China Economic Journal

ISSN: 1753-8963 (Print) 1753-8971 (Online) Journal homepage: http://www.tandfonline.com/loi/rcej20

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To cite this article: Fan Yu, Chu Wang, Jun Shen, Yuxuan Shi & Tang Li (2017) Effect of cognitive abilities and non-cognitive abilities on labor wages: empirical evidence from the Chinese Employer-Employee Survey, China Economic Journal, 10:1, 76-89, DOI: 10.1080/17538963.2016.1274005

To link to this article: https://doi.org/10.1080/17538963.2016.1274005

CHINA ECONOMIC JOURNAL, 2017
VOL. 10, NO. 1, 76–89
http://dx.doi.org/10.1080/17538963.2016.1274005

Routledge
Taylor & Francis Group

Effect of cognitive abilities and non-cognitive abilities on labor wages: empirical evidence from the Chinese Employer-Employee Survey

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ABSTRACT

The existing literature suggests that worker's cognitive and non-cognitive abilities have a significant impact on wages. However, presently there is little research in this area of China's labor force, due to scanty data. To this end, this Paper conducted a CEES-based data research, which found that, the cognitive and non-cognitive abilities of male, skilled workers have a greater impact on their wages, as compared with those of the female, unskilled workers. The OLS regression based on the Mincer Wage Equation found that, the impact of non-cognitive abilities on wages is generally larger than that of the cognitive abilities. All cognitive abilities have a positive impact on wages, wherein English proficiency has the greatest elasticity of wages, which is 12.1%. Of all non-cognitive abilities, Conscientiousness has the highest wage elasticity, which is 13.6%, whereas Agreeableness has a negative wage elasticity of −6.32%.

Abbreviations: CEES: Chinese Employer-Employee Survey OLS: Ordinary least squares

ARTICLE HISTORY
Received 26 April 2016
Accepted 13 December 2016

KEYWORDS
CEES; cognitive abilities; non-cognitive abilities; labor wages

JEL CLASSIFICATION
O15; O18; E24

1. Introduction

Presently, there is an abundance of literature using the labor force's education, work experience and other indicators to estimate the impact of human capital on wages (Becker 1975; Zhou and Song 2016; Yu and Wang 2016; Li, Han, and Yu 2016; Li and Ning 2016). However, aside from the above factors influencing human capital's role in the labor market, the cognitive and non-cognitive abilities of workers have an important impact on their socio-economic behaviors (Heckman and Urzua 2006). Heckman (1999) pointed out, if we only measure the cognitive abilities of labor, while ignoring their abilities to adapt to society, the assessment of human capital will result in a very serious estimation error. The social adaptability herein refers to the non-cognitive abilities of workers to achieve self-worth in society. The importance of workers' cognitive and non-cognitive abilities for their market performance has attracted more and more attention of scholars, who began to focus more on the effect of heterogeneity

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of workers' cognitive and non-cognitive abilities on labor productivity and, furthermore, wages (Li, Han, and Yu 2016).

However, due to data limitations, researches in this area are scanty. In the US, the data on cognitive abilities include mathematical reasoning, text recognition, reading comprehension, arithmetic, encoding speed etc., which are collected from the Armed Services Vocational Aptitude Battery (ASVAB), and the National Longitudinal Survey of Youth (NLSY). The British National Child Development Study (NCDS) collects personal data of cognitive abilities based on the General Ability Test (GAT). The German Socio-Economic Panel Survey (SOEP), based on the Symbol Correspondence Test (SCT) and Word Fluency Test (WFT), collected Verbal IQ and Performance IQ data reflecting personal cognitive abilities. Based on the data, researchers have investigated the effect of personal cognitive abilities on wages, education, marriage, and social involvement in illegal activities, etc., (Kautz et al. 2014; Cawley, Heckman, and Vytlacil 2001; Heineck and Anger 2010). Compared with the research on cognitive abilities, only a few literature focuses on non-cognitive abilities. However, some literature held that, albeit non-cognitive abilities like perseverance or credit can be of great help for employer-employee and employee-customer relationship building, some aggressive or passive non-cognitive abilities will bring negative market returns to labor (Heineck and Anger 2010). Further, Heckman and Urzua (2006) used a 2-phase model to better solve the problem of self-selection in education; the endogenous problems of education and cognitive/non-cognitive abilities; and the problem of overlooked family background factors while taking test scores as a proxy variable, and other measurement errors. PISA-based empirical data found that non-cognitive abilities not only have a direct impact on the wages of labor, but can affect students' educational choices, thereby affecting the workforce market performance. Further study found that non-cognitive abilities are equally important as cognitive abilities in many dimensions, and some non-cognitive abilities have greater influence on labor market performance than cognitive abilities do.

From the above analysis, it is not difficult to see that the cognitive and non-cognitive abilities of workers have an important impact on their wages and market performance. However, to date, only the researchers from United States, Britain, and Germany have used the corresponding survey data for an empirical test of the effects of cognitive and non-cognitive abilities on wages (Heckman and Urzua 2006; Groves 2005; Heineck and Anger 2010). Faced with the pressure of rising labor costs, the importance of the impact of studying the effect of Chinese labor's cognitive and non-cognitive abilities on labor wages looms large. This Paper shall perform CEES-based research on the effect of Chinese labor's cognitive and non-cognitive abilities on labor wages (Cheng et al. 2016), which can provide policy recommendations to enhance the quality of labor and human capital, and ease the pressure of rising labor costs.

2. Literature review

A review of the existing literature found that there has been no consensus on the studies of market performance involving cognitive abilities, wages, etc. Through empirical analysis, some scholars found a positive correlation between cognitive abilities and wages. Bronars and Oettinger (2006) used the National Longitudinal Survey of Youth

1979 (NLSY79) data, controlled family fixed effects, and found a significant positive impact of cognitive abilities on wages by introducing the cognitive abilities data of the Armed Forces Qualification Test (AFQT) into the Wage Equation. Green and Riddell (2003) used the direct measures of literacy to examine the influence of cognitive ability on earnings, and found that cognitive skills contribute significantly to earnings and that their inclusion in earnings equations reduces the measured impact of schooling. Some scholars suggested that cognitive abilities have limited explanatory power for wages. Cawley, Heckman, and Vytlacil (2001) summarized and reviewed the existing literature, and found that wage payment by ability does vary across race and gender in the US, and that the fraction of wage variance explained by cognitive ability is modest. Zax and Reese (2002) explored the effects of peers, friends, family, IQ, and academic performance, observed in the last year of high school, on earnings at ages 35 and 53; the empirical results show that, after controlling family background, academic performance and other factors, the effect of IQ on wages is very small.

For non-cognitive abilities, some have a positive impact on wages, while some have a negative impact. Heineck (2011) used the data from the British Household Panel Study (BHPS); the empirical research found that Openness, one of the personality traits, has a positive correlation with wages, while Agreeableness have a negative correlation with wages. For women, Neuroticism has a negative correlation with wages. Conscientiousness has no linear relationship with wages, but has a strong nonlinear gradient relationship. Semykina and Linz (2005) used survey data collected from over 2600 Russian employees between 2000 and 2003, and found that men are more likely to exhibit an internal locus of control and need for challenge, while women are more likely to exhibit an external locus of control and need for affiliation. Gender differences can lead to heterogeneous effects of non-cognitive abilities on wages, women's earnings are strongly affected by personality, while the effect of personality on men's earnings is small and not always significant. Overall, personality traits explain as much as 8% of the gender wage gap. Mueller and Plug (2006) adopted the Five-Factor Model of personality structure to explore how personality affected the earnings of a large group of men and women who graduated from Wisconsin high schools in 1957 and were re-interviewed in 1992. The empirical results show that gender differences will produce different effects on wages. Among men, substantial earnings advantages were associated with antagonism (the obverse of agreeableness), emotional stability (the obverse of neuroticism), and openness to experience. For men, confrontational (agreeableness antithesis), emotional stability (neuroticism antithesis) and openness has a positive effect on wages, among women, with conscientiousness and openness to experience. Nyhusa and Ponsb (2005) used the Dutch DNB Household Survey data and found that emotional stability (the obverse of Neuroticism) is positively associated with the wage of both women and men, while agreeableness is significantly associated with lower wages for women. At the beginning of employment, Conscientiousness will increase the male's wages. The economic returns of the personality factors in wage determination vary between educational groups.

Taking into account the interaction of cognitive and non-cognitive abilities (Furnham, Forde, and Cotter 1998), it is necessary to study two abilities together. Groves (2005) found that, when personality traits are put into the model, cognitive abilities have positive correlation with American women's wages, and no positive correlation with women's wages. Aside from the above-mentioned study on the impact of non-cognitive abilities and

wages, Mueller and Plug (2006) also used Henmon-Nelson mental ability tests to obtain the subject's level of intelligence, based on empirical data, they found a positive linear relationship between intellectual level of workers and wages. Cebi (2007) employed the data from the National Longitudinal Survey of Youth (NLSY), the Armed Forces Qualification Test (AFQT), and locus of control (LOC); the empirical analysis found that, when cognitive abilities are introduced into the estimation model, the non-cognitive abilities can hardly predict a student's decision-making in attending college. The authors also pointed out that the cognitive abilities represented by the AFQT data cannot fully capture the data of LOC-represented non-cognitive abilities, which can bring a market return for laborers. Heckman and Urzua (2006) found that, cognitive abilities and non-cognitive abilities are equally important in terms of their impact on workers' wages. Heineck and Anger (2010) used the German Socio-Economic Panel Survey (SOEP) to obtain relevant data characterizing cognitive abilities, and data of non-cognitive abilities characterizing personal characteristics, their empirical analysis found that fluid intelligence has an positive impact on male wages only; the influences of personality traits on wages are heterogeneous; but external locus of control has robust wage penalty for both men and women.

Given that scholars have not reached a unified conclusion on studying the impact of cognitive and non-cognitive abilities on wages, and that no scholars have used the Chinese data to study the effects of Chinese workers' cognitive and non-cognitive abilities on their wages, this paper shall, based on CEES data, perform an in-depth empirical analysis of the above effects in a Chinese setting.

3. CEES data and measurement

The data used in this paper are drawn from the Chinese Employer-Employee Survey (CEES) in 2015. In order to ensure the representative of the samples, Guangdong province, which is one of the largest manufacturing industry in China, is selected as the survey region. To ensure the randomness of the samples, the survey selected randomly 19 regions from 21 cities in Guangdong province as the basic research units and extracted randomly the sample enterprises based on the employment weighted method from the 30090 manufacturing enterprises in the third economic census. The survey selected 30% of senior managers and 70% of workers on the production line as the object by randomly stratified sampling method. Through a series of high-quality survey process controls, 5364 valid questionnaires were finally recovered, including 570 enterprise questionnaires and 4794 employee questionnaires. The questionnaires cover cognitive abilities including mathematics, reading, English, and problem solving; the non-cognitive abilities including the Big Five personality and the employee wages. Therefore, based on the CEES data, we can study the effects of Chinese labor force's cognitive and non-cognitive abilities on their wages comprehensively.

3.1. *Measurement of cognitive ability*

Existing surveys mainly test the interviewee's intelligence through answering questions. According to the intelligence division by Cattell, existing surveys test mainly crystallized intelligence and fluid intelligence. Crystallized intelligence includes language ability,

reading ability and so on, while fluid intelligence includes mathematical reasoning, problem solving ability and so on. It is specifically tested through Programmed for International Student Assessment (PISA), carried out by the Organization for Economic Co-operation and Development (OECD), using Achievement Tests to check students' crystallized intelligence and IQ Tests to check fluid intelligence. The German Socio-Economic Panel (SOEP) is based on the Wechsler Adult Intelligence Scale, which include Word Fluency Test for the crystallized intelligence and the Symbol Correspondence Test for fluid intelligence.

Cognitive ability in mainstream survey data is achieved through basic questions, but this article suggests that employee's cognitive ability plays a more important role during work, which can truly reflect the impact of cognitive ability on employee's wages. Therefore, this article will use the effect of self-assessment scores of employee's cognitive ability in work to check his or her cognitive abilities.

Specifically, to investigate employee's language skills and reading skills, which can represent one's crystallized intelligence, CEES does the investigation by asking the following items: is English frequently used in your daily work? Four options respectively are: often, sometimes, rarely, basically no. How is your English listening and speaking ability? Four options respectively are: very good, good, fair, and not good. How is your English reading skills? Four options respectively are: very good, good, fair, and not good. Written materials are sometimes needed to be read in work (such as manual), how many pages of the longest work-related written materials you typically read? Six options respectively are: less than one page, two to five pages, six to ten pages, eleven to twenty-five pages, over twenty-five pages, and the work does not need to the file to be read. It should be noted that, in order to facilitate the calculation, employee's English ability will be calculated using the arithmetic mean of English frequency, English listening, speaking, and reading abilities.

To investigate employee's mathematical reasoning and problem solving ability, which can represent one's fluid intelligence, CEES does the investigation by asking the following items: are advanced mathematics (linear algebra, geometry, calculus, probability theory, etc.), physics and chemistry often used in your daily work? Five options respectively are: more than once a day on average, at least once a week, at least once a month, less than one time a month, and never. Have you ever encountered some new situations or difficult problems to solve in the work that it takes at least 30 minutes to find a good solution? Five options respectively are: more than once a day on average, at least once a week, at least once a month, less than one time a month, and never.

3.2. *Measurement of non-cognitive ability*

Although some scholars use the Big Three or the Big Nine personality characteristics to measure non-cognitive ability, Big Five personality classification is still the most widely accepted (Almlund et al. 2011), including: openness to experience, conscientiousness, extraversion, agreeableness and neuroticism (OCEAN). CEES uses 44 items to investigate the Big Five Personality, and each type of personality includes 8–10 items. Employees can choose from the answers scoring from 1–5, respectively representing strongly disagree, disagree, neutral, agree, and strongly agree.

4. Statistical analysis

Extensive literature empirically found that there is gender heterogeneity existing between the impact of cognitive ability and non-cognitive ability on wages (Mueller and Plug 2006). Based on this fact, the statistical analysis in this section will firstly divide into two groups according to gender, to check whether the heterogeneity exists. Some literature suggest that cognitive ability of skilled workers has a significant positive effect on their wages, while non-cognitive ability of unskilled workers has significant effects (Lindqvist and Vestman 2011), which means skilled-workers and unskilled-workers have ability heterogeneity. Therefore, a further analysis grouped by the skill levels will be made to check the heterogeneity.

4.1. *Grouped by gender*

Figure 1 depicts the distribution of four kinds of cognitive abilities and five kinds of non-cognitive abilities according to the gender. On the graph, the solid blue line represents the distribution of the male, while the red dashed line represents the female. It is not difficult to see from the figure, for cognitive ability, except for English ability, male's read ability, math ability and problem-solving ability are better than female; for the non-cognitive ability, male's average score of extroversion and openness are slightly higher than female, while there is no significant difference on conscientiousness, agreeableness and neuroticism. On the whole, male's cognitive ability is better than female, but as to non-cognitive ability, there is no big difference, and this conclusion is consistent with the existing literature (Mueller and Plug 2006).

Figure 2 depicts the distribution of decile of cognitive and non-cognitive ability and corresponding mean log wage under the subgroup by gender. Meanwhile, in order to facilitate comparison, the range of the vertical axis is from 7.8 to 8.7. Overall, in addition to neuroticism, most of the abilities have a positive correlation with wage. For cognitive ability, English and read ability have positive and steady effects on wages, but math and problem-solving ability's effect on wages is positive on the whole but partial negative. It is worth noting that male's four kinds of cognitive ability have stronger positive effects on wages than female's, and this conclusion is consistent with the existing literature (Heineck and Anger 2010). For non-cognitive ability, in addition to the above mentioned negative effect of neuroticism on wages, the other four non-cognitive ability's effects on wages show generally positive but partial negative. Similar to cognitive ability, the effects of male's conscientiousness, extraversion, openness, and agreeableness on wages are stronger than female and the negative effect of male's neuroticism on wages is weaker than that of female. And these conclusions are consistent with the existing literature (Heineck 2011; Mueller and Plug 2006; Nyhusa and Ponsb 2005).

4.2. *Grouped by skill level*

Figure 3 depicts the distribution of cognitive and non-cognitive abilities according to the skill level. It should be noted that CEES survey divides employees into junior and senior managers, other management staff, technicians or design staff, sales staff, front-

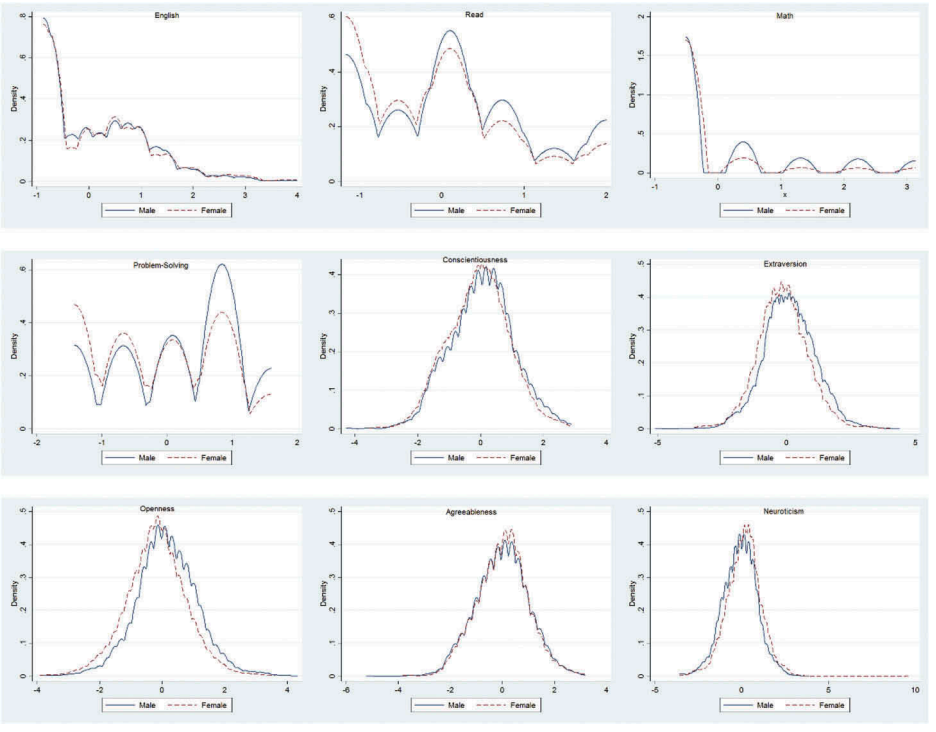

Figure 1. Distribution of cognitive and non-cognitive abilities by gender.

The data for cognitive ability (English ability, reading ability, math ability, and problem-solving ability) and non-cognitive ability are standardized data from CEES.

line workers, and other employees. Based on the existing literature, the first four categories can be defined as skilled workers, while the other two categories are non-skilled workers (Berman and Griliches 1994). It is not difficult to see from the figure, for the cognitive ability, the ability of skilled workers in English, reading, math, and problem-solving are better than non-skilled workers; for non-cognitive ability, except for neuroticism, which characterizes the negative personality traits, skilled workers score higher than the unskilled ones in conscientiousness, extraversion, openness, and agreeableness. On the whole, the average score of both cognitive and non-cognitive abilities of skilled workers are higher than unskilled ones.

Figure 4 depicts the distribution of decile of cognitive and non-cognitive ability and corresponding mean log wage under the subgroup by skill level. On the whole, except for neuroticism personality traits, most of the abilities are positively correlated with wages. For cognitive ability, skilled worker's English and reading abilities positively and steadily affect their wages, but their math and problem-solving ability's effects on wages present generally positive but partially negative. Unskilled worker's reading and math abilities show steadily positive effect, but the English and problem-solving abilities present generally positive but partially negative. It is worth noting that the positive effect of the cognitive abilities of skilled workers on wages are all stronger than unskilled ones (Lindqvist and Vestman 2011). For non-cognitive abilities, the conscientiousness, extraversion, openness and agreeableness of skilled worker's effects on wages

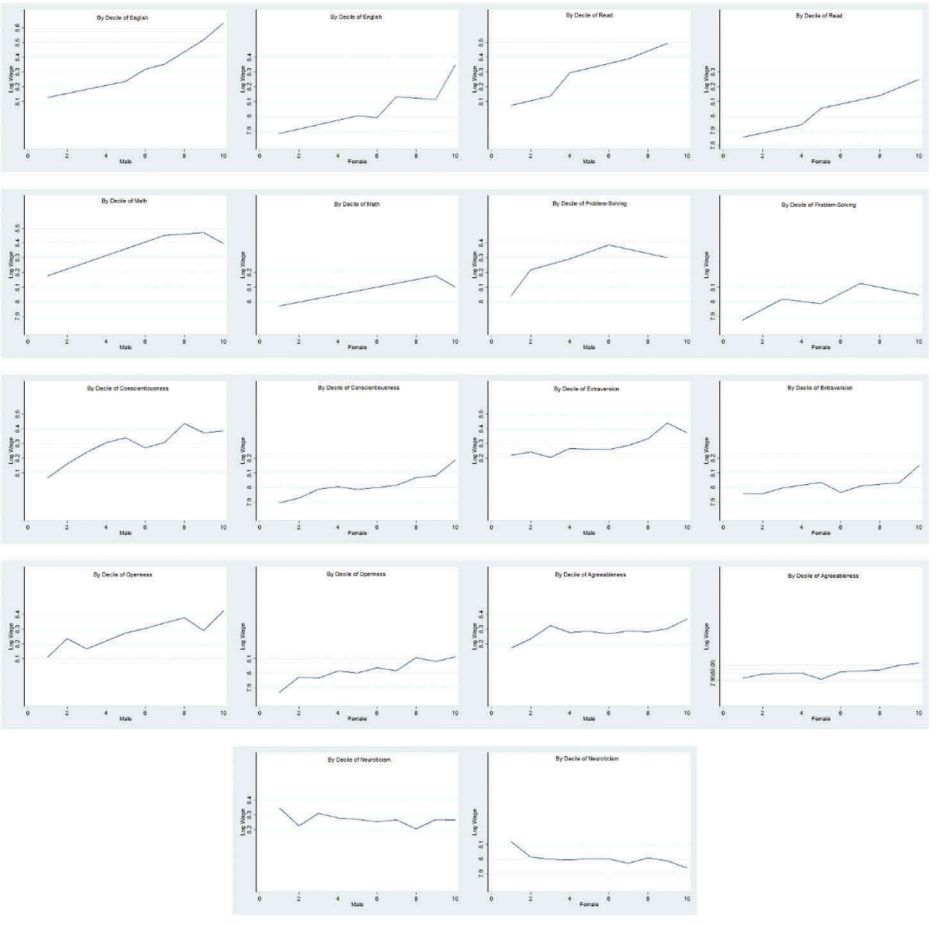

Figure 2. Mean Log Wages by decile of cognitive and non-cognitive abilities (by gender).

show generally positive but partial negative, while neuroticism has a negative effect. It is different to skilled workers that the effects of unskilled worker's conscientiousness, extraversion and openness on wages are generally positive but partially negative, but agreeableness and neuroticism have negative effects on wages. Similar to cognitive ability, the effects of skilled worker's conscientiousness, extraversion, openness and agreeableness on wages is stronger than that on unskilled worker's wages. What's more, the negative effect of skilled worker's neuroticism on wages is weaker than unskilled workers, and the conclusion is the opposite of existing literature (Lindqvist and Vestman 2011).

5. Regression analysis

Based on the Mincer wage equation, Table 1 lists the OLS regression estimation of cognitive and non-cognitive ability on wages. Models 1-4 respectively put four cognitive abilities, i.e., English, reading, math, and problem-solving abilities in the wage equation. The results show that the four kinds of cognitive abilities have significant positive

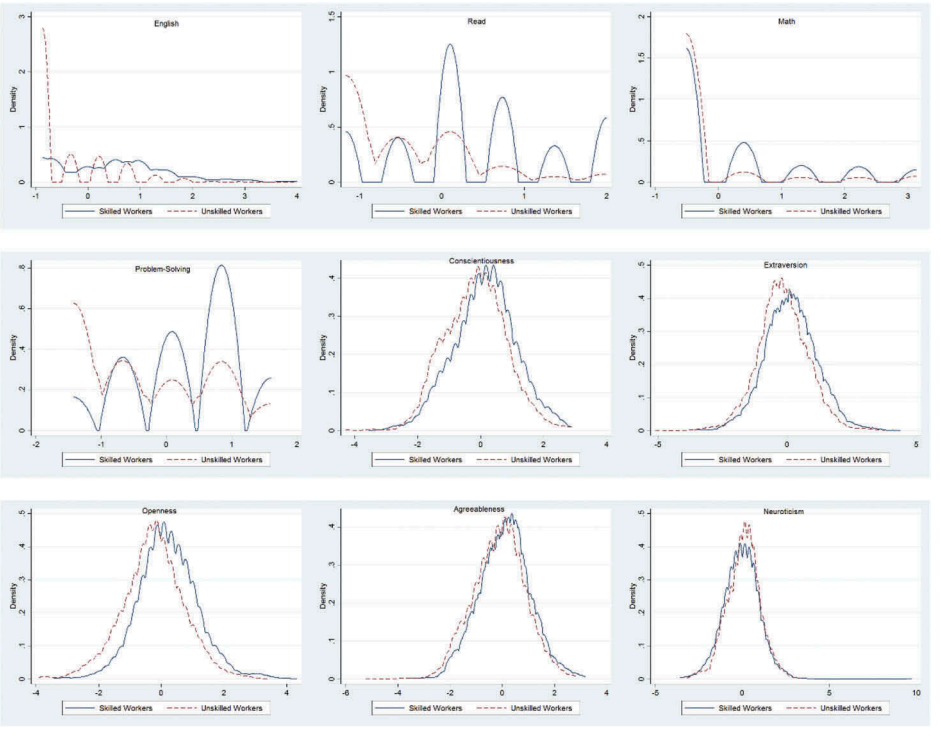

Figure 3. Distribution of cognitive and non-cognitive abilities by skill level.

correlations on wages. Among them, the coefficient of elasticity of English ability on wages was the highest, which reached 15.7%. The coefficients of elasticity of reading ability, math, and problem-solving abilities on wages are relatively low. Model 5 put the four abilities into the equation at the same time and the result remained significant, but the correlation coefficient of the four abilities on wages decreased. Among them, the coefficient of elasticity of English ability on wages remained the highest (12.7%), while the elastic coefficient of reading, math, and problem-solving abilities on wages ranged from 1.86% to 3.03%. This conclusion is slightly higher than the existing conclusions (Green and Riddell 2003). Model 6–10 respectively put five kinds of non-cognitive abilities, i.e., conscientiousness, extraversion, openness, agreeableness, and neuroticism into the equation. The results show that four kinds of non-cognitive abilities except for neuroticism, have significant positive correlations on wages. Neuroticism has a significant negative correlation on wages. Model 11 put the five non-cognitive abilities into the equation at the same time and the correlation coefficient of conscientiousness and openness on wages remain significantly positive, while agreeableness has significant negative correlation on wages. Among them, the elasticity coefficient of conscientiousness on wages was 16.3%, which is higher than 5.7% (Mueller and Plug 2006). The elasticity coefficient of openness on wages was 5.62%, which is between 2.4%–12.2% (Mueller and Plug 2006). The elasticity coefficient of agreeableness on wages was −7.3% %, which is almost the same with −6.8% (Nyhusa and Ponsb 2005). Considering that cognitive and non-cognitive abilities could be influenced by each other, Model 12 put four kinds of cognitive abilities and five kinds of non-cognitive abilities together into

Figure 4. Mean log wages by decile of cognitive and non-cognitive abilities (by skill level).

the equation. Regression results show that elastic coefficients of all kinds of abilities on wages decreased. Openness turned out to be insignificant while other abilities were still significant. The elastic coefficients of four kinds of cognitive abilities on wages range between 1.58% and 12.1%, which is almost the same with 6.6%–12% (Mueller and Plug 2006). For the non-cognitive abilities, the elasticity coefficient of conscientiousness on wages reached 13.6%, which was higher than 1.3%–1.5% (Heineck and Anger 2010). The elasticity coefficient of agreeableness on wages reached −6.32%, which was almost the same with −2.1%–(−8.7%) (Mueller and Plug 2006).

6. Conclusion

Based on existing literature, this paper grouped workers by gender and skill levels, and studied the effects of cognitive and non-cognitive abilities on wages among different types of employees. The results show that the effects of both cognitive and non-cognitive ability are bigger in male workers than female workers; the effects are bigger in skilled workers than unskilled workers. The conclusions are basically the same with existing literature

Table 1. Cognitive and non-cognitive abilities on log wage (OLS).

Independent variables	Dependent variable: Log wage											
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
English	0.157***	-	-	-	0.127***	-	-	-	-	-	-	0.121***
	(8.913)				(6.943)							(5.955)
Reading	-	0.0471***	-	-	0.0303***	-	-	-	-	-	-	0.0283***
		(8.737)			(5.336)							(4.592)
Math	-	-	0.0369***	-	0.0186**	-	-	-	-	-	-	0.0158*
			(4.841)		(2.425)							(1.946)
Problem-solving	-	-	-	0.0342***	0.0203***	-	-	-	-	-	-	0.0194***
				(5.442)	(3.241)							(2.792)
Conscientiousness	-	-	-	-	-	0.129***	-	-	-	-	0.163***	0.136***
						(7.117)					(6.483)	(5.530)
Extraversion	-	-	-	-	-	-	0.0587***	-	-	-	0.000212	−0.0102
							(2.816)				(0.008)	(−0.390)
Openness	-	-	-	-	-	-	-	0.0835***	-	-	0.0562**	0.0121
								(4.200)			(2.491)	(0.536)
Agreeableness	-	-	-	-	-	-	-	-	0.0363*	-	−0.0730***	−0.0632**
									(1.727)		(−2.759)	(−2.417)
Neuroticism	-	-	-	-	-	-	-	-	-	−0.0335*	0.0247	0.0151
										(−1.876)	(1.103)	(0.682)
Age	0.00197*	0.00156	0.00162	0.00173	0.00271**	0.000571	0.00147	0.00186	0.00122	0.00139	0.00138	0.00249**
	(1.769)	(1.404)	(1.438)	(1.538)	(2.471)	(0.484)	(1.266)	(1.603)	(1.053)	(1.183)	(1.104)	(2.031)
Female	−0.223***	−0.202***	−0.202***	−0.200***	−0.200***	−0.209***	−0.211***	−0.198***	−0.216***	−0.212***	−0.200***	−0.194***
	(−14.569)	(−12.966)	(−12.805)	(−12.628)	(−12.877)	(−13.003)	(−13.019)	(−12.240)	(−13.379)	(−13.054)	(−11.596)	(−11.208)
Marriage	0.148***	0.142***	0.143***	0.142***	0.138***	0.135***	0.145***	0.146***	0.152***	0.147***	0.136***	0.131***
	(8.265)	(7.914)	(8.021)	(7.969)	(7.712)	(7.398)	(7.925)	(7.980)	(8.233)	(8.023)	(7.047)	(6.765)
Education	0.0370***	0.0432***	0.0516***	0.0500***	0.0296***	0.0519***	0.0537***	0.0523***	0.0544***	0.0551***	0.0518***	0.0303***
	(10.559)	(12.683)	(16.166)	(15.136)	(8.123)	(15.969)	(16.502)	(15.728)	(16.719)	(16.984)	(14.694)	(7.445)
BMI	−0.0167	−0.0151	−0.0155	−0.0153	−0.0160	−0.0267	−0.0254	−0.0202	−0.0208	−0.0214	−0.0334	−0.0294
	(−0.832)	(−0.761)	(−0.750)	(−0.746)	(−0.810)	(−1.239)	(−1.205)	(−0.964)	(−0.961)	(−1.010)	(−1.446)	(−1.345)

(*Continued*)

Table 1. (Continued).

Independent variables	Dependent variable: Log wage											
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
BMI square	0.000548	0.000491	0.000519	0.000511	0.000516	0.000781*	0.000721	0.000622	0.000620	0.000632	0.000914*	0.000829*
	(1.286)	(1.174)	(1.179)	(1.174)	(1.237)	(1.714)	(1.610)	(1.399)	(1.349)	(1.410)	(1.862)	(1.787)
Working experience	0.00142	0.00143	0.00154	0.00137	0.00164	0.00112	0.00147	0.00149	0.00148	0.00132	0.00145	0.00180
	(1.162)	(1.160)	(1.244)	(1.107)	(1.344)	(0.879)	(1.146)	(1.182)	(1.162)	(1.033)	(1.081)	(1.346)
Working Changes	−0.00386	−0.00378	−0.00449	−0.00388	−0.00302	−0.00424	−0.00409	−0.00361	−0.00520	−0.00557	−0.00409	−0.00293
	(−1.029)	(−0.951)	(−1.127)	(−0.954)	(−0.815)	(−1.059)	(−1.002)	(−0.910)	(−1.235)	(−1.316)	(−1.010)	(−0.758)
Hukou	−0.0238	−0.0354*	−0.0413**	−0.0405**	−0.0198	−0.0418**	−0.0439**	−0.0366*	−0.0420**	−0.0371*	−0.0433**	−0.0248
	(−1.270)	(−1.859)	(−2.137)	(−2.104)	(−1.069)	(−2.117)	(−2.219)	(−1.859)	(−2.117)	(−1.872)	(−2.098)	(−1.245)
Observations	3,143	3,139	3,142	3,141	3,105	2,998	3,027	2,995	3,028	3,008	2,718	2,680
R2	0.239	0.230	0.219	0.219	0.255	0.227	0.215	0.218	0.214	0.214	0.235	0.271

1. The dependent variable in OLS regression is employee's log wages, independent variables are four cognitive abilities (English, reading, math and problem-solving) and five non-cognitive abilities (conscientiousness, extraversion, openness, agreeableness, and neuroticism). Control variables are age, gender, marriage status, education level, BMI, BMI squared. At the same time, we control work experience, the frequency of changing jobs and hukou. 2. The regression in this paper includes 12 regression models. Models 1 to 4 respectively put English, reading, math and problem-solving abilities into the OLS regression. Model 5 takes four cognitive abilities together into regression equation. Models 6–10 respectively put conscientiousness, extraversion, openness, agreeableness, and neuroticism into the OLS regression. Model 11 takes five non-cognitive abilities into the regression equation. Model 12 puts all cognitive and non-cognitive abilities together into the regression equation. 3. T values are listed in the brackets. 4. The signal ***, ** and * represent the significance level at 0.01, 0.05 and 0.1 respectively.

(Mueller and Plug 2006; Heineck and Anger 2010; Heineck 2011; Nyhusa and Ponsb 2005; Lindqvist and Vestman 2011). Different to the existing results (Lindqvist and Vestman 2011), the results of data analysis in this paper show that the skilled workers' non-cognitive abilities have greater effect on wages than unskilled workers.

Finally, this paper put cognitive and non-cognitive abilities into the Mincer wage equation. Regression results show that in general non-cognitive ability's effect on wages are greater than cognitive ability; conscientiousness of the non-cognitive ability has the greatest influence on wages than all cognitive ability. The conclusion was basically the same with Heckman and Urzua (2006). It is worth noting that the elastic coefficient of cognitive abilities of English ability on wages is as high as 12.1%. The survey data for cognitive ability had been focused on the IQ test, therefore, there are few tests focused on language ability. Due to this limitation, it is difficult to compare our results to other literature. Despite this, some research specialized in foreign language ability and income pointed out that premium levels of foreign language ability can achieve 16.9% (Chiswick and Miller 1995). The conclusion is slightly higher than the results in this paper. The difference may be that the cognitive and non-cognitive abilities are not taken into consideration. In addition, the impact of conscientiousness on wages is as high as 13.6%, which was far higher than the existing literature (Mueller and Plug 2006; Nyhusa and Ponsb 2005).

Acknowledgments

The authors are grateful for research support from the projects below: The Key Project of Philosophy and Social Sciences Research from the Ministry of Education of China (15JZD023); The National Key Research and Development Program of China (2015BAH27F01); The National Key Research and Development Program of China (2016YFC0801906); The Key Project of National Social Science Fund (16ZDA045).

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the The Key Project of Philosophy and Social Sciences Research from the Ministry of Education of China; [15JZD023]; The National Key Research and Development Program of China; [2015BAH27F01]; The National Key Research and Development Program of China; [2016YFC0801906]; The Key Project of National Social Science Fund; [16ZDA045].

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