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The role of non-cognitive skills in the adoption of information and communication technology in Indonesia

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ABSTRACT

Non-cognitive skills play an essential role in economic development because they help determine the adoption of technological innovations, such as information and communication technology (ICT). However, evidence of the influence of non-cognitive abilities on ICT adoption in Indonesia is limited. Therefore, this study aims to analyze the role of non-cognitive skills in ICT adoption in Indonesia. This study employed the big five personality traits to measure individuals' non-cognitive abilities. Using the national representative data from the Indonesian family life survey, the probit regression analysis was applied to analyze the role of non-cognitive skills on ICT adoption. The findings show that openness and extraversion can significantly increase ICT adoption. Meanwhile, conscientiousness, agreeableness, and neuroticism show a negative and significant influence. The disaggregate analysis based on gender and location shows different results. The findings in this study have shown that policymaking needs to consider the roles of non-cognitive skills. This finding implies that non-cognitive skills, such as the big five personality traits, should be considered in the formulation of the economic development policy.

Contribution/Originality: This study is the first attempt to determine the effect of the big five personality traits (openness, conscientiousness, extraversion, agreeableness, and neuroticism) on ICT adoption in Indonesia. It also provides a disaggregate estimation based on gender and urban–rural setting.

1. INTRODUCTION

The adoption of information and communication technologies (ICT), such as cell phones and the internet, has grown exponentially in the past two decades. According to World Bank data from 2000 to 2020, the proportion of internet users in the global population increased by 53% (World Bank, 2022). Between 2014 and 2016, businesses' and individuals' average digital adoption index (DAI) increased by 3.36% and 5.51%, respectively (World Bank, 2016). This indicates the significance of ICT in conducting business.

Research has found that ICT can increase product innovation (Chege, Wang, & Suntu, 2020; Ollo-López & Aramendía-Muneta, 2012), reduce the greenhouse effect by increasing energy efficiency (Ollo-López & Aramendía-

Muneta, 2012), and support business performance (Chege et al., 2020), productivity (Jorgenson, Ho, & Stiroh, 2010), technical efficiency (Fernández-Menéndez, López-Sánchez, Rodríguez-Duarte, & Sandulli, 2009), supply chain management (Zhang, Van Donk, & Van Der Vaart, 2011), expansion (Matthews, 2007), consumer satisfaction (Hameed, Nadeem, Azeem, Aljumah, & Adeyemi, 2018; Mao & Lyu, 2017), sales growth (Fazli, Sam, & Hoshino, 2013), and product and service quality (Lindbeck & Wikstrom, 2000). ICT can also reduce market asymmetry (Nwafor, Ogundeji, & Van Der Westhuizen, 2020) and provide intangible benefits to corporate development, such as empowerment, self-esteem, and social cohesion (Ricardo & Shun, 2012). However, not all businesses have the capacity to implement ICT because they may lack funds, knowledge, education, and skills (Arendt, 2008). This phenomenon has drawn researchers' interest in conducting further studies on ICT adoption.

Previous studies have explored the factors that influence ICT adoption, mostly focusing on the demographic profiles of business owners/entrepreneurs, such as age, education, marital status, household size, and vehicle ownership (Oluwatayo & Ojo, 2017; Rini & Rahadiantino, 2020; Yakubu, Abubakar, Atala, Muhammed, & Abdullahi, 2013). Non-cognitive skills have also been found to affect ICT adoption. They can be defined as a person's relatively permanent thinking, feeling, and acting patterns, which shape his/her responses to situations (Roberts, 2009). Several studies have focused on the influence of non-cognitive skills in business. For example, Montalvao, Frese, Goldstein, Kilic, and Frese (2017) found that non-cognitive skills influence the adoption of potential export commodities and the attainment of better agricultural information services. Ali, Bowen, and Deininger (2020) did a study involving 1,200 lowland rice farmers and showed that non-cognitive skills drove technology adoption and improved farmers' technical efficiency. Rosen, Glennie, Dalton, Lennon, and Bozick (2010) believe that non-cognitive skills are equally important as—if not more important than—cognitive skills in predicting income and employment status. According to Marcati, Guido, and Peluso (2008), internal factors, such as personality traits, form the basic foundation of human capital, which correlates with entrepreneurial innovations.

Two theories are widely used in analyzing non-cognitive skills. Eysenck's theory defines three basic personality factors: extraversion–introversion, neuroticism, and psychoticism (Eysenck, 1991). Meanwhile, the big five personality traits are agreeableness, conscientiousness, extraversion, openness, and neuroticism (McCrae et al., 2000). The big five theory is grounded in logic and statistics and is the most applied in previous research, which indicates its suitability in explaining variations in personality. The five characteristics are considered universal features of genetic traits, covering not only phenotypic factors but also genotypic expressions (Matthews, 2009; Payne, 2021). The definitions are as follows: 1) agreeableness reflects an individual's cooperation and social harmony; 2) conscientiousness is the ability to control, regulate, and direct impulses; 3) extraversion is characterized by involvement with the outside world; 4) openness often distinguishes innovative and creative individuals from conventional people; and 5) neuroticism is the tendency to experience negative emotions (McCrae et al., 2000).

This study contributes to the body of knowledge by analyzing a large sample of entrepreneurs in the Indonesian Family Life Survey 5 (IFLS5) data. The IFLS is a continuous socioeconomic and health survey that provides data on individual and household behaviors and outcomes. The IFLS survey sample represents about 83% of the population living in 13 of the 26 provinces in Indonesia (Strauss, Witoelar, Sikoki, & Wattie, 2016). Another contribution of this paper is the consideration of gender in the model. This is necessary because previous studies found differences in technology adoption and personality traits based on gender.

The existing literature has shown that women display higher levels of neuroticism and agreeableness, while men show higher levels of extraversion and openness (Costa, Terracciano, & McCrae, 2001; Vianello, Schnabel, Sriram, & Nosek, 2013). However, Antoncic, Bratkovic Kregar, Singh, and DeNoble (2015) found that men only showed a higher level of openness (not conscientiousness, extraversion, or agreeableness) than women. Differences between men and women result from continuous psychological adaptations and development that evolve into culturally universal disparities over time (Schmitt et al., 2017). Regarding technology adoption, men tend to be more open than women.

Women also show a lower level of technology adoption, most likely due to low confidence in operating new technology (Li, Glass, & Records, 2008) and a lack of awareness of the benefits (Ameen & Willis, 2019).

In brief, this study aims to expand knowledge of personality traits and assess their influence on technology adoption.

2. METHODOLOGY

2.1. Research Data

We use cross-sectional data from the 2014–2015 Indonesian Family Life Survey 5 (IFLS5), accessible from http://www.rand.org/labor/FLS/IFLS.html. The IFLS5 data collection was initiated by research and development (RAND) corporation in 1993 (Batch 1), then continued in 1997 (Batch 2), 2000 (Batch 3), 2007 (Batch 4), and finally, 2014–2015 (Batch 5). RAND uses a stratified sampling design to obtain a family-based sample of 7,224 households in the first batch. The sample represented 83% of the population in 13 Indonesian provinces in 1993 (Rahman et al., 2022). The survey applied by RAND was a longitudinal survey, which means that the sample in the first batch (or their descendants) was interviewed in groups (Agustian et al., 2020). The IFLS was approved by RAND's ethical review and Gadjah Mada University committees before being tested on 393 household members (Nugroho, Hanani, Toiba, & Sujarwo, 2022). We used 31,387 observations from 12,874 individuals living in rural areas and 18,513 in urban areas. We also categorize individuals by gender, namely 14,681 males and 16,706 females.

2.2. Data Analysis

The probit regression analysis seeks to discover the impact of personality traits on technology adoption. This study assumes that farmers' technology adoption is a function of non-cognitive skills and socio-demographics. Specifically, this model can be translated as follows:

$$Adopt_i^* = qO_i + wC_i + uE_i + tA_i + yN_i + \beta X_i + e_i, \; with \; Adopt_i^* = 1 \; if \; adopting, 0 \; otherwise$$

Adopt is a farmer's decision to adopt the technology or not, as described by a dummy variable (1 if adopting and 0 otherwise); O is openness; C is awareness; E is extraversion; A is agreeableness; N is neuroticism; X_i is a socio-demographic variable, such as age, education, marital status, family members, and asset ownership; q, w, u, t, y, and β are parameters to be estimated; and e_i is the error term.

3. RESULTS

3.1. Descriptive Statistics

Table 1 presents the variables selected for this study. The value indicates that 35% of our sample has adopted ICT, specifically internet use. Regarding the big five personality traits, this study reveals that Indonesian residents tend to have higher agreeableness, followed by conscientiousness, openness, and neuroticism. The personality that is least prominent among Indonesian residents is extraversion. The socio-demographic information shows that the average age of the participants is 38–39 years old, with most Indonesians only achieving primary education. Only 10% of Indonesian residents achieved university education, 5.15% of the respondents have children under 15 years old, and the average total family members is 4–5 people. Finally, 75.9% of the respondents have private transportation.

3.2. Empirical Results

The first part of the analysis looks at the effect of personality traits on ICT adoption using the total sample, as shown in Table 2. The second part looks at the effect of personality traits on ICT adoption by area type (urban and rural) and gender (male and female), as shown in Table 3 and Table 4. Regarding socio-demographic variables, we found the same results in the three models. Age has a negative effect on technology adoption—the older the entrepreneur, the lower the chances of them adopting ICT. Meanwhile, low education shows a negative effect and a larger coefficient on ICT adoption. Only diploma and university levels show a positive influence, which means that

the lower the education, the lower the chances of adopting ICT. Regarding status, married entrepreneurs and those with children under 15 show a lower ICT adoption rate. Meanwhile, private vehicle ownership shows a positive effect, with those who own vehicles adopting ICT more than others.

Table 1. Descriptive statistics.

Variable	Measurement	Mean	Std. dev.
ICT	Dummy, 1 if the respondents adopt ICT; 0 otherwise	0.350	0.477
Openness	Total score for openness indicator	11.112	2.006
Conscientiousness	Total score for openness indicator	11.444	1.660
Extraversion	Total score for openness indicator	10.327	2.000
Agreeableness	Total score for openness indicator	11.705	1.534
Neuroticism	Total score for openness indicator	11.011	1.780
Age	Age of respondent in years	38.496	18.924
No education	Dummy (1 = No education, 0 = otherwise)	0.051	0.219
Primary education	Dummy (1 = Primary education, 0 = otherwise)	0.299	0.458
Junior education	Dummy (1 = Junior education, 0 = otherwise)	0.190	0.392
Senior education	Dummy (1 = Senior education, 0 = otherwise)	0.188	0.391
Diploma	Dummy (1 = Diploma education, 0 = otherwise)	0.036	0.185
University	Dummy (1 = Associate degree, 0 = otherwise)	0.100	0.300
Child15	Dummy (1 = If the respondent has a child under 15 years old, 0 = otherwise)	0.515	0.500
Marital_status	Dummy (1 = Married, 0 = otherwise)	0.709	0.454
Hhsize	Numbers of family members	4.269	1.943
Transportation	Dummy (1 = Has private transportation, 0 = otherwise)	0.759	0.439

Table 2. The effect of personality trait on ICT adoption (Pooled).

ICT adoption	Coeff.	Std. error	Sig.
Openness	0.066	0.006	0.000***
Conscientiousness	-0.011	0.007	0.084*
Extraversion	0.022	0.005	0.000***
Agreeableness	-0.014	0.007	0.044**
Neuroticism	-0.021	0.007	0.002***
Age	-0.061	0.001	0.000***
No_education	-1.922	0.182	0.000***
Primary education	-1.370	0.034	0.000***
Junior education	-0.878	0.030	0.000***
Senior education	-0.170	0.029	0.000***
Diploma	0.697	0.051	0.000***
University	1.118	0.039	0.000***
Child15	-0.279	0.027	0.000***
Marital_status	-0.441	0.032	0.000***
Hh size	-0.005	0.005	0.337
Transportation	0.290	0.025	0.000***
_cons	1.940	0.114	0.000***
Log-likelihood = -10757.766			
LR chi^2 (16) = 19532.74			
Prob > chi^2 = 0.0000			
Pseudo R^2 = 0.4758			
Number of observations = 31,387			

Note: *, ** and *** denote significance at 10%, 5%, and 1%, respectively.

By area and gender, we found contradictory results for the influence of demographic variables. Among female entrepreneurs, diploma and university levels of education have a positive effect on ICT, with higher coefficients than men. However, the variable of transportation ownership has a lower coefficient for women. However, variables with a negative effect among female entrepreneurs also show higher coefficients, namely age, elementary and secondary

levels of education, having children under 15 years old, and being married. Regarding area, the coefficients between rural and urban areas do not show a big discrepancy.

Table 3. The effect of personality traits on ICT adoption by gender.

ICT adoption	Gender					
	Male			Female		
	Coeff.	Std. error	Sig.	Coeff.	Std. error	Sig.
Openness	0.055	0.009	0.000***	0.046	0.009	0.000***
Conscientiousness	-0.011	0.009	0.232	-0.018	0.009	0.063*
Extraversion	0.026	0.007	0.000***	0.046	0.007	0.000***
Agreeableness	-0.021	0.010	0.027	-0.009	0.010	0.398
Neuroticism	0.001	0.009	0.944	-0.018	0.010	0.070*
Age	-0.061	0.002	0.000***	-0.069	0.002	0.000***
No_education	-1.563	0.226	0.000***	-2.444	0.430	0.000***
Primary education	-1.169	0.046	0.000***	-1.640	0.055	0.000***
Junior education	-0.721	0.042	0.000***	-1.042	0.045	0.000***
Senior education	-0.097	0.040	0.016**	-0.237	0.042	0.000***
Diploma	0.709	0.079	0.000***	0.769	0.068	0.000***
University	1.130	0.055	0.000***	1.152	0.056	0.000***
Child15	-0.093	0.038	0.015**	-0.433	0.039	0.000***
Marital_status	-0.388	0.047	0.000***	-0.449	0.046	0.000***
Hhsize	-0.006	0.007	0.432	-0.009	0.008	0.292
Transportation	0.312	0.035	0.000***	0.290	0.038	0.000***
_cons	1.817	0.157	0.000***	2.167	0.172	0.000***
Log-likelihood = -5575.2384				Log-likelihood = -4903.1596		
LR chi^2 (16) = 8758.29				LR chi^2 (16) = 11003.97		
Prob > chi^2 = 0.0000				Prob > chi^2 = 0.0000		
Pseudo R^2 = 0.4399				Pseudo R^2 = 0.5288		
Number of obs. = 14,681				Number of obs. = 16,706		

Note: *, ** and *** denote significance at 10%, 5%, and 1%, respectively.

Table 4. The effect of personality traits on ICT adoption by area.

ICT adoption	Area					
	Rural			Urban		
	Coef.	Std. err	Sig.	Coef.	Std. err	Sig.
Openness	0.084	0.010	0.000***	0.057	0.008	0.000***
Conscientiousness	-0.013	0.011	0.226	-0.014	0.008	0.100
Extraversion	0.006	0.008	0.463	0.032	0.006	0.000***
Agreeableness	-0.013	0.011	0.257	-0.010	0.009	0.230
Neuroticism	-0.016	0.011	0.147	-0.026	0.008	0.002***
Age	-0.062	0.002	0.000***	-0.065	0.001	0.000***
No_education	-2.149	0.464	0.000***	-1.767	0.217	0.000***
Primary education	-1.087	0.058	0.000***	-1.389	0.045	0.000***
Junior education	-0.650	0.053	0.000***	-0.886	0.038	0.000***
Senior education	-0.087	0.054	0.108	-0.144	0.035	0.000***
Diploma	0.725	0.102	0.000***	0.695	0.060	0.000***
University	1.124	0.072	0.000***	1.168	0.047	0.000***
Child15	-0.307	0.045	0.000***	-0.264	0.034	0.000***
Marital_status	-0.524	0.052	0.000***	-0.354	0.041	0.000***
Hhsize	0.002	0.010	0.826	-0.008	0.007	0.225
Transportation	0.265	0.039	0.000***	0.248	0.034	0.000***
_cons	1.554	0.191	0.000***	2.249	0.145	0.000***
Log-likelihood = -3844.8111				Log-likelihood = -6677.8069		
LR chi^2 (16) = 6744.17				LR chi^2 (16) = 12033.01		
Prob > chi^2 = 0.0000				Prob > chi^2 = 0.0000		
Pseudo R^2 = 0.4672				Pseudo R^2 = 0.4672		
Number of obs. = 12,874				Number of obs. = 18,513		

Note: *** denote significance at 1%, respectively.

The decrease in ICT adoption opportunities by entrepreneurs due to increasing age is higher in rural areas than in urban areas. Chances for ICT adoption by entrepreneurs with no formal education in rural areas are lower than those in urban areas. However, the adoption trend among those with elementary and secondary levels of education (junior high school) is higher among urban entrepreneurs than those in rural areas. Meanwhile, senior high school education had no significant effect on increasing ICT adoption among rural entrepreneurs, which is in contrast to the trend among urban entrepreneurs. Regarding entrepreneurs with a diploma, the coefficient in rural areas is higher than in urban areas. By contrast, the coefficient of university-educated entrepreneurs is lower in rural areas.

The chances of ICT adoption among entrepreneurs with children under 15 years old and married entrepreneurs in rural areas are lower than those in urban areas. Similar to the effect of a diploma education, the transportation ownership coefficient on ICT adoption is higher among rural entrepreneurs.

4. DISCUSSION

Age negatively influences ICT adoption, which means that the older the entrepreneur, the lower the chances. Young entrepreneurs are more likely to adopt ICT because they are open to challenges and are willing to take risks (Adeoti & Adeoti, 2008; Rahman et al., 2022). By gender and area, the coefficient discrepancy is marginal, meaning that older female and male entrepreneurs in urban and rural areas show a lower probability of ICT adoption by almost the same rate.

A low level of education will reduce the probability of entrepreneurs adopting technology. Table 2 shows that all entrepreneurs, regardless of gender and area, with no formal education or with elementary and secondary levels of education show negative results, which indicates a lower probability of adopting ICT. By contrast, diploma and university level education indicates a positive correlation. These results align with previous research stating that company leaders' education is a strong determinant of business adoption and evolution, especially in applying ICT (Chatzoglou & Chatzoudes, 2016).

In the agricultural sector, educated farmers as business owners adopt modern ICT to obtain agricultural information (Jain, 2017). The magnitude of the influence of education, as seen from the coefficient values, is higher among female entrepreneurs in all education levels (both with positive and negative signs). Therefore, it is recommended that education should be promoted among women because their probability of implementing ICT is higher than among men. Furthermore, the opposite is true—if female entrepreneurs have low education, the probability of adopting technology is also lower than men. This is in line with previous findings, suggesting that women are more likely to apply ICT, especially social media and network technology (Orser & Riding, 2018), if their education is higher.

In terms of area, the probability of adoption among those without formal education is lower in rural areas than in urban areas. This shows the importance of education for rural communities to increase ICT adoption. People living in rural areas tend to have limited knowledge, even more so when they receive no formal education. Meanwhile, although urban communities may not be formally educated, they have access to information related to ICT from other sources because the facilities and infrastructure are better in urban areas (Nugroho et al., 2022). However, in urban areas, the adoption rate among entrepreneurs with elementary and secondary education levels is lower. This may be due to the non-optimal level of education in urban areas.

Entrepreneurs with children under 15 years old showed a lower probability of adopting an ICT device, regardless of gender. This is probably because they need to spend time raising their children. At the same time, they have to increase productivity and manage household budgets, which often induces stress (Nugroho et al., 2022). This may discourage them from adopting technology to avoid the risks of further stress if their attempt to understand and adopt the new technology fails. The effect of being a parent on technology adoption is stronger among women. This is probably due to the conventional perception of parenthood, where mothers take on a bigger role than fathers in

raising children. Previous findings suggest that the interaction between a mother and a child is calmer, more affectionate, socially oriented, and didactic. Meanwhile, a father's parenting also has a didactic element but tends to involve physical activities (Schoppe-Sullivan, Kotila, Jia, Lang, & Bower, 2013; Steenhoff, Tharner, & Væver, 2019). Entrepreneurs in rural areas with children under 15 years old show a lower rate of ICT adoption than urban entrepreneurs. People in rural communities may spend more time with their children, so they have less time to search for ICT information. Meanwhile, people in urban communities have the opportunity to secure better jobs so they can obtain more information related to ICT.

Married entrepreneurs are less likely to adopt technology than those with other marital statuses. This may be because married entrepreneurs will allocate their income to their families, while unmarried entrepreneurs do not have this responsibility, so they can afford new devices (Neway & Zegeye, 2022). Married female entrepreneurs are less likely to adopt new technology because they spend more time caring for the family. A common perception in Indonesia is that women have a bigger responsibility in taking care of the family. We also found that married entrepreneurs in rural areas are less likely to adopt ICT. Rural communities have a close relationship with their families (Hofferth & Iceland, 1998) and they may not want to take risks that might jeopardize their family's livelihood. They do not want to try new things that might risk their business because it will threaten the family's survival.

Finally, private vehicle ownership positively affects ICT adoption among both men and women, which means that they are more likely to adopt new technology. In Indonesia, private vehicles can be an indicator of wealth. The probability of owning a vehicle will increase as wealth increases (Wu, Zhao, & Ou, 2014). Therefore, they are more likely to adopt ICT because they have better financial resources (Langyintuo & Mungoma, 2008). Men are more likely to own a private vehicle than women (Zambang, Jiang, & Wahab, 2020), so they are also more likely to adopt new technology. By area, the probability of ICT adoption by rural entrepreneurs with a vehicle is higher. This may be due to the importance of having a means of transportation for the mobility of people in rural communities. Only wealthy people have private vehicles because it is a luxury for rural communities. Meanwhile, private vehicles in urban communities have been considered a necessity, so they may not be an indicator of wealth. Therefore, the impact on ICT adoption is smaller.

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