthier. Agreeableness is associated with lower levels of education and negative labour market outcomes. Openness is strongly and positively related to educational attainment. In contrast to previous studies (e.g. Mueller & Plug, 2006; Rammstedt et al., 2017) we do not find relationship between openness and wages.

This article also compares criterion validity of Big Five and grit: the extent to which these measures are related to the outcomes and incremental validity of grit: whether this new scale explains the outcomes of interest beyond what Big Five does. Although literature suggests that grit and conscientiousness are conceptually similar (e.g. Credé et al., 2017), their relationships with outcomes differ. In contrast to conscientiousness, grit is unrelated to labour market outcomes but explains additional variation in educational attainment and trust. Grit explains some additional variation in educational attainment and in a number of subjective outcomes: health, trust, job and life satisfaction, even after adjusting for the effects of cognitive skills and Big Five traits.

5.2. The complementarity of cognitive and non-cognitive skills

Non-cognitive skills play significant role in wage determination, not only as separate factors that influence wages, but also as complements to cognitive skills. The analysis presented as the third chapter of the thesis shows that the more neurotic an individual is, the lower his or her returns to cognitive skills. A possible theoretical explanation for this finding is that neurotic individuals tend to underestimate their abilities, as neuroticism is related to lower self-esteem; and that they expend less effort, which results in lower returns to cognitive skills. An alternative or complementary proposed mechanism predicts that neurotic individuals engage in less competitive tasks (Müller & Schwieren, 2012), which also yield lower returns to cognitive skills. This sorting into less competitive tasks can take place within occupations as well.

The other Big Five traits and grit were not found to be complementary to cognitive skills. In particular, social skills were not shown to be complementary to cognitive skills in Poland, unlike the earlier results in the United States (Deming, 2017; Weinberger, 2014). This result is robust to the measure of social skills used: i.e., to either the extraversion subscale of the Big Five model or an indicator based on job tasks. This discrepancy might be explained either by the differences in the measures of social skills available in the studies or by the difference in the relationship. The relationship might differ between these countries, because of the lower level of technology adoption in Poland (Eden & Gaggl, 2020), as technological change has been driving the increased demand and rewards for social skills that are difficult to automate (Deming, 2017).

5.3. The role of cognitive skills and personality traits in overeducation

The omitted variable bias is one of the main challenges when estimating the overeducation wage penalty (Leuven & Oosterbeek, 2011). However, omitted variables are important as long as we can name potential candidates. Workers with a given level of education can have different skills and abilities, additional training and different work trajectories (Meroni & Vera-Toscano, 2017).

The analysis presented as the fourth chapter of the thesis shows that accounting for cognitive and non-cognitive skills does not change the size and the statistical significance of overeducation wage penalty estimates. Non-cognitive skills are one of the contributors to the risk of being overeducated among workers aged 18 to 29 but not among people aged 30 to 68. Conscientiousness decreases the risk of being overeducated while agreeableness is associated with higher risk of overeducation. The other personality traits are not related to the risk of overeducation. Moreover, lower cognitive skills are associated with the probability of being overeducated and this result is mainly driven by workers aged 30 to 68 years. The differences in the analysed skills between overeducated and well-matched workers seem, however, too limited to account for a substantial part of the overeducation wage penalty. It can be also the case that these skills are related to overeducation in occupations or industries where wages are rigid and not related to cognitive and non-cognitive skills.

Moreover, the analysis shows heterogeneity of the overeducation wage penalty among educational groups: overeducated workers with tertiary education experience higher wage penalty than overeducated workers with secondary education. Similar results were obtained for skills mismatch in Poland by Liwiński & Pastore (2019) who showed that quality of skills-job match is related to wages of tertiary graduates but not to wages of graduates from secondary education. This is potentially related to the differences in education premium between these levels of education. The differences in wages are bigger between workers with tertiary and secondary education than between workers with secondary and lower than secondary education (Strawiński et al., 2018).

6. Contribution to economic and psychological literature

The investigation of life-relevant skills and human differences that affect choices is of interest to both economics and psychology. The economic literature that studies the role of non-cognitive skills can be divided into three main branches: studies that establish empirical importance of non-cognitive skills, research on skills measurement and incorporating psychological constructs into economic models, and evaluations of interventions aiming at fostering non-cognitive skills. This literature is continuously growing, and this thesis fills some of the important gaps mainly in the first branch of this literature. It also offers implications for the other strands of literature on non-cognitive skills. Moreover, my results contribute also to the psychological literature on the measurement properties of psychological scales.

While the importance of cognitive skills for labour market outcomes is already established among economists, the research on non-cognitive skills is far from concluded. The first contribution of this thesis is showing the importance of non-cognitive skills for explaining the variability in a wide range of policy-relevant outcomes compared to well-established measures of cognitive skills used in large-scale international surveys. This result combined with relatively small burden on respondents in terms of required time may contribute to incorporating measures of personality traits into international competence surveys. Gathering reliable data on both cognitive and non-cognitive skills in an international context would open new avenues for research e.g. in analyses of economic growth.

Second, the thesis contributes also to knowledge on the complementarities between cognitive and non-cognitive skills in the wage determination process. It extends the few existing studies that have investigated the complementarities between social and cognitive skills, adding evidence on other non-cognitive skills. It finds that emotional stability and cognitive skills are complementary: i.e., neurotic individuals have lower wage returns to cognitive skills than their less neurotic counterparts. These results suggest that to obtain unbiased estimates of the returns to cognitive skills, it is necessary to account for non-cognitive skills. In the context of policy interventions, these results therefore suggest that efforts to foster cognitive skills may not bring about the expected results if individuals lack some crucial non-cognitive skills.

The mechanisms behind the overeducation wage penalty have not yet been fully understood. Numerous studies in labour economics and economics of education focused on estimating the incidence of overeducation and the wage penalty connected with it but few studies looked at the differences in cognitive and non-cognitive skills. The omitted variable bias is still identified as one of the main challenges of the literature aiming at estimating the overeducation wage penalty (Leuven and Oosterbeek, 2011). The third contribution of this thesis is ruling out cognitive and non-cognitive skills, which are usually unobserved, as a source of potential bias. The results show that the differences in cognitive and non-cognitive skills among overeducated and well-matched workers with the same level of education do not explain the overeducation wage penalty. It is rather matching inefficiencies which account for the overeducation.

Fourth, the thesis also offers some methodological contributions on personality scales properties. It complements few studies that have examined the incremental validity of grit (e.g. Duckworth & Quinn, 2009; Eskreis-Winkler et al., 2014; Suzuki et al., 2015) and extends it across more life domains. It also shows that the relationships with outcomes differ between grit and conscientiousness. These results suggest that the emerging view of grit as a facet of conscientiousness (Credé et al., 2017) is rather premature. However, when a broad range of life outcomes is of interest, using the Big Five model seems preferable to using grit as the former covers multiple aspects of personality.

Finally, to the best of my knowledge it is the first comprehensive analysis of the role of non-cognitive skills in the Polish context. Both economic characteristics, such as institutional setting and occupational structure, and culture, may influence personality-outcome relationships. Therefore, It is

important to investigate these relationships in countries with diverse economic and cultural contexts. To date the topic was not widely investigated in Central and Eastern Europe. Using data representative for the Polish working-age population is the additional strength of the analyses.

7. Conclusions

Although the papers collected in this thesis tackle quite different aspects of the role of non-cognitive skills in explaining life outcomes, they jointly show that these skills are important drivers of decisions in economic models. It is important to note that the nature of personality traits differs from that of cognitive skills. First, dominant theories of personality incorporate more than one factor unlike a general intelligence factor “g” for cognitive ability. Second, “more” does not necessarily mean “better” in case of personality traits. Some of them are beneficial in some specific work environments but not in others. From the policy-making perspective, the decision which traits to foster may therefore be a difficult one. These attributes of non-cognitive skills suggest that one should not expect one general answer about their place in economic theory. Some of them emerge as additional dimensions of human capital supplementing the human capital theory while others are closer to the concept of economic preferences.

I believe that sufficient evidence has been accumulated that non-cognitive skills are important determinants of micro-economic behaviour and relying solely on traditional measures of human capital or economic preferences offers too simplified conclusions. The recent transformations in the labour market driven by, among others, technological change and transition to a greener economy make the research on different types of skills even more important. Thus, despite methodological and conceptual challenges, advances toward incorporating such factors as personality in economic models will be more common in the future.

This implies that more research exploring the interrelations of economics with psychology is needed. Future studies could therefore concentrate on investigating the causal mechanisms between non-cognitive skills and life outcomes. As there is only very limited evidence on the role of productivity, self-selection into occupations and tasks, and engagement in training, more research on these topics – including research that uses experimental methods – would be desirable to identify the mechanisms that underlie the observed relationships. With a deeper knowledge about these mechanisms it would be possible to identify skills desirable in many contexts and, ultimately, to design scalable interventions which foster these skills in a long-lasting way. It would be very important contribution of the literature investigating non-cognitive skills to public policy. Also availability of more longitudinal data, covering extended periods of time with frequent skills assessments, would contribute to establishing causal relationships. As the degree of malleability of non-cognitive skills is still an open question, longitudinal data would also enhance the research on non-cognitive skills development over the lifecourse.

Articles constituting the doctoral thesis:

1. Palczyńska, M., Świst, K. (2018). Personality, cognitive skills and life outcomes: evidence from the Polish follow-up study to PIAAC. *Large-scale Assessments in Education*, 6(2), <https://doi.org/10.1186/s40536-018-0056-z>
2. Palczyńska, M. (2021). Wage premia for skills: the complementarity of cognitive and non-cognitive skills. *International Journal of Manpower*, 42(4), 556-580. <https://doi.org/10.1108/IJM-08-2019-0379>
3. Palczyńska, M. (2021). Overeducation and wages: the role of cognitive skills and personality traits. *Baltic Journal of Economics*, 21(1), 85-111. <https://doi.org/10.1080/1406099X.2021.1950388>

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