



Job market compensation for cognitive reflection ability

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ABSTRACT

Using a sample of 12,982 Brazilian professional accountants collected in 2012, we show that reflective accountants receive higher job compensation (wages) compared to their impulsive peers. Results are robust to matching on gender, age, education, number of children, place of residence, and job-related covariates. Results were also replicated in a sample of 1,932 professional accountants collected in 2017 with a different cognitive reflection scale, showing the persistence and robustness of the effect either to an alternative proxy for cognitive reflection and a different timeframe.

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1. Introduction

Studies on cognition and impulsivity show that thinking quickly may lead educated people to make mistakes on simple reasoning decisions (Frederick, 2005; Kahneman, 2011). Moreover, a lower cognitive ability (impulsiveness) is associated with lower performance in minimizing losses and maximizing gains (Cáceres and San Martín, 2017), and impulsive people who act quickly but without planning may tend to make disadvantageous choices compared to nonimpulsive people (Jelihovschi et al., 2018). Impulsiveness may also lead to negative consequences, such as substance abuse (Loree et al., 2015) and obesity (Fields et al., 2013). Moreover, it significantly impacts educational performance (Diamantopoulou et al., 2007) and employment behaviors (Everton et al., 2005). Despite the impairments caused by impulsiveness in daily life, Dickman (1990) suggests that impulsivity may also be functional, as acting with little forethought may be appropriate in some contexts—e.g., sports (Lage et al., 2011).

In economics, finance, and accounting studies, reflectivity used to be analyzed as an explanatory or control variable to rational decision-making, such as in pricing assets (Thoma et al., 2015), auditing financial statements (Viator et al., 2014), or interpreting financial information (Cardoso et al., 2018). Regarding individual characteristics besides cognitive reflection ability, there is evidence that personality traits affect employees' compensation (Barrick and Mount, 1991); however, whether the market compensates for reflectiveness is currently unclear.

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Reflectiveness is a broad category “encompassing a wide range of abilities such as reasoning, problem-solving, and abstract thinking” (Peng, 2019). Moreover, cognitive ability also is shown to influence economic decision making (Kawamura and Ogawa, 2019). Reflectiveness is also known as a Type 2 reasoning, while the impulsiveness is known as Type 1 (Kahneman, 2011). While the Type 1 reasoning is effortless it can be highly biased, however while Type 2 is regarded as producing better judgment and decision making, it is cognitive costly.

Thus, although “Type 1 responses are sometimes of high quality”, they can “lead to low quality decision making” (Griffith, Kadous, and Young, 2016). Therefore, it is expected that the job market should recognize a higher cognitive ability trait as desirable, and compensate for it in the form of higher wages. In this paper we test this hypothesis using data from the 2012 Survey of Accountants conducted by the Brazilian Accounting Association.

Results indeed show that a higher cognitive ability is associated with higher job compensation in the form of wages. We then proceed to estimate a number of robustness tests, such as estimating the effect with more consistent estimators (Ordinal Logit and Ordinal Probit instead of OLS), and we strengthen the causality claim of our results with a propensity score matching which reproduces the results. Additionally, we replicated the results using data collected in 2017, five years after the first data collection.

Hence, this paper fills the literature gap by showing that the job market indeed recognizes cognitive reflection ability as a positive and valuable trait, thus showing the rationality of the job market. Moreover, we also show the importance of building one's cognitive ability in order to improve one's potential value for the job market.

The paper is structured as follows: Section 2 describes the data used in this study. Section 3 presents the results, including robustness estimations such as propensity-score matching and an alternative proxy for impulsiveness, and details replication of the results conducted five years after the main collection. Section 4 concludes.

2. Data

We included the three questions from the original Cognitive Reflection Test (CRT) (Frederick, 2005) in the 2012 Survey of Accountants' Profile performed by the Brazilian Accountants Association (BAA). The survey also collected demographic information (for a summary and explanation of demographic variables, see Table 1).

The demographic variables included information such as income, gender, age, number of children, education level, state of residence, if the accountant lives in the state capital or not, features of employment (whether participant is a private sector employee, public servant or partner of an accounting firm), if the professional seeks for specialization through additional courses, classes, books, videos, etc. and if the person has another source of income (second job).

Data on income was collected as a seven-point categorical variable, originally measured in Real (the Brazilian official currency, BRL) and based on the monthly income, the usual way to receive the salary in Brazil. Due to inflation, and aiming to have comparability between both surveys, the income categories were set on the basis of the official minimum wage, as follows: (1) up to 3 minimum wages; (2) from 3 to 5 minimum wages; (3) from 5 to 10 minimum wages; (4) from 10 to 20 minimum wages; (5) from 20 to 30 minimum wages; (6) from 30 to 50 minimum wages; (7) more than 50 minimum wages. In 2012 the official minimum wage was BRL 622.00, which converted at the average foreign exchange rate for the period (i.e., USD 1 = BRL 2.29), was equivalent to USD 271.62. Hence, in the 2012 survey the seven-point annual income in US dollars are: (1) up to \$10,593; (2) \$10,593–\$17,655; (3) \$17,655–\$35,310; (4) \$35,310–\$70,620; (5) \$70,620–\$105,930; (6) \$105,930–\$176,550; (7) more than \$176,550. In 2017 the official minimum wage was BRL 937.00, which converted at the average foreign exchange rate for the period (i.e., USD 1 = BRL 3.23), was equivalent to USD 290.34. In the 2017 survey the seven-point annual income in US dollars are: (1) up to \$11,323; (2) \$11,323–\$18,872; (3) \$18,872–\$37,745; (4) \$37,745–\$75,490; (5) \$75,490–\$113,234; (6) \$113,234–\$188,724; (7) more than \$188,724.

Table 1
Summary of variables.

Variable	Range	Description
Income	1–7	This variable describes the income bracket of each individual and is our main dependent variable.
CRT Score	0–3 / 0–4	This variable describes the cognitive reflection score for each individual.
CRT Dummy	Dummy	Conversion of the CRT Score to a dummy variable, 1 if reflective and 0 if impulsive.
CRT Contrast	3 values: -1, 0, +1	Conversion of the CRT Score in the replication to a dummy variable, +1 if reflective and -1 if impulsive.
Gender	Dummy	1 if female.
Children	Continuous	Number of Children.
Age	Continuous	Age of the participant.
Education	3 dummy variables	Series of 3 dummies: MBA, MSc and PhD with bachelor's degree as baseline.
State	26 dummy variables	Series of 26 dummy variables to account for the 27 states of Brazil.
Capital	Dummy	1 if lives in the capital of a state, 0 otherwise.
Other	Dummy	1 if the participant has another source of income apart from his or her main job.
Search	Dummy	1 if the participant seeks to keep updated with the profession through courses, reading, videos, etc.
Type	6 dummy variables	Series of six dummy variables to denote the type of job: owner of a firm, employee of an accounting firm, employee from any other type of firm, employee from a government-owned firm, civil servant, employee from a non-profit institution.

3. Results

3.1. Baseline regression

We estimated the following ordinary least squares regression using the data from the 2014 survey:

$$Income_i = \beta_0 + \beta_1 CRT_Score_i + \beta Controls_i + \varepsilon_i.$$

Table 2 presents the results. An increase of 1 point in the CRT score (which ranges from 0 to 3) increased the income bracket by 0.154 point ($t = 15.08$). We also estimated a CRT dummy, with a value of 1 if the person was reflective (CRT score = 2 or 3) and 0 if they were impulsive (CRT score = 0 or 1). Reflective accountants had, on average, an income bracket 0.278 point ($t = 16.03$) greater than impulsive accountants did, even when controlling for different covariates.

Thus, we showed that there is an association between a higher cognitive reflection ability and an increased job compensation (wage). This confirms the theory in which the Type 2 way of reasoning (i.e. a more reflective person) is beneficial for individuals, and that the job market, at least for accounting, compensates for this personal trait.

In the next subsections we perform a series of robustness tests in order to increase the plausible causality claim of the association between cognitive reflection ability and increased wages.

3.2. Ordinal Logistic and Probit regressions

Because data on income is a categorical variable with 7 levels, the OLS estimator may not be appropriate. Therefore, we test the robustness of our main results using both an Ordinal Logistic Regression and an Ordinal Probit Regression. Results are presented at Table 3.

As presented on Table 3, results are shown to be robust to these additional estimators which are known to be more consistent when fitting a categorical dependent variable. Using OLS is therefore more desirable, especially due to the fact that the OLS coefficients can be more easily interpreted (instead of being the natural logarithm of the odds ratio for the OL or a transformation of the normal curve CDF for the OP).

3.3. Propensity score matching

We calculated the propensity score of a person being impulsive (CRT dummy = 0) or reflective (CRT dummy = 1) in the following logistic regression specification:

$$\ln(p(CRT_dummy_i = 1 | Controls_i)) = \beta_0 + \beta Controls_i + \varepsilon_i.$$

Table 2
Results from baseline estimations.

	I	II	III	IV
CRT Score	0.233 (20.22)	0.154 (15.08)		
CRT Dummy			0.437 (18.70)	0.278 (16.03)
N	12982	12949	12982	12949
R ²	0.03	0.30	0.03	0.30
Controls?	No	Yes	No	Yes

t-values in parentheses.

Sample size differs among tests due to missing values for some control variables.

Table 3
Results from robustness estimations.

	OL.I	OL.II	OL.III	OL.IV	OP.I	OP.II	OP.III	OP.IV
CRT Score	0.335 (20.61)	0.267 (15.47)			0.190 (20.22)	0.149 (15.05)		
CRT Dummy			0.608 (18.77)	0.461 (13.51)			0.351 (18.66)	0.265 (13.43)
N	12982	12949	12982	12949	12982	12949	12982	12949
Pseudo-R ²	0.01	0.12	0.01	0.12	0.01	0.12	0.01	0.12
Estimator	OL	OL	OL	OL	OP	OP	OP	OP
Controls	No	Yes	No	Yes	No	Yes	No	Yes

t-values in parentheses.

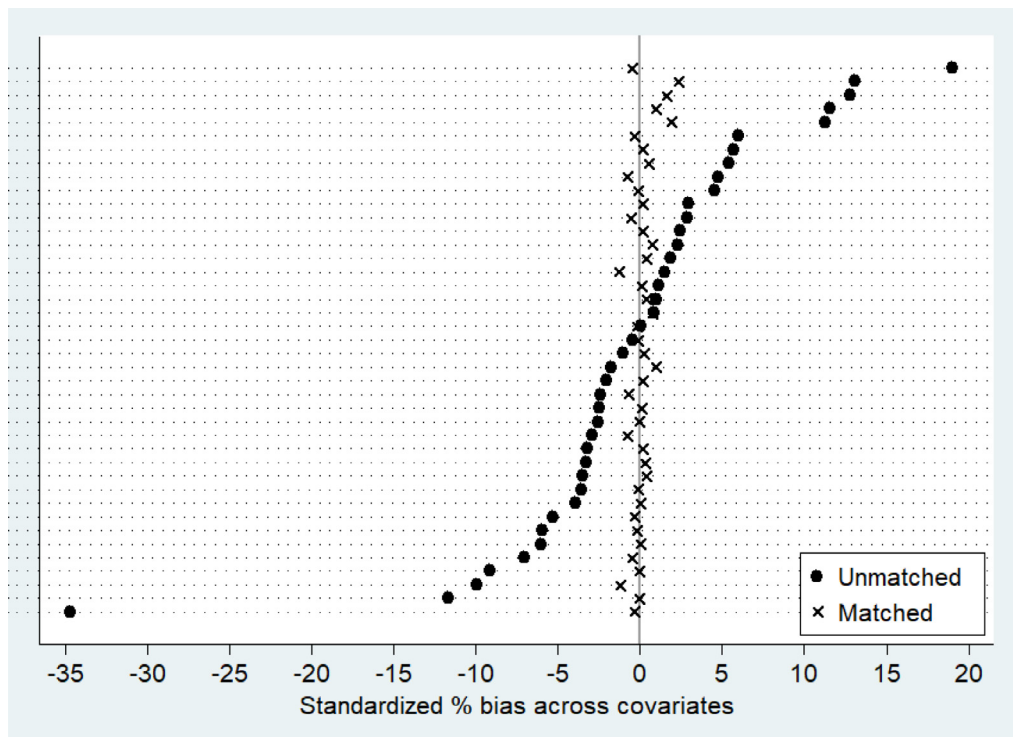


Fig. 1. Bias reduction due to kernel-weighted propensity score matching.

We then used the propensity score to create comparable groups of impulsive and reflective individuals regarding gender, age, education, number of children, place of residence, and job-related variables. Fig. 1 shows the results of bias reduction due to the kernel-weighted matching procedure.

Table 4 presents the estimation results. All coefficients remain similar when compared to the main results. Reflective accountants had, on average, an income bracket 0.2 point greater than impulsive accountants did. Because the groups are comparable, the inclusion of controls did not change the results. Fig. 2 shows the income distribution over the two nearest-neighbor matched groups. While there are more impulsive accountants than reflective ones in the lower income brackets (1, 2, and 3), there are more reflective than impulsive accountants in higher brackets (4–7).

3.4. Alternative proxy for impulsivity

The previous estimations considered CRT score values of 0 and 1 as a proxy for impulsivity, and 2 or 3 as reflective. However, those who scored 1 may have been more comparable to those that scored 2 than to those that scored 0. Hence, the cut point could be perceived as arbitrary, which could hinder our results.

Thus, we present additional results using an alternative proxy that only considers people who scored 0 as impulsive and those that scored 3 as reflective. Hence, we consider only the extremes of the scale, which removes the possible interpretation of the arbitrary cut point as a measurement problem. This reduced the sample to 4,788 participants.

Table 4
Results from matching estimations.

	I	II	III	IV
CRT Dummy	0.281 (12.29)	0.283 (14.46)	0.237 (8.21)	0.239 (9.81)
N	12949	12949	8063	8063
R ²	0.01	0.28	0.01	0.28
Controls?	No	Yes	No	Yes
Matching	Kernel	Kernel	NN	NN

t-values in parentheses. NN = Nearest neighbor.
Sample size differs between tests I & II and III & IV due to the NN matching selection criteria.

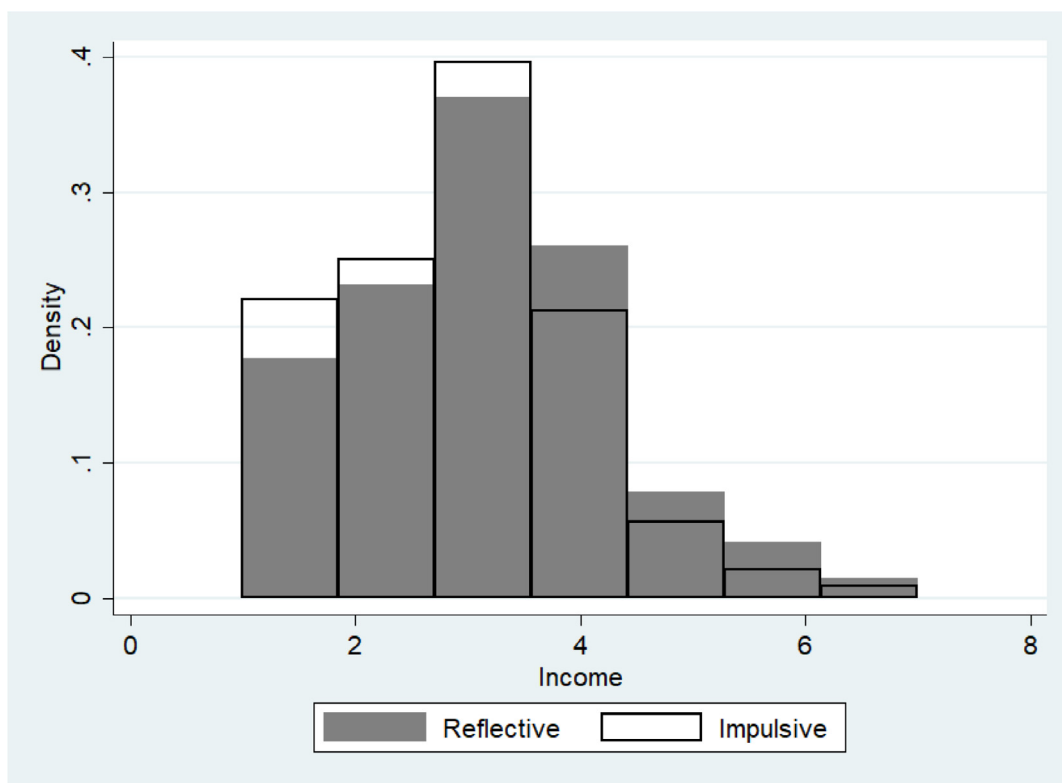


Fig. 2. Income distribution in the matched sample (nearest-neighbor matching).

Table 5

Results from alternative estimations.

	I	II	III	IV
Alternative CRT Dummy	0.670 (17.30)	0.457 (12.53)	0.463 (12.06)	0.469 (14.08)
N	4788	4770	4770	4770
R ²	0.06	0.30	0.03	0.27
Controls?	No	Yes	No	Yes
Matching	No	No	Kernel	Kernel

t-values in parentheses.

Sample size differs among tests due to missing values for some control variables.

Table 6

Replication results.

	I	II	III	IV
CRT Score	0.141 (5.71)			
CRT Dummy (0, 1)		0.296 (4.86)		0.133 (2.52)
CRT Contrast (-1, 0, +1)			0.184 (5.33)	
N	1932	1932	1932	1932
R ²	0.02	0.01	0.01	0.31
Controls?	No	No	No	Yes

t-values in parentheses.

As shown in Table 5, more reflective accountants had again a higher income bracket, on average, than did impulsive ones. In this specification, the income bracket averaged 0.5 point greater for reflective than for impulsive accountants. Notice that this coefficient has a greater magnitude when compared to previous estimations, which is in line with the fact that we are now comparing the extremes of the scale.

3.5. Replication in 2017

We replicated our results in 2017 with a different sample and a different scale for measuring cognitive reflection ability. This replication shows the robustness of our results first in the timeframe of the data collection, and also shows that results are independent of the test used to measure cognitive reflection ability.

We used an alternative CRT questionnaire for the replication, with four questions drawn from Toplak, West & Stanovich (2014) and Thomson & Oppenheimer (2016). All questions are presented at the end of the paper as an Appendix section.

The sample comprised 1,932 professional accountants from the 2017 Survey of Accountants performed by the BAA. The income was again divided into seven brackets, but the nominal amounts were adjusted for minimum wage inflation (see Section 2 for more details). Hence, income brackets in the 2017 survey had similar purchasing power as in the 2012 survey.

As explained, the alternative CRT was comprised of four questions. Hence, we coded reflectivity in three different ways: the new CRT score, which varies from 0 (no correct answer) to 4 (all correct answers); a CRT dummy in which a higher score than the sample's average (1.82 points) was coded as 1, and 0 otherwise; and the CRT contrast, coded as +1 if the person had a score of 3 or 4, 0 if their score was 2, and -1 if their score was 0 or 1. Table 6 presents the results.

Reflectivity, therefore, was again positively associated with job compensation. Hence, the main results are robust not only to timeframe, since they were replicated five years after the first data collection, but also regarding choice of CRT, because in the replication we used an updated version of the test.

4. Conclusion

This study evidences that employers compensate employees for their reflectivity. That is, accountants that consider and evaluate options before making decisions receive higher salaries than do those who are impulsive. Hence, the job market compensates for cognitive reflection ability.

During reflective actions, important cognitive processes such as working memory are necessary for positive results in decision-making. Libby et al. (2002) suggest that decision-makers have limited capacity to retain and retrieve required information from their memory, and insights about their own process of decision-making and preferences are also bounded. Thus, to improve reflectiveness, professionals should be aware of their ability to manage working memory by training their attention and other aspects related to this cognitive function (Gibson et al., 2012, 2013; Brehmer et al., 2011). Thereby, decision-making should improve, and thus not only productivity should follow but also the job compensation, as we showed in the present study.

The robustness of our results relies on three factors. First, we used two measures of cognitive reflection ability, the original CRT (Frederick, 2005) and an alternative measure that incorporated two other proposals. Second, we collected data at two time points (2012 and 2017) from similar samples (Brazilian professional accountants), and results remained similar. Third, in addition to collecting data from two reasonably comparable participant samples, we used several covariates to match impulsive and reflective accountants, using a propensity score matching approach.

Notwithstanding, our paper relies on data collected from just one sample of professionals from one specific country (Brazil). Further research could use a cross-country comparison to investigate how different cultural factors influence these results. Moreover, further research can also analyze the impact of cognitive ability on wages from different samples of professionals.

Declaration of Competing Interest

One of the co-authors worked as independent consultant, helping the BAA to organize the survey questionnaire and data. He did not receive any monetary compensation but was allowed to include in the survey some questions of his academic research interest, such as the CRT questions. Thus, the authors declare no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.rie.2020.02.002](https://doi.org/10.1016/j.rie.2020.02.002).

Appendix

Cognitive Reflection Test Questionnaire

Original cognitive reflection test (data collection, 2012):

[Frederick \(2005\)](#):

A bat and a ball cost \$1.10 in total. The bat costs \$1.00 more than the ball. How much does the ball cost? \$____ [correct answer \$0.05; impulsive answer \$0.10].

If it takes 5 machines 5 min to make 5 widgets, how long would it take 100 machines to make 100 widgets? ____ min [correct answer 5 min; impulsive answer 100 min].

In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? ____ days [correct answer 47 days; impulsive answer 24 days].

Alternative cognitive reflection test (data collection, 2017):

[Toplak, West & Stanovich \(2014\)](#):

If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? ____ days [correct answer 4 days; impulsive answer 9].

Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? ____ students [correct answer 29 students; impulsive answer 30].

Simon decided to invest \$8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: (a). broken even in the stock market, (b). is ahead of where he began, (c). has lost money [correct answer c, because the value at this point is \$7,000; impulsive answer b].

[Thomson & Oppenheimer \(2016\)](#):

Emily's father has three daughters. The first two are named April and May. What is the third daughter's name? ____ [correct answer Emily; impulsive answer June]

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