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Psychological traits and wages in the Czech Republic*

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Abstract

Psychological traits have received significant attention in labour market research in recent decades. Unfortunately, empirical evidence remains limited for some psychological traits and their interactions. To address this gap, we conduct a representative survey of employees, assessing competitiveness, persistence, and risk tolerance using single-item scales. This comprehensive study sheds light on the connection between these traits and wages. Our results confirm that individuals possessing these traits tend to earn higher wages, even when we account for indirect factors, such as higher educational attainment and better job positions. It also suggests that competitiveness and risk tolerance are particularly valuable for individuals with middle and high incomes, while persistence is valuable for those with low and middle incomes. These findings support the systematic development of competitiveness, persistence, and risk tolerance through education and sporting activities.

Keywords: competitiveness, persistence, risk tolerance, wage, psychological traits

JEL Codes: J24, J31, J71, C21, C26

1. Introduction

Psychological traits, preferences, and motivation, often referred to as "non-cognitive skills" (Heckman et al., 2006), represent an important determinant of worker productivity and labour market success. As their measurement is far from straightforward, as Heckman and Rubinstein

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(2001) noted, many empirical studies employ similar measurement tools such as the Big Five personality test (e.g., Laible and Brenzel, 2021; Collischon, 2020; Lee and Ohtake, 2018; Maczulskij and Viinikainen, 2018), Rotter's locus of control scale (e.g., Bühler et al., 2020; Cobb-Clark, 2015; Girtz, 2015), or Rosenberg's self-esteem scale (e.g., Beck, 2021; Botea et al., 2021; DeBeaumont and Girtz, 2020). This makes it possible to provide robust evidence on several psychological traits but inevitably leads to an understudying of a number of other, usually more work-oriented psychological traits. Among these qualities, employers value competitiveness, persistence, and risk tolerance the most often.

Previous empirical studies, although limited in number, examining the impact of competitiveness, persistence, and risk tolerance on productivity and other labour market outcomes consistently demonstrate their positive relationships. For instance, Collischon (2020) and Braakmann (2009) have both revealed a positive correlation between risk tolerance and wages in Germany. Several studies have emphasized the significance of competitiveness for employee performance, measured not only by wages (Karatepe et al., 2006; Karatepe and Olugbade, 2009; Schrock et al., 2014). Díaz et al. (2013), Feng and Papi (2020), and Buechel et al. (2018) have concentrated on persistence and have found a positive relationship between this personality trait and the performance of students and employees. It is worth noting that, with the exception of Collischon (2020), Braakmann (2009), and Feng and Papi (2020), who employed representative samples of employees in Germany or Peru, all the other articles have analysed specific samples of workers or university students. Furthermore, to the best of our knowledge, no study has explored these psychological traits in relation to wages in the Czech Republic.

To address this gap in the literature, our article aims to provide detailed evidence on the link between individual productivity, approximated by wage level and psychological traits such as competitiveness, persistence and risk tolerance. For this purpose, it employs data on 1,978 prime working-age employees in the Czech Republic.

The research design and data used in this article provide it with several advantageous features. Firstly, the focus on competitiveness, persistence, and risk tolerance seeks to address the insufficient attention paid to these traits in recent empirical literature, despite their close relationship to the diligence, efficiency, and achievement orientation required by employers in job applicants and employees (see Balcar et al., 2014). Secondly, measuring various psychological traits in one dataset makes it possible to explore the synergy effects of their interaction with each other, as well as with cognitive skills. Thirdly, this article contributes to the limited empirical research into the relationship between wages and psychological traits in the Czech Republic, making it a solid foundation for comparing our results with findings of other studies.

Our results suggest that competitiveness, persistence, and risk tolerance are significantly associated with higher wages, even when controlling for their effect on educational attainment and job selection. However, this effect is not uniform across the labour market, as competitiveness and risk tolerance are more highly rewarded in high- and middle-income jobs, while persistence is positively correlated with wages in low- and middle-income jobs. The investigation of synergistic effects suggests that individuals who are both more competitive and persistent may earn higher wages due to the combination of these traits. The synergy of persistence and, to some extent, competitiveness with attained education is also confirmed. Since it appears that competitiveness, persistence and risk tolerance are correlated with higher productivity and wages, their development through education, sports or other activities should be encouraged and supported.

2. Empirical Literature Review

Wage determinants have been studied systematically since the early 1970s, when Mincer (1974) expressed the relationship between human capital, approximated by education and age/potential work experience, and wages. His equation served as a methodological basis for researching wage determinants. Gradually, more variables were added to the model to investigate the influence of other wage determinants, such as personal characteristics (gender, marital status, number of children), labour status (occupation, working hours and type of job contract), employer characteristics (firm size, private and non-private sectors, industries) and institutional and regional factors (minimum wage, legal protection of employment, unions, and region). Although these wage determinants were able to encompass many objective factors affecting wages, a significant portion of wage differences remained unexplained. Therefore, over the last two decades, psychological and sociopsychological factors have increasingly been considered as possible explanations for labour outcomes.

Unfortunately, measuring personality and psychological traits is far from straightforward, as noted by Heckman and Rubinstein (2001). Psychological traits are most commonly assessed using personality inventories (e.g., the Big Five personality test), low-dimensional scores (e.g., Rotter's locus of control scale, Rosenberg's self-esteem), or single-item scales (e.g., Nichols and Webster, 2013; Nagy, 2002; Robins et al., 2001). The limited number of valid and reliable measurement tools adversely affects the diversity of traits examined in empirical literature. As a result, we have substantial knowledge of the effects of the Big Five personality traits – extraversion, agreeableness, openness, conscientiousness, and neuroticism (e.g., Nyhus and Pons, 2005; Salgado, 1997; Barrick and Mount, 1991) – as well as locus of control and self-esteem (e.g., Feinstein, 2000; Goldsmith et al., 1997, 1998 and 2000) on productivity, wages, unem-

ployment, and other labour market categories. However, research focus on other psychological traits, such as competitiveness, persistence, and risk tolerance – traits often sought by employers in job applicants and employees – is less common.

Willingness to take risks has been found to be associated with various benefits on the labour market. For example, Collischon (2020) discovered that a one-standard-deviation increase in willingness to take risks is linked to a 0.8% higher probability of earning higher wages and a 1.5% higher probability of full-time employment in Germany. Braakmann (2009) confirmed the positive effects of risk tolerance on employment in Germany for women, showing a 3.8% higher probability of full-time employment associated with a one-standard-deviation increase in risk tolerance. However, he found no statistically significant wage benefits from this psychological trait for either women or men at the 0.05 significance level. Di Mauro and Musumeci (2011) demonstrated that individuals with higher risk tolerance tend to self-select into jobs with more variable wages, such as those involving sales bonuses, while more risk-averse individuals prefer jobs with fixed wages. Farlie and Holleran (2012) provided evidence that more risk-tolerant individuals are more likely to participate in entrepreneurship training and derive greater benefits from it compared to their risk-averse counterparts.

Recent studies have increasingly focused on the impact of competitiveness and persistence on labour outcomes. Karatepe et al. (2006) demonstrated that the competitiveness of front-line hotel employees in Northern Cyprus significantly predicts their performance. A subsequent study conducted in Nigeria (Karatepe and Olugbade, 2009) provided evidence that competitiveness enhances commitment, absorption in work, and enthusiasm among front-line hotel employees. More competitive employees tend to be more energetic and fully engaged in their work. Furthermore, Schrock et al. (2014) conducted an assessment of the direct and interactive effects of competitiveness and the competitive environment on sales performance and organizational commitment. Their findings indicate that this personality trait positively influences sales performance, particularly in highly competitive environments.

Díaz et al. (2013) focused on persistence and found that an increase in persistence by one standard deviation is associated with a 15% wage premium on the Peruvian labour market, but only for educated individuals or those with developed cognitive skills. However, it is also possible to observe an indirect effect of persistence on labour market success through education. Feng and Papi (2020) provided evidence that more persistent students tend to set long-term goals, are more motivated to study hard and achieve better academic results. Similarly to competitiveness, persistence is also significantly influenced by the working environment. For instance, Buechel et al. (2018) conducted an experiment revealing the positive impact of peers who discuss their successes with motivation on persistence. The work environment can have a similar effect, al-

lowing employees to observe each other's work performance (Gerhards and Gravert, 2020). This suggests that more competitive individuals may also exhibit greater levels of persistence.

It is worth noting that Bertrand (2010) conducted a comprehensive review of experiments investigating the role of psychological attributes in the gender wage gap. The review included in-depth examinations of risk-taking, competition and attitudes towards negotiation. Bertrand's findings indicate that women tend to be more risk-averse (Jung et al., 2018) and less competitive than men, as supported by multiple studies (Gneezy et al., 2003; Datta Gupta et al., 2005; Dohmen and Falk, 2006; Niederle and Vesterlund, 2007; Booth, 2009; Carpenter et al., 2018). These psychological differences may help explain a portion of the gender wage gap.

As this review suggests, there is limited knowledge regarding the effects of competitiveness, persistence, and risk tolerance on wages. Based on the studies above, we can anticipate a positive correlation between each of these psychological traits and wages. Nevertheless, numerous questions remain unanswered. Are these traits significant when considered separately, or is a combination of them necessary? Do their wage effects remain consistent across the entire labour market, or do they vary across different market segments? "These questions will be addressed in the following paragraphs."

3. Empirical Strategy

3.1 Data

The estimation of the relationship between competitiveness, persistence, risk tolerance, and wage is based on individual data from a tailor-made survey of 1,978 employees aged 25 to 54 years in the Czech Republic. We focused on individuals aged 25–54 to capture the prime working-age population, as younger individuals are often in university studies, while those aged 55+ typically have stable careers or are entering retirement. The survey was conducted by the FOCUS Social and Marketing Research Agency in October and November 2011 and provided detailed data on Czech employees, such as income, personal characteristics, education, work experience, preferences related to the job, family and life roles, physiological traits and characteristics of family background, household, and workplace[2]. The data were obtained through standardized

2 The survey questionnaire was designed (in alphabetic order) by Jiří Balcar (VSB-TU Ostrava), Lenka Johnson Filipová (VSB-TU Ostrava), Jaromír Gottvald (VSB-TU Ostrava), and Mariola Pytliková (VSB-TU Ostrava). Valuable comments were provided by Alicia Adsera (Princeton University), Tor Eriksson (Aarhus University), Armin Falk (Bonn University), James Heckman (University of Chicago), Leslie Stratton (Virginia Commonwealth University) and anonymous respondents participating in two pilot surveys (the affiliations are relevant to the time of questionnaire design).

interviews conducted by 481 interviewers from the FOCUS Agency. Due to the use of quota sampling, where interviewers were instructed to reach predetermined quotas based on gender, age, education, region, and the size of the municipality of the respondent's residence, and with only one member per household allowed to participate, the sample of respondents is representative in terms of the aforementioned characteristics. Subsequently, the FOCUS Agency verified the data and supplemented the codes of individual jobs according to the ISCO classification, as well as the identification number of the employer. The availability of employer identification numbers allowed us to enrich the survey data with information on employers' characteristics. These data were sourced from the Albertina Firm Monitor database, which covers approximately 2.7 million economic entities in the Czech Republic and includes information on factors such as the company establishment date, ownership, legal form, and the number of employees.

Definitions of variables used in this article and their descriptive statistics can be found in Table A1.

The unique combination of wage determinants covered by this survey, particularly seldom-captured psychological traits, gender roles, life preferences, etc., renders this survey exceptionally suitable for exploring the relationship between competitiveness, persistence, risk tolerance and wage level in the Czech Republic. The authors of this article are not aware of any other dataset from the Czech Republic that would allow an investigation into the interplay of these psychological traits. This holds true even for a new wave of the survey on wage determination in the Czech Republic from 2022, which either lacked the psychological variables examined in this study or defined them differently. Nonetheless, we employ data from 2022 to assess alterations in the relationship between wage levels and competitiveness since it is the only psychological trait that remains consistent across surveys (all control variables utilized in the model are entirely comparable). The new wave of the survey was conducted in January 2022 to collect individual data from the population of the Czech Republic. We specifically focused on individuals aged 25–54 years to capture the economic activity of the prime working-age population. The online survey was conducted by advisory companies Nielsen Admosphere, a.s. (https://www.nielsen-admosphere.cz) and Engage Hill s.r.o. (https://www.engagehill.com). The former company was responsible for recruiting respondents using quota sampling based on sex, age, education, labour market status, NUTS 3 region and size of the municipality of residence. The latter was responsible for gathering the data. The original sample consisted of 2,251 individuals with different employment statuses, but we only utilize data on employees (N = 1,564) here.

3.2 Psychological variables

The psychological traits examined in this article were assessed through self-assessment using single-item scales. Numerous studies, such as Nichols and Webster (2013), Nagy (2002), and Robins et al. (2001), have indicated that direct questions about the investigated traits are often highly correlated with the results of established psychological scales. Therefore, respondents were asked to provide answers to the following questions in order to evaluate their levels of competitiveness, persistence and risk tolerance: (a) *Do you feel a really strong need to excel in what you do and be better than others*? (answers on the scale Yes – Rather yes – Rather no – No); (b) *Does it often happen that you abandon the goal you set when you find it difficult*? (answers on the scale Yes – Rather yes – Rather no – No); (c) *How high a risk are you willing to take in your working career*? (answers on a scale from 0 for none to 10 for very high). Subsequently, these variables were recoded to reflect higher levels of the examined traits as the variable values increased, and standardized using z-scores to facilitate easy comparison of the results.

It should be noted that there is no consensus regarding the treatment of variables based on Likert-type or similar ordered scales as nominal or continuous in regression models. Both approaches offer significant advantages: treating a variable as nominal allows capturing non-linearity in its relationship with the dependent variable, while treating it as continuous enables straightforward interpretation of the results (Gardner, 1975; Knap, 1990). Therefore, Pasta (2009) and Williams (2016) suggest testing the linearity of the relationship between ordered and dependent variables. If a statistically significant non-linear relationship with the dependent variable is found, the predictor should be treated as categorical; otherwise, it should be treated as continuous. The testing procedure described by Williams (2016) was applied to both the base and full models used in this article (Models 1 and 4 in Table 1). The results showed no statistically significant nonlinear relationship between the dependent variable and psychological variables. This finding supports the treatment of psychological variables as continuous. Additionally, the Shapiro-Wilk normality tests confirmed this conclusion for competitiveness and persistence, as a normal distribution further justifies treating these variables as continuous. Furthermore, we estimated both the base and full wage models using differently specified ordinal-type variables to assess the quality of these alternative specifications. We evaluated them based on the adjusted R^2, Akaike's information criterion (AIC) and Bayesian information criterion (BIC). The psychological variables were included in the model as continuous variables (Model 1: adj. $R^2 = 0.172$, AIC = 1321.5, BIC = 1444.5; Model 4: adj. $R^2 = 0.473$, AIC = 466.5, BIC = 824.2), as well as dummy variables representing all categories/answers (Model 1: adj. $R^2 = 0.170$, AIC = 1338.5, BIC = 1534.2; Model 4: adj. $R^2 = 0.473$, AIC = 482.3, BIC = 912.8). All of the described procedures implied treating ordered variables as continuous,

allowing a more straightforward interpretation of results, which is the approach adopted in this article.

3.3 Empirical model and estimation strategy

The data were used to estimate the Mincer-based regression model (Mincer, 1974), which explains the logarithm of the gross monthly wage (*ln w*) by *n* explanatory variables (*x*) that capture psychological traits, personal characteristics, family and background characteristics, job and employer characteristics and location for individuals (*i*); see Equation (1), where *βj* are regression coefficients and *ε* residuals. A comprehensive description of all the control variables used in our model can be found in Table A1.

$$\ln w_i = \beta_0 + \sum_{j=1}^{n} \beta_j \times x_{j,i} + \varepsilon_i \tag{1}$$

Our empirical strategy relies on hierarchical regression analysis. Initially, we establish a baseline model (Model 1), which includes psychological traits and location variables. This model serves to estimate the overall relationship between wages and competitiveness, persistence, and risk tolerance. We then enhance this model with gender (Model 2), education (Model 3) and other supply-side characteristics (Model 4) in order to uncover the indirect effects of psychological traits, particularly the effects mediated by the attainment of a higher level of education. In Model 5, we introduce occupation controls to explore the indirect effects mediated by gaining a better-paid occupation. Model 6 represents the full model, incorporating all relevant controls and enabling the estimation of the net relationship between wages and psychological traits. Subsequently, we explore the functional form of the relationship, assess the correlation between wages and psychological traits at different income levels (employing unconditional quantile regression; see Firpo et al., 2009) and investigate interactions between psychological traits and between these traits and educational attainment.

The human capital theory (Becker, 1962) posits causality from individual characteristics, such as education, health, and psychological traits, to their productivity and wages. However, due to the cross-sectional nature of the data employed in this article, we are unable to definitively establish or disprove the expected causality. Instead, we can only draw conclusions regarding the correlation between psychological traits and wages. This would not pose an issue if personality and personal traits were innate and remained stable throughout one's lifespan, as we could easily assume a causal effect. However, these traits tend to evolve slowly over time (e.g., Hudson and Fraley, 2015; Hudson et al., 2012; Roberts and Mroczek, 2008). In such cases, we must consider the possibility of reverse causality, wherein the performance of managerial or other

well-paid positions requiring a high level of competitiveness, persistence or risk tolerance may strengthen these psychological traits in individuals working in these roles. Furthermore, a higher salary can serve as motivation for increased persistence, competitiveness and risk tolerance. Since our dataset lacks suitable instruments for employing IV regression, which could help identify causality between psychological traits and wage levels, we refer to our findings as correlations rather than asserting causal relationships.

It is worth noting that considerable attention was devoted to data validation and model specification in our study: (1) A data check was undertaken to exclude observations with unrealistic (extreme) values and obvious measurement errors. (2) A check for empty and small cells was conducted to support model stability. (3) All the models underwent rigorous testing for specification errors (including the Ramsey RESET test and link test), multicollinearity (assessed using the VIF test), heteroscedasticity (examined using the Breusch-Pagan test) and autocorrelation (evaluated with the DW test). None of these tests revealed any violations of the OLS assumptions.

4. Results

4.1 Competitiveness, persistence and risk tolerance are correlated with higher wages

When considering differences in psychological traits and location (see Model 1 in Table 1), the results clearly demonstrate that individuals who are more competitive, persistent, and risk-tolerant tend to achieve higher levels of success on the labour market, as evidenced by their higher wages. This relationship is substantial, with wages increasing by 6.8%, 6.5%, and 5.3% for a one-standard-deviation increase in competitiveness, persistence, and risk tolerance, respectively. The inclusion of additional control variables allows us to explore the indirect relationships between psychological traits and wage levels. Initially, we introduced the gender variable (Model 2), which had a negligible effect on the coefficients of competitiveness and persistence. However, it had a significant impact on the coefficient of risk tolerance, decreasing it by −43.4%, indicating that women tend to have significantly lower risk tolerance. Expanding the model to include years of schooling led to a further decrease in the regression coefficients of competitiveness, persistence, and risk tolerance by −32.8%, −26.6% and −20.0%, respectively (compare Models 2 and 3). This suggests a positive relationship between the examined psychological traits and the level of educational attainment, which in turn leads to higher wages. That corresponds with the result of Feng and Papi (2020), who provided evidence about the importance of persistence and competitiveness on better academic results of students.

Controlling for other personal, family and background characteristics (Model 4) did not result in significant changes in regression coefficients. However, given the expected substantial indirect effect of occupations on the relationship between psychological traits and wage levels, we estimated Model 5, which includes this variable. When we controlled for occupation according to the 1-digit ISCO classification, there was a decrease in the correlation between wage levels and competitiveness, persistence, and risk tolerance by −18.4%, −15.4% and −17.4%, respectively. This indicates that individuals with these skills tend to occupy more highly paid positions, as a higher ISCO category is associated with higher wages. Finally, Model 6 reveals that the examined psychological traits remain significantly related to wage levels (at the 0.01 significance level) even among employees who share the same education, occupation, and many other characteristics. We observe that a one-standard-deviation increase in competitiveness, persistence and risk tolerance is correlated with a 3.3%, 2.8%, and 1.9% wage premium, respectively. The correlation of wages with these psychological traits is similar to other results from the Czech Republic provided by Balcar (2016) for the mean of 15 soft skills (a one-standard-deviation increase is correlated with a 3.4% wage premium; $P < 0.05$) and by Balcar and Dokoupilová (2021) for communication skills (their one-standard-deviation increase is correlated with a 2.6% wage premium; $P<0.05$). Our findings are also consistent with the study by Collischon (2020), which found that risk tolerance is associated with a 0.8% higher likelihood of earning higher wages in Germany. This supports the general picture of a positive relationship between non-cognitive skills and wage levels. The results provided here raise the question of whether the described relationships are stable across the labour market or whether they reflect the fact that jobs at different ends of the wage distribution require different psychological traits.

The re-estimation of Model 6 using unconditional quantile regression (Model 7 in Table 2) suggests that the relationships between psychological traits and wages vary across different income groups. At the 0.05 significance level, we found that competitiveness and risk tolerance are positively related to wage levels only for middle- and high-income individuals, but not for low-income ones. In contrast, persistence is related to wage levels in the case of low- and middle-income individuals, but not in the case of high-income ones. This aligns with theoretical expectations, as high-income employees are often found in managerial and specialist roles where decision-making in competitive and risky environments is common, while low-income employees typically work in positions requiring persistence, such as assembly line workers or clerks.

Table 1: Psychological traits and wages

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**
Psychological traits						
Competitiveness	0.068*** (0.008)	0.064*** (0.008)	0.043*** (0.008)	0.038*** (0.008)	0.031*** (0.007)	0.033*** (0.007)
Persistence	0.065*** (0.008)	0.064*** (0.008)	0.047*** (0.007)	0.039*** (0.007)	0.033*** (0.007)	0.028*** (0.007)
Risk tolerance	0.053*** (0.008)	0.030*** (0.008)	0.024*** (0.007)	0.023*** (0.007)	0.019*** (0.007)	0.019*** (0.007)
Personal characteristics						
Female		−0.224*** (0.015)	−0.243*** (0.014)	−0.259*** (0.014)	−0.245*** (0.015)	−0.207*** (0.015)
Years of schooling			0.052*** (0.004)	0.042*** (0.004)	0.022*** (0.005)	0.026*** (0.004)
Other work experience				0.006** (0.003)	0.007*** (0.002)	0.009*** (0.002)
Other work experience squared				−0.000*** (0.000)	−0.000*** (0.000)	−0.000*** (0.000)
Tenure						0.014*** (0.003)
Tenure squared						−0.000*** (0.000)
Grades in maths at age 15				−0.053*** (0.010)	−0.035*** (0.010)	−0.032*** (0.009)
Health limitation of work performance				−0.077*** (0.023)	−0.062*** (0.021)	−0.070*** (0.020)
Family and background characteristics [I.]				yes	yes	yes
Job and employer characteristics						
Occupation according to 1-digit ISCO					yes	yes
Other job and employer characteristics [II.]						Yes
Location [III.]	Yes	yes	yes	yes	yes	yes
Constant	10.017*** (0.023)	10.125*** (0.024)	9.380*** (0.056)	9.608*** (0.078)	9.612*** (0.082)	9.519*** (0.085)
Observations	1,978	1,978	1,978	1,978	1,978	1,978
Adjusted R^2	0.172	0.259	0.340	0.367	0.424	0.473

Notes: robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. I. Partnership status, number of children in 5 age categories, non-Czech mother tongue; II. Workload, prevailing economic activity according to NACE classification, number of employees; III. NUTS 3 region, residence town size.

Source: authors' calculations

Table 2: Unconditional quantile regression

	Model 6 specification			
	(6)	(7)		
	OLS	1st decile	Median	9th decile
Variables	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**
Competitiveness	0.033*** (0.007)	0.030* (0.017)	0.030*** (0.008)	0.031** (0.016)
Persistence	0.028*** (0.007)	0.036** (0.017)	0.028*** (0.010)	0.022* (0.012)
Risk tolerance	0.019*** (0.007)	−0.003 (0.015)	0.033*** (0.009)	0.037*** (0.013)
Other variables of Model 6	yes	yes	yes	yes
Constant	9.519*** (0.085)	8.903*** (0.163)	9.550*** (0.108)	9.873*** (0.164)
Observations	1,978	1,978	1,978	1,978
Adjusted R^2	0.473	0.220	0.307	0.231

Notes: robust standard errors (OLS) and bootstrapped standard errors based on 200 replications (UQR) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Source: authors' calculations

In the previous models, we approximated psychological traits using linear terms. However, it is plausible to expect a non-linear relationship between the psychological traits in question and wages, as extreme levels of competitiveness, persistence and risk tolerance may be associated with reduced productivity. For instance, low competitiveness could result in insufficient work effort, while extremely high competitiveness might be linked to a lower willingness to cooperate with others. We re-estimated Models 1 and 6, incorporating quadratic terms for the psychological traits (not reported here). The results did not support this assumption, as the quadratic terms were found to be statistically insignificant. This suggests that higher levels of competitiveness, persistence and risk tolerance among employees are consistently correlated with higher wages. This conclusion aligns with the findings of the linearity test described in the methodology section.

4.2 Synergy effects of competitiveness, persistence, risk tolerance and cognitive skills

The existence of synergy effects between psychological traits represents another intriguing question that could alter our perspective on their importance and functioning. Therefore, we re-estimated both the base and full models (Models 1 and 6) by including respective interaction terms between the examined psychological traits. The results presented in Table 3 indicate that the regression coefficients for competitiveness, persistence and risk tolerance are individually statistically significant, indicating a positive correlation between each trait and wage level. Additionally, we observed that the interaction between competitiveness and persistence embodies a positive relationship with wage level, reaching a significance level of 0.064 for the base model (see Model 8) and 0.085 for the full model (see Model 11). On the other hand, interactions involving other psychological traits were found to be statistically insignificant.

Table 3: Interaction of psychological traits

	Model 1 specification			**Model 6 specification**		
	(8)	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
Variables	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**
Competitiveness	0.067*** (0.008)	0.068*** (0.009)	0.068*** (0.009)	0.033*** (0.007)	0.033*** (0.007)	0.033*** (0.007)
Persistence	0.066*** (0.008)	0.065*** (0.008)	0.065*** (0.008)	0.028*** (0.007)	0.028*** (0.007)	0.028*** (0.007)
Risk tolerance	0.053*** (0.008)	0.053*** (0.008)	0.053*** (0.008)	0.018*** (0.007)	0.018*** (0.007)	0.018*** (0.007)
Interactions						
Competitiveness & persistence	0.012* (0.007)			0.009* (0.005)		
Competitiveness & risk tolerance		−0.001 (0.007)			0.004 (0.005)	
Competitiveness & risk tolerance			0.001 (0.007)			0.005 (0.006)
Other variables of Model 1	yes	yes	yes			
Other variables of Model 6				yes	yes	yes
Constant	10.013*** (0.023)	10.017*** (0.023)	10.016*** (0.023)	9.514*** (0.085)	9.516*** (0.085)	9.515*** (0.085)
Observations	1,978	1,978	1,978	1,978	1,978	1,978
Adjusted R2	0.173	0.171	0.171	0.474	0.473	0.473

Notes: robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: authors' calculations

According to empirical literature (e.g., Díaz et al., 2013), we can anticipate that psychological traits do not only interact with each other but also with cognitive skills. In our dataset, these skills are represented by two variables: grades in maths at age 15, approximating analytical and quantitative cognitive skills (e.g., Murnane et al., 2000; Murnane et al., 1995), and years of schooling, reflecting general cognitive skills. Both these variables are significantly associated with wages. A one-grade increase in maths, i.e., worse math skills (where grade 1 is the best and 5 is the worst), is linked to a −3.2% decrease in wages and each additional year of schooling is associated with a 2.6% wage increase (see Model 6). When we re-estimated Model 6 with the corresponding interaction terms, we found no evidence of a synergy effect between grades in maths at age 15 and any of the psychological traits, regardless of whether grades in maths were represented by a linear term or categories (not reported here). The interaction between the linear term of years of schooling and psychological traits was also found to be statistically insignificant (not reported here). However, when using categories of educational attainment instead of a linear term, different results emerged. These results indicate that the correlation between persistence and wage level is 0.079 to 0.102 higher for individuals with secondary or higher education compared to those with primary education. The evidence for other psychological traits is less robust, as the correlation between competitiveness and wage level is higher (at the 0.05 significance level) only for individuals with secondary education compared to those with primary education. No statistically significant interaction was observed at the 0.05 significance level for risk tolerance (see Table A2).

4.3 Consistency of the relationship between competitiveness and wages over time

This article offers a detailed analysis of the relationship between psychological traits, specifically competitiveness, persistence and risk tolerance and wages in the Czech Republic using data from 2011. Given the temporal aspect, it presents an excellent opportunity for future research to explore the evolution of this relationship over time. Regrettably, there is currently no available dataset in the Czech Republic that would enable the replication of this study with up-to-date data. As mentioned in the data section, the new wave of the wage determination survey in the Czech Republic allows for a partial comparison of the results, with only "competitiveness" being measured identically in both the 2011 and 2022 surveys.

Table 4: Competitiveness and wage in 2011 and 2022

	Model 1 specification		Model 6 specification	
	Year 2011	Year 2022	Year 2011	Year 2022
	(14)	(15)	(16)	(17)
Variables	**ln gross monthly wage**	**ln net monthly wage**	**ln gross monthly wage**	**ln net monthly wage**
Psychological traits				
Competitiveness	0.100*** (0.008)	0.077*** (0.011)	0.043*** (0.007)	0.034*** (0.008)
Other variables of Model 1	yes	yes		
Other variables of Model 6			yes	yes
Constant	10.026*** (0.024)	10.229*** (0.030)	9.507*** (0.085)	10.343*** (0.119)
Observations	1,978	1,564	1,978	1,564
Adjusted R^2	0.117	0.058	0.466	0.553

Notes: robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: authors' calculations

We re-estimated Models 1 and 6 using data from 2011 and 2022, with competitiveness as the only psychological trait (see Table 4). While the results are not entirely comparable due to differences in the dependent variable (natural logarithm of gross monthly wage in 2011 and natural logarithm of net monthly wage in 2022), the regression coefficients indicate a consistent correlation between competitiveness and wage levels over time. This suggests that the conclusions drawn from the comprehensive 2011 dataset remain relevant today.

5. Conclusion

The recent empirical literature has considered psychological traits to be important determinants of individual productivity, which is reflected in their employment and wage levels. Although measuring psychological traits is far from straightforward, leading to potential issues with reliability and validity of results in the case of individual studies, the body of empirical research as a whole provides convincing evidence of the relationship between these traits and

labour performance. This article aimed to provide evidence of the link between wages and competitiveness, persistence, and risk tolerance – psychological traits closely related to diligence, efficiency and achievement orientation, which employers often demand from job applicants and employees. We leveraged data from a representative sample of 1,978 employees in the Czech Republic, which included information on psychological traits such as competitiveness, persistence, and risk tolerance, along with a comprehensive set of demographic, family, job and employer characteristics of the interviewed employees. This dataset enabled us to analyse the link between wages and psychological traits in a model that controls for a comprehensive range of employee characteristics and provide robust and reliable results.

The Mincer-type wage equations employed in this article demonstrated a substantial gross positive association between wages and the examined psychological traits. Specifically, a one-standard-deviation increase in competitiveness, persistence and risk tolerance is associated with wage premiums of 6.8 %, 6.5 %, and 5.3 %, respectively (see Model 1 in Table 1). Further analysis revealed that these relationships are largely mediated by higher educational attainment and employment in better-paid occupations. It is worth noting that higher educational attainment is primarily linked to increased competitiveness, whereas securing a higher-paying occupation is associated slightly more with competitiveness and risk tolerance than with persistence. Importantly, all three psychological traits maintain a significant correlation with wages (at the 0.01 level), even when controlling for numerous demographic, family, job, and employer characteristics. The net link between psychological traits and wages amounts to 3.3 %, 2.8 %, and 1.9 % for a one-standard-deviation increase in competitiveness, persistence, and risk tolerance, respectively. These results align with findings from other studies conducted in the Czech Republic that have focused on correlating various types of non-cognitive skills with wage levels. Our results are further consistent with the findings in the analysis of risk tolerance on the German labour market.

Furthermore, our analysis using unconditional quantile regression revealed that the association between these traits and wages varies significantly based on income levels. Specifically, competitiveness and risk tolerance show positive correlations with wages among individuals with medium and high incomes, whereas persistence is primarily relevant for individuals with medium and low incomes. This observation aligns well with job characteristics at different income levels, as lower-income jobs are often associated with routine work that requires persistence, while higher-income positions are linked to high work performance and a tolerance for risk. In our investigation of synergistic effects, we found that individuals who exhibit both higher competitiveness and persistence receive a wage bonus. A similar effect was observed for persistent individuals with secondary or higher education compared to those with only primary

education. However, the evidence for synergistic effects involving other psychological traits and education is less robust.

The results suggest that more developed competitiveness, persistence, and risk tolerance are correlated with higher productivity, although this relationship differs for particular traits across the labour market. Furthermore, the combination of these traits, both among themselves and in conjunction with education, represents another factor correlated with higher productivity. These findings inevitably lead to a recommendation for systematic development of examined traits, especially within the education sector. This can be achieved by supporting a competitive environment, as well as an environment requiring independence and responsibility. Moreover, competitiveness and persistence can also be effectively developed through sports activities.

It is important to note the limitations of our study as well. The theoretical literature assumes a causal effect of psychological traits on employees' productivity and wages. However, the cross-sectional nature of the data and the lack of suitable instrumental variables prevented us from confirming this assumption. The second limitation is related to the measurement of psychological traits, which were captured by single-item scales. Using different measurements for these traits would be useful in supporting the robustness of our results. The last limitation arises from the absence of a comparable dataset from recent years containing all three examined psychological traits, which would allow us to assess whether their relationship with wage levels has evolved over time. Competitiveness was included as one of the investigated psychological traits only in the 2022 wage determination survey. This survey allowed at least a partial comparison of the results, revealing a consistent correlation between competitiveness and wage levels over time.

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Appendix

Table A1: Definition of variables and descriptive statistics

Variable description	Coding	Mean	SD	Min	Max
Dependent variable					
Ln income *Please state your gross monthly income from your main employment (free answer)*	Continuous variable	9.84	0.369	8.29	11.41
Psychological traits					
Competitiveness *Do you feel a really strong need to excel at what you do and be better than others? (No – Rather no – Rather yes – Yes)*	Normalized variable	0	1	–1.91	1.78
Persistence *I often abandon the goal I have set, when I find it difficult to reach (Yes – Rather yes – Rather no – No)*	Normalized variable	0	1	–2.36	1.50
Risk tolerance *How high risk are you disposed to take in your work career? Please, rank it on scale from 0 (no risk) to 10 (very high risk).*	Normalized variable	0	1	–2.16	2.15
Personal characteristics					
Female *(based on quota sampling)*	Male	0.53	0.499	0	1
	Female	0.47	0.499	0	1
Years of schooling *(based on quota sampling; computed number of years necessary for reaching respondent's educational attainment)*	Continuous variable	13.30	2.146	9	21
Tenure *How many years have you been employed at your current employer (consider only your main employment)? Do not count maternity/ parental leave and long-term sick leave into this time. (free answer)*	Continuous variable	7.43	6.533	0.08	37
Other work experience *Please state the total number of years you have worked for all your employers (excluding your current employer) or have been self-employed. Do not count maternity/parental leave, military service, long-term sick leave, periods of unemployment, as well as temporary/ summer jobs and contracts for services. (free answer)*	Continuous variable	8.97	7.969	0	35

Grades in maths at age 15 *What grade did you get from mathematics in your last year of primary school (or corresponding year of long-term grammar school)? Use grading scale from 1 (the best) to 5 (the worst).*	Continuous variable	2.36	0.869	1	4
Health limitation of work performance *Please evaluate your long-term health condition. (a) It does not represent any limitation of my work performance at my current job; (b) It limits my work performance at my current job*	No health limitation	0.88	0.327	0	1
	Health limitation	0.12	0.327	0	1
Family and background characteristics					
Partnership status *Please indicate your marital/partnership status (pre-defined options, recoded)*	Single	0.29	0.454	0	1
	No partner cohabitation	0.07	0.257	0	1
	Partner cohabitation	0.64	0.481	0	1
Number of children *Please state the number of your children aged 0–2, 3–5, 6–14, 15–18, 19+ years.*	Number of children 0–2 years of age	0.07	0.272	0	2
	Number of children 3–5 years of age	0.12	0.345	0	2
	Number of children 6–14 years of age	0.34	0.632	0	2
	Number of children 15–18 years of age	0.17	0.420	0	2
	Number of children 19+ years of age	0.46	0.791	0	2
Mother tongue *Please state your mother tongue. The mother tongue is a language that you were taught by your parents from birth. (pre-defined options, re-coded)*	Czech language	0.99	0.105	0	1
	Other	0.01	0.105	0	1
Job and employer characteristics					
Occupation (1-digit ISCO classification) *Please state the title of your job position in your main employment and describe it. (free answer, subsequently classified)*	Legislators, senior officials and managers (ISCO 1)	0.03	0.173	0	1
	Professionals (ISCO 2)	0.11	0.316	0	1
	Technicians and associate professionals (ISCO 3)	0.23	0.421	0	1
	Clerks (ISCO 4)	0.15	0.359	0	1
	Service workers and shop and market sales workers (ISCO 5)	0.16	0.363	0	1
	Skilled agricultural, forestry and fishery workers (ISCO 6)	0.01	0.081	0	1
	Craft and related workers (ISCO 7)	0.14	0.342	0	1
	Plant and machine operators and assemblers (ISCO 8)	0.11	0.313	0	1
	Unskilled workers (ISCO 9)	0.07	0.248	0	1
Scheduled working hours *Please state the extent of your workload. (free answer, subsequently categorised)*	Full-time	0.94	0.245	0	1
	Part-time	0.06	0.245	0	1

Prevailing economic activity (NACE classification) *(added from Albertina Database)*	Agriculture, forestry… + mining… (NACE A+B)	0.02	0.149	0	1
	Manufacturing + electricity, gas,… + water supply… (NACE C+D+E)	0.24	0.429	0	1
	Construction (NACE F)	0.06	0.232	0	1
	Wholesale and retail trade (NACE G)	0.17	0.380	0	1
	Transporting and storage (NACE H)	0.06	0.242	0	1
	Accommodation and food service activities (NACE I)	0.04	0.205	0	1
	Information and communication (NACE J)	0.03	0.170	0	1
	Financial and insurance activities (NACE K)	0.03	0.166	0	1
	Real estate activities (NACE L)	0.02	0.141	0	1
	Professional, scientific and technical activities (NACE M)	0.04	0.186	0	1
	Administrative and support service activities (NACE N)	0.03	0.164	0	1
	Public administration and defence,… (NACE O)	0.07	0.247	0	1
	Education (NACE P)	0.08	0.275	0	1
	Human health and social work activities (NACE Q)	0.06	0.235	0	1
	Arts, entertainment and recreation (NACE R)	0.02	0.134	0	1
	Other services activities (NACE S)	0.03	0.170	0	1
Number of employees (added from Albertina Database)	0–49 employees	0.89	0.317	0	1
	50–249 employees	0.05	0.216	0	1
	250+ employees	0.06	0.245	0	1
Location					
Region of living at NUTS3 level *(based on quota sampling)*	Prague	0.12	0.321	0	1
	Central Bohemian region	0.11	0.315	0	1
	South Bohemian region	0.06	0.243	0	1
	Plzeň region	0.06	0.233	0	1
	Karlovy Vary region	0.03	0.169	0	1
	Ústí and Labem region	0.07	0.258	0	1
	Liberec region	0.04	0.197	0	1
	Hradec Králové region	0.05	0.214	0	1
	Pardubice region	0.05	0.218	0	1
	Vysočina region	0.05	0.222	0	1
	South Moravian region	0.11	0.319	0	1
	Olomouc region	0.06	0.243	0	1
	Zlín region	0.06	0.231	0	1
	Moravian-Silesian region	0.12	0.330	0	1
Size of municipality of residence *(based on quota sampling)*	Up to 1,999 inhabitants	0.21	0.407	0	1
	2,000–4,999 inhabitants	0.15	0.360	0	1
	5,000–19,999 inhabitants	0.18	0.387	0	1
	20,000–49,999 inhabitants	0.12	0.322	0	1
	50,000–99,999 inhabitants	0.11	0.313	0	1
	100,000+ inhabitants	0.23	0.419	0	1

Source: authors' calculations

Table A2: Interaction of psychological traits and educational attainment

	Based on Model 4		
	(AP1)	**(AP2)**	**(AP3)**
Variables	**ln gross monthly wage**	**ln gross monthly wage**	**ln gross monthly wage**
Interactions between education and &…	**competitiveness**	**persistence**	**risk tolerance**
Secondary education & …	0.082** (0.033)	0.092*** (0.032)	0.030 (0.028)
Higher vocational school & bachelor degree & …	0.065 (0.039)	0.079** (0.039)	−0.059* (0.035)
Master & doctoral degree & …	0.062* (0.037)	0.102*** (0.037)	0.021 (0.032)
Education			
Primary education (ISCED 2A/EQF 2)	baseline	baseline	baseline
Secondary education (ISCED 3C & 3A/EQF 3 & 4)	−0.065 (0.058)	−0.066 (0.054)	−0.104* (0.054)
Higher vocational school & bachelor degree (ISCED 5B & 5A/EQF 6)	−0.158* (0.092)	−0.154* (0.090)	−0.185** (0.089)
Master & doctoral degree (ISCED 5A & 6/EQF 6, 7 & 8)	−0.145 (0.104)	−0.150 (0.103)	−0.187* (0.102)
Psychological traits			
Competitiveness	−0.042 (0.032)	0.033*** (0.007)	0.034*** (0.007)
Persistence	0.028*** (0.007)	−0.061* (0.031)	0.028*** (0.007)
Risk tolerance	0.018*** (0.007)	0.019*** (0.007)	−0.003 (0.028)
Other variables of Model 6	yes	yes	yes
Constant	9.299*** (0.144)	9.309*** (0.143)	9.351*** (0.144)
Observations	1,978	1,978	1,978
Adjusted R^2	0.476	0.476	0.477

Notes: robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Source: authors' calculations