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The role of cognitive reflection in decision making: Evidence from Pakistani managers

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Abstract

Assessing how managers discount and evaluate risks is crucial in designing effective managerial policies. In this work, we examine whether risk preferences (RP; both in the domains of gain and loss) and time preferences (TP) are related to managers' cognitive reflection (CR). To achieve this, the current study focuses on the responses of 601 corporate decision-makers, such as CEO and CFO, of 200 non-financial firms listed at the Pakistan Stock Exchange. Using the three-item of Cognitive Reflection Test (CRT; Frederick, 2005) as a measure of CR, we observe that males perform better on this test than females. Correlation analysis reveals that individuals' RP in the gain domain are positively associated with their TP, implying that risk-taking individuals are more patient. Our evidence further shows that higher CR is associated with a higher likelihood of increased patience and a lower likelihood of willingness to take risks in the domain of loss. Greater CR is also linked to a higher likelihood of risk-taking in the domain of gain. These findings have important implications regarding the ability of managers to make financial decisions that involve uncertainty and delayed rewards but maximize firm value.

Keywords: risk and time preferences, cognitive reflection, judgment, decision making, managers, behavioral economics.

1 Introduction

Managers make many decisions in their everyday life involving time discounting and a large degree of uncertainty. Empirical evidence from experimental economics, neuroeconomics and cognitive psychology suggests that risk preferences (RP), preferences for risky versus safe outcomes, and time preferences (TP), preferences for immediate versus deferred outcomes, are related to decision making in many critical real-life domains, such as economics, finance, health and wealth (Anderson and Mellor (2008); Allen, Weeks and Moffitt (2005); Barsky et al. (1997); Boyle et al. (2012); Cohn et al. (1975); Guiso and Paiella (2008); James et al. (2015); Jarmolowicz et al. (2014); Harrison, Lau and Rutström (2007)). For example, people who are risk-averse prefer to invest in *safe*, low-yield options, such as Treasury bonds, rather than *risky*, high-yield ones, such as stocks (Cohn et al., 1975). Greater risk aversion is also associated with poor financial and healthcare decision making (Boyle, Yu, Buchman, et al., 2012), and dangerous health behavior, such as cigarette smoking, heavy drinking and being overweight (Anderson & Mellor, 2008). Likewise, impatience is significantly associated with lower level of income and education (Reimers et al., 2009), poorer school performance (James et al., 2015), being overweight or obese (Chabris et al., 2008; Jarmolowicz et al., 2014; Reimers et al., 2009), smoking (Chabris et al., 2008; Reimers et al., 2009), alcohol consumption (MacKillop et al., 2010; Petry, 2001; Vuchinich & Simpson, 1998), craving (MacKillop et al., 2010), drug addiction (Bickel & Marsch, 2001; Kirby, Petry & Bickel, 1999; Kirby & Petry, 2004), engaging in unsafe sex (Reimers et al., 2009), less exercise (Chabris et al., 2008), higher amounts of credit card debt (Meier & Sprenger, 2010) and under-utilization of health insurance (Hsu, Lin & McNamara, 2008). Thus, understanding how managers discount and evaluate risks is essential for making optimal financial decisions such as investment and risk-taking.

Several experimental studies have investigated the role of *inter-individual differences*, with specific reference to cognitive abilities, in individual risk and time preferences for decision-making. Perhaps importantly, these studies suggest that high-ability individuals tend to reveal preferences that differ from their counterparts. More precisely, the literature demonstrates that higher cognitive ability (CA) is significantly associated with more pronounced patience (Białek & Sawicki, 2018; Booth & Katic, 2013; Frederick, 2005; James et al., 2015; Melikian, 1959; Nofsinger & Varma, 2007; Shamosh & Gray, 2008), more risk-seeking in the domain of gain (Byrnes, Miller & Schafer, 1999; Croson & Gneezy, 2009; Donkers, Melenberg & Van Soest, 2001;

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Eckel & Grossman, 2008; Ioannou & Sadeh, 2016; Weber, Blais & Betz, 2002) and greater risk aversion in the domain of loss (Burks et al., 2009; Frederick, 2005; Kirchler et al., 2017; Nofsinger & Varma, 2007; Noori, 2016). However, not all researchers have reached the same conclusion; for example, Andersson, Holm, Tyran and Wengström (2016) suggest both a negative and a positive correlation between risk aversion and CA, while Brañas-Garza, Guillen and del Paso (2008) and Booth and Katic (2013) find no relationship between CA and risk attitudes. Similarly, Kirby, Winston and Santiesteban (2005) document a negative correlation between students' grades and delay-discount rates, whereas Monterosso et al. (2001) and Noori (2016) do not find any relationship between patient behavior and CA.

Results from recent literature of student subjects and general population suggest that CA seems to be the robust predictor of risk attitudes and intertemporal choices (Basile & Toplak, 2015; Białek & Sawicki (2018); Boyle et al., 2011; Cueva et al., 2016; Park, 2016). However, until now, to the authors' best knowledge, no research has been conducted to test the effects of cognitive reflection (CR) on risk and time preferences among managers.

With this backdrop, the present study utilizes data from a sample of 601 *managers* of 200 non-financial firms listed at the Pakistan Stock Exchange to examine: 1) the associations of risk attitudes with intertemporal choices; 2) gender differences in the Cognitive Reflection Test (CRT); and 3) the correlations between RP (both in the domains of gain and loss), TP and CR. We use Frederick's CRT to measure CR. RP are assessed using standard behavioral finance questions in which subjects were asked to choose between a certain payoff or a gamble in which they could gain more or gain nothing at all. Similarly, to measure TP, we asked subjects to choose between a smaller-sooner reward versus a larger-later one. These (and other) questions that we asked in our survey were purely hypothetical, and no compensation was offered for the participation; hence, the reality might not be reflected truthfully. This could be seen as a weakness of the data. Fortunately, the literature suggests that, for simple choice tasks, subjects do not need monetary incentives to elicit their preferences (Beattie & Loomes, 1997; Brañas-Garza, Kujal & Lenkei, 2015; Campos-Vazquez, Medina-Cortina and Velez-Grajales, 2018; Donkers et al., 2001; Jullien & Salanié, 2000).

Our results indicate that managers' risk-taking in the gain domain is positively associated with their patience. In accordance with previous research (e.g., Frederick, 2005; Noori, 2016), we find that males perform better on the CRT than females. Finally, we observe that better CRT performance is positively correlated with risk-seeking in the gain domain, and negatively with risk-seeking in the loss domain and impatient behavior.

The remainder of the paper is organized as follows. Section 2 describes, in relative detail, our method. Section 3 presents our key empirical results and discusses important findings. Finally, Section 4 concludes and draws out some implications and limitations of this research.

2 Method

2.1 Subjects

This study uses survey data. In total, 601 Pakistani corporate financial decision-makers of 200 non-financial firms listed at the Pakistan Stock Exchange participated in the present study. 63 of the subjects are female. The average age of the sample is 37.62 years (*STDEV* = 10.50; range: 24–72). The sample comprises 21 Board Directors, 17 Chief Executive Officers (CEOs), 7 Vice Presidents, 71 Chief Financial Officers (CFOs), 19 Finance Directors, 47 General Managers (GMs), 16 Financial Controllers, 45 Senior Managers, 11 Chief Accountants, 11 Heads of Accounts, 220 Managers, 22 Accountants, 21 Executives and 75 Officers. The mean value of tenure (i.e., the number of years an individual has been in the current position) is 5.67 (*STDEV* = 3.55; range: 1.6-12). The sample contains 116 lower- 272 middle- and 213 top-level managers. The average values of past experience (in years) and highest qualification are 6.17 (*STDEV* = 4.19; range: 0-12) and 1.84 (*STDEV* = 0.57; range: 1-4), respectively. 350 of the subjects hold a business degree (e.g., MBA). Of the participants, 154, 221 and 120 indicate accounting, finance and both accounting & finance, respectively, as their academic major, and the remaining 106 subjects are those who indicated "other" as their academic major.

2.2 Procedure

Financial managers were surveyed by the investigators at their respective companies between September 1, 2017 and January 23, 2018. The survey was conducted by employing a three-stage approach: e-mail, telephone, and face-to-face. We downloaded the companies' address book[1] from the Pakistan Stock Exchange data portal section. The address book contains all the required information, such as company address, telephone number, e-mail address and name of the company representative, which were needed for reaching the target subjects. E-mails containing the questionnaire and participant's information sheet were sent to the potential subjects inviting them to take part in the enclosed survey. In each e-mail, we provided our contact details and explained the purpose of conducting the survey. Survey invitations were sent to 372 non-financial companies' e-mail addresses, which were extracted from the address book. Out of the 372 firms, just three firms filled out the questionnaires, which yielded a response rate of less than 1%. To get the required

[1]The address book can be found at https://dps.psx.com.pk/.

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responses, we then used the telephonic approach and contacted the potential subjects using firms' contacts, which were extracted from the address book. In addition to obtaining a reasonable response rate, we also used this method to reach the subjects who were geographically dispersed.[2] Compared to the first technique, this method was relatively successful because approximately twenty percent of the all responses were collected through this approach.[3] The last approach used to collect the data was a face-to-face mode of administering the questionnaire. The researchers personally visited the target firms that were located in the big cities of Pakistan and distributed the questionnaires to three levels of management. Compared to the previous two modes, this technique was very helpful because around eighty percent of the total responses were collected by this approach.

Potential subjects were informed of their right to withdraw from participating at any time without giving a reason. All of the questionnaires were filled out individually. The instructions for survey filling were given in the questionnaire. It was emphasized that all the items had to be answered. A small number of subjects returned the questionnaires with a few items blank. The researchers asked these subjects to fill out the unanswered questions. Because of this procedure, there are no missing data. No time limit was imposed to complete the survey; on average, a survey lasted 25 minutes. Subjects were not paid.

2.3 Materials

Subjects were asked to fill in a six-section survey questionnaire[4] including the following tasks: (i) demographic and socio-economic characteristics; (ii) optimism (not reported here) and risk & time preferences; (iii) mindfulness (not reported here); (iv) financial literacy (not reported here); (v) CRT; and (vi) behavioral biases (not reported here). The titles given in the questionnaire for each of the sections were: "Demographics", "Life Attitudes", "Day-to-Day Experiences", "Financial Literacy", "Cognitive Reflection" and "Behavior and Attitudes". The tasks (CRT, risk and time preferences, and demographic and socio-economic characteristics) that are used in the current study are described in detail below.

[2]A majority of the target firms were in the largest cities of Pakistan, such as Karachi, Lahore, Islamabad/Rawalpindi, Faisalabad and Multan, but some of the firms (one or two in numbers) were in small cities of Pakistan, like Chakwal, Bannu, Haripur and Mardan. Therefore, due to time and budget constraints, it was not feasible for us to personally visit the small-city firms, and almost all of them were contacted using the e-mail and telephonic approaches.

[3]Managers who showed a willingness to participate in the survey shared their e-mail addresses, and subsequently, we e-mailed them the questionnaires.

[4]The subjects did all the tasks in English, which is their foreign language.

2.3.1 Cognitive Reflection (CR)

In our survey, we measured CR by employing the three items in the CRT (Frederick, 2005) to gauge an individual's mode of reasoning and CR. The same test is used by Albaity, Rahman and Shahidul (2014), Andersson et al. (2016), Białek and Sawicki (2018), Campitelli and Labollita (2010), Cueva et al. (2016), Nofsinger and Varma (2007), Noori (2016), Oechssler, Roider and Schmitz (2009), Taylor (2013) (2016) and Thomson and Oppenheimer (2016) to study the relationships between economic preferences and CR. The following three problems are extracted from Frederick's (2005, p. 27) paper that constitute our CRT score:

1. A bat and a ball together cost 110 cents. The bat costs 100 cents more than the ball. How much does the ball cost? (____cents). [*Intuitive (incorrect) answer: 10 cents; Correct answer: 5 cents*]
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets? (____min). [*Intuitive (incorrect) answer: 100 min; Correct answer: 5 min*]
3. 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). [*Intuitive (incorrect) answer: 24 days; Correct answer: 47 days*]

Figure 1 presents the distribution of CRT responses of the sample subjects. The figure shows that for the Bat & Ball question, the "impulsive" answer (10) is more frequent than the "reflective" one (5). Whereas, for the Machines and Lily Pads questions, the reflective answers (5 and 47, respectively) are much more frequent than the impulsive ones (100 and 24, respectively). These statistics suggest that the majority of the subjects' answers are either reflective or impulsive. However, Figure 1 also indicates that some of answers differ from the reflective or impulsive ones.

Furthermore, in our sample, 24.8% of the managers solved all of the three problems correctly, 22% solved two problems correctly, 18.6% solved one problem correctly, and the remaining 34.6% solved none of the problems correctly. On average, the managers have solved 1.37 (*STDEV* = 1.19; range: 0–3) of the CRT problems correctly. Cronbach's alpha for our sample is 0.72, which is higher than that reported in Campitelli and Gerrans (2014), Liberali et al. (2012, Study 2), Morsanyi, Busdraghi and Primi (2014), Primi et al. (2016) and Weller et al. (2013), and lower than that in Liberali et al. (2012, Study 1). Further, averages of intuitive and non-intuitive errors are 1.39 (*STDEV* = 1.14; range: 0–3) and 0.24 (*STDEV* = 0.50; range: 0–3), respectively. This finding corroborates Frederick's (2005) view that the CRT problems prompt intuitive, but incorrect answers.

Moreover, average score of correct responses for males is 1.43 (*STDEV* = 1.20; range: 0–3) and for females is 0.83 only

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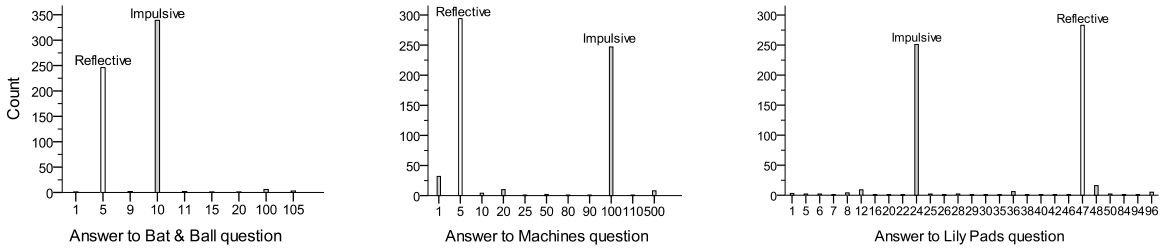

FIGURE 1: Answer distribution of the three CRT problems.

(*STDEV* = 0.99; range: 0–3; $p < 0.001$ for the difference, by Mann-Whitney U test). This gender difference is perfectly in line with past results in the literature (Albaity et al., 2014; Cueva et al., 2016; Frederick, 2005; Noori, 2016; Oechssler et al., 2009; Thomson & Oppenheimer, 2016).

2.3.2 Risk Preferences (RP)

With the aim of assessing the relationship between CR and RP, we included the following two gamble items in the survey. For both of the questions, participants were having the option of choosing either a certain payment of x or a lottery choice with a 75% chance of getting $2x$ and a 25% chance of getting nothing. The first question of RP is in the domain of gain (x = +10 lakhs Rs.)[5], while the second item as a measure of RP is in the domain of loss (x = −1m Rs.).[6]

1. Assume you have the choice between two alternatives. Alternative 1: You receive Rs. 10 lakhs. Alternative 2: You receive a lottery ticket that yields a 75% chance of winning Rs. 20 lakhs. With a 25% probability, it is worthless. Which alternative do you choose?
   (a) Alternative 1 (b) Alternative 2
2. Suppose you have to pay Rs. 1m as your debt due. Would you prefer to replace this payment through the following alternative: With a probability of 75% you must pay Rs. 2m. With a 25% probability, you do not have to pay anything.
   (a) Yes (b) No

2.3.3 Time Preferences (TP)

To test the presumption that people with higher cognitive abilities are more patient, the researchers use the following item for measuring TP, which is a slightly modified version of a question used by Oechssler et al. (2009, as well as Albaity et al., 2014, and Noori, 2016).

> Presume that you won Rs. 2m as a prize in a lottery and there are two options, which one do you choose:
> (a) Take the prize immediately (b) Take the prize after 1 month with 5% premium

The test item gives two hypothetical choices to check whether subjects prefer to take the prize immediately (impatient option) or after a month with five percent increment (patient option).

2.3.4 Other Covariates

Existing research (e.g., Andersson et al., 2016; Boyle et al., 2011; Burks et al., 2009; Croson & Gneezy, 2009; Donkers et al., 2001; Eckel & Grossman, 2008; James et al., 2015; Taylor, 2013, 2016) have suggested that demographic characteristics (e.g., gender, age and education) and contextual factors (such as past experience) also influence individuals' economic preferences. Accordingly, in the present study, subjects were also asked to answer a set of background questions, which we include as covariates to perform secondary analyses. These covariates are: gender (Male = 0, Female = 1); age in years (range: 24–72); CEO title (CEO = 1, Non-CEO = 0); tenure, i.e., the number of years an individual has been in the current position (range: 1.6–12); level of management (Lower = 1, Middle = 2, Top = 3); past experience in years (range: 0–12); highest qualification (Bachelor = 1, Master = 2, MPhil = 3, PhD = 4); business degree (No = 0, Yes = 1); and academic major (Accounting, Finance or Both Accounting & Finance = 1, "Other" = 0). Age, tenure and past experience are treated as ordered (categorical) variables,[7] level of management and highest qualification as (discrete) ordinal variables, and the remaining background characteristics are treated as nominal variables.

3 Results

The present study follows, among others, Campitelli and Labollita (2010), Shenhav, Rand and Greene (2017) and Thomson and Oppenheimer (2016) in using the CRT score as

[5]Rs. is the Pakistani rupee, and one lakh is equal to 100 thousand. In early September 2017, the exchange rate was approximately 105 Pakistani rupees/U.S. dollar, therefore 10 lakhs Rs. ≅ $9,500.

[6]These two questions are based on Oechssler et al. (2009, p. 151–2). Albaity et al. (2014) and Noori (2016) used similar items.

[7]We convert these interval measures to numerical variables by interpolation (Bhandari & Deaves, 2006). That is, we take interval midpoints (e.g., 35 in case of age 30–40); and to depart by 20% for an open-ended interval (e.g., 72 in case of age above 60).

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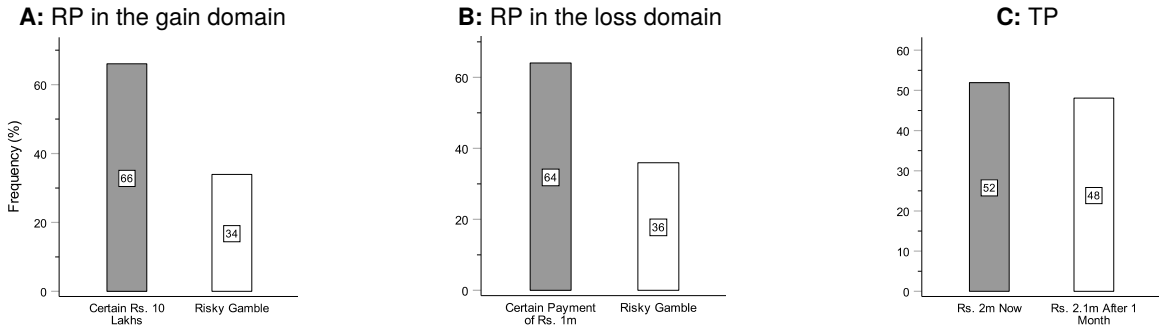

FIGURE 2: Frequency (%) of risk and time preferences.

a continuous measure of CR instead of high-low split (Frederick, 2005; Oechssler et al., 2009) because dichotomous measures have been criticized for sacrificing statistical power (Altman and Royston, 2006; Fitzsimons, 2008; González-Vallejo & Phillips (2010); Irwin & McClelland, 2001,, 2003; MacCallum, Zhang, Preacher and Rucker, 2002) and creating spurious effects (Altman and Royston (2006); Fitzsimons (2008); Maxwell and Delaney (1993)).

3.1 Risk and Time Preferences and Cognitive Reflection (CR)

As discussed above, we asked the subjects two risky choice questions. For the first question, which was in the gain domain, 66.1% of the sample (397) chose the option of certain payment of Rs. 10 lakhs, while remaining 33.9% of the respondents (204) preferred the lottery option (that yields a 75% chance of winning Rs. 20 lakhs) [Panel A in Figure 2]. Similarly, for the second item, which was in the loss domain, three hundred eighty-five subjects (64.1%) took the certain option while the remaining two hundred and sixteen subjects (35.9%) picked the risky gamble option (Panel B in Figure 2). Therefore, the sample of the current research could be considered safe (both in the domains of gain and loss).

To measure temporal preferences, we confronted the subjects with a single intertemporal choice question in which they were asked to choose between an immediate, smaller payoff and a deferred, larger one. At the aggregate level, 312 managers (51.9%) chose to "take the prize immediately" while the remaining 289 managers (48.1%) preferred to "take the prize after one month with 5% premium" (Panel C in Figure 2). These preliminary results suggest that slightly over half of the sample in the present research is impatient.

To investigate the relationships between CR and decision tasks, we calculate the bivariate correlations among these measures using both Pearson and Spearman correlation coefficients. As seen in Table 1, CRT score is positively correlated with RP in the gain domain, suggesting that good performance in the CRT is positively related to risk-taking in the gain condition. This finding is perfectly in line with the results of previous studies, namely, Benjamin, Brown and Shapiro (2013), Dohmen et al. (2010), Frederick (2005), James et al. (2015), Kirchler et al. (2017), Monterosso et al. (2001), Nofsinger and Varma (2007), Oechssler et al. (2009) and Park (2016). For the second item of RP, which is in the loss domain, the obtained results indicate that CRT score is negatively correlated with this item, implying that CRT performance is inversely linked to risk-seeking in the loss condition. This finding is similar to the results of Burks et al. (2009), Frederick (2005), Kirchler et al. (2017), Noori (2016) and Oechssler et al. (2009). As expected, CRT score shows a significant negative correlation with (impatient) TP, which suggests that high performance in the CRT is negatively linked to impatient behavior. This result is consistent with several other studies (e.g., Albaity et al., 2014; Basile and Toplak, 2015; Dohmen et al. (2010); Frederick, 2005; Hirsh et al., 2010; Melikian, 1959; Shamosh et al., 2008; Slonim, Carlson and Bettinger, 2007), suggesting that subjects with higher CR are more patient. To sum up, our results reveal that managers who are high on CR are more

TABLE 1: Intercorrelations among CR and risk and time preferences.

Variable	1	2	3	4
1. CRT score		0.104^{**}	-0.175^{***}	-0.146^{***}
2. RP in gains	0.106^{***}		0.027	-0.351^{***}
3. RP in losses	-0.176^{***}	0.027		0.048
4. TP	-0.147^{***}	-0.351^{***}	0.048	

N = 601. All reported values are Pearson's (Spearman's) correlation coefficients below (above) the diagonal. RP in gains and RP in losses are binary variables, coded as 1 if a subject chooses a risky option and 0 otherwise. TP is also a binary variable, coded as 1 if a subject chooses an impatient option and 0 otherwise. See the Method section for a detailed description of the variables.

*** $p < 0.01$, two-tailed; ** $p < 0.05$.

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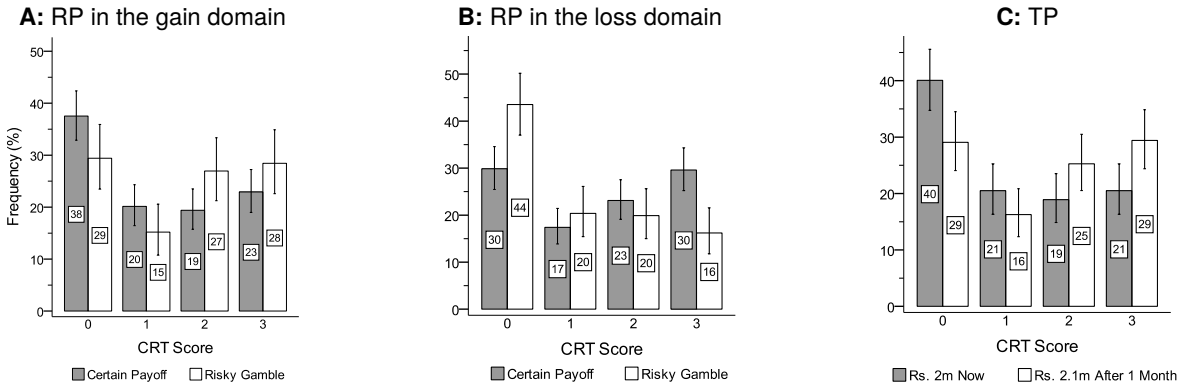

FIGURE 3: Frequency (%) of risk and time preferences.

(less) likely to take risks in the gain (loss) domain and are less impatient.

Our results in Table 1 remain unchanged when we use high-low (CR) classification (Frederick, 2005; Oechssler et al., 2009) instead of the CRT score as a continuous measure of CR. The findings in Table 1 are also robust to the application of alternative methods of estimation, such as OLS and (Binary) Logistic regressions, instead of inspections of the correlation coefficients.

Figure 3 reports the frequencies (%) of the two decision-making tasks (RP and TP) when broken down by the four CRT scores. Panel A shows a majority of the sample with zero and one CRT scores selected the sure payment of Rs. 10 lakhs instead of the risky gamble (38% vs. 29% and 20% vs. 15%, respectively), while this pattern is exactly opposite for the sample with two and three CRT scores. For the loss domain, Panel B demonstrates that the majority of the zero and one CRT scorers preferred the risky gamble alternative on paying a sure debt (of Rs. 1 million) (44% vs. 30% and 20% vs. 17%, respectively), while this pattern is again exactly opposite for the managers with two and three CRT scores. Finally, it is apparent from Panel C that a substantial number of the subjects having zero and one CRT scores preferred to take the prize immediately instead of taking it after one month with 5% increase (40% vs. 29% and 21% vs. 16%, respectively), while this pattern is exactly opposite for the subjects having two and three CRT scores. Overall, Figure 3 suggests that the higher proportions of the managers with zero and one CRT scores chose a certain payoff in the gain domain, a risky gamble in the loss domain and an impatient option, while this pattern is precisely opposite for the managers having two and three CRT scores.

3.2 Associations between Risk and Time Preferences

Part of the reason for discounting future rewards depends on the risk factor resulted by the delay period. It is possible that preferences towards risk and time are motivated by similar processes (Ioannou & Sadeh, 2016). The literature on the relationship between risk and time preferences is scant, and the results are mixed. For instance, Burks et al. (2009) find evidence that subjects' patience and willingness to take risks are significantly correlated with each other, both in short- and long-run. Menon and Perali (2009) also find that impatient subjects are also more risk-averse. Campitelli and Labollita (2010) report no significant correlation between intertemporal and risky choices. Recently, James et al. (2015) document that risk aversion is weakly correlated with (both large and small stakes) temporal discounting. In a more recent paper, Ferecatu and Önçüler (2016) note that risk aversion is negatively correlated with impatience. Finally, Ioannou and Sadeh (2016), find that individuals' intertemporal choices are not correlated with their risk aversion. Therefore, we next assess whether our measures derived from the two decision making characteristics (RP and TP) are correlated. These results are also presented in Table 1.

As can be seen from Table 1, managers' RP in the gain domain are negatively and weakly correlated with their (impatient) TP. In other words, our result implies that less patient managers are more risk-averse in the gain domain. This is consistent with previous results in the literature (e.g., Burks et al., 2009; James et al., 2015; Menon and Perali, 2009). However, we find no significant correlation between risk-taking in the loss domain and impatient TP ($p > 0.24$) (Campitelli & Labollita, 2010), as well as between both risk-taking measures ($p > 0.51$) (Thomson & Oppenheimer, 2016).

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TABLE 2: Intercorrelations between risk and time preferences and other covariates.

Variable	RP in gains		RP in losses		TP	
Gender	−0.039	(−0.039)	0.151***	(0.151***)	0.036	(0.036)
Age (in years)	−0.001	(0.007)	0.123***	(0.125***)	0.027	(0.024)
CEO title	0.090**	(0.090**)	−0.002	(−0.002)	−0.097**	(−0.097**)
Tenure (years in current position)	−0.030	(−0.006)	0.132***	(0.145***)	0.023	(0.017)
Level of management	0.064	(0.072)	−0.009	(−0.005)	−0.020	(−0.028)
Past experience (in years)	0.027	(0.028)	0.039	(0.039)	−0.001	(−0.004)
Highest qualification	−0.011	(−0.021)	0.020	(0.015)	0.034	(0.038)
Business degree (e.g., MBA)	−0.034	(−0.034)	−0.006	(−0.006)	−0.025	(−0.025)
Academic major	0.046	(0.046)	−0.099**	(−0.099**)	−0.026	(−0.026)

$N = 601$. All reported values are Pearson's (Spearman's) correlation coefficients. RP in gains and RP in losses are the binary variables, coded as 1 if a subject chooses a risky option and 0 otherwise. TP is also a binary variable, coded as 1 if a subject chooses an impatient option and 0 otherwise. Gender is a dummy variable that takes the value of 1 if the subject is female and 0 otherwise. Age, Tenure and Past Experience are treated as ordered (categorical) variables; see the Method section for operationalization of these variables. CEO Title is a dummy variable that takes the value of 1 if a subject has the job title CEO and 0 otherwise. Level of Management and Highest Qualification are treated as (discrete) ordinal variables; see the Method section for operationalization of these variables. Business Degree is a dummy variable that takes the value of 1 if a subject holds a business degree (e.g., MBA) and 0 otherwise. Academic Major is a dummy variable that takes the value of 1 if a subject indicated accounting, finance or both accounting & finance as his/her academic major and 0 otherwise. See the Method section for a detailed description of the variables.
*** $p < 0.01$, two-tailed; ** $p < 0.05$, two-tailed.

3.3 Associations between Risk and Time Preferences and Other Covariates

We now turn our attention to the analysis on how demographic characteristics and contextual factors are related to risk and time attitudes, using both Pearson and Spearman correlation coefficients, Table 2 reports the bivariate correlations among these measures. The obtained results show that RP in the gain domain have a significant positive correlation with CEO title, but not with any other covariates. This finding suggests that CEOs are more likely to take risks in the gain domain as compared to non-CEOs. RP in the loss domain show a significant positive correlation with gender (Thomson & Oppenheimer, 2016), age and tenure, and a significant negative correlation with academic major. In other words, our results indicate that a manager's gender, age and the number of years s/he has been in the current position are related to her/his risk-seeking behavior in the domain of loss. Further, managers who are specialized in accounting, finance or both accounting and finance are less likely to take risks in the loss domain as compared to those who have "other" academic specialization. Finally, TP are negatively correlated with CEO title, but not with any other covariates. This outcome implies that CEOs are less likely to take an immediately available inferior reward as compared to non-CEOs.

4 Conclusion

Risk aversion and time discounting are the two key determinants of many important real-world outcomes, such as economic, finance and health, but, as yet, there lacks a study on risk aversion and time discounting among managers. Thus, the present research fills the gap and contributes to the subject matter. Through the use of a large sample ($N = 601$) of Pakistani financial decision-makers, such as CEO and CFO, of 200 non-financial firms listed at the Pakistani Stock Exchange, we test whether risk attitudes and time discounting, are correlated with CR as measured by the CRT (Frederick, 2005). We find that individuals' risk tendencies in the gain domain are positively associated with their patient behavior. In keeping with existing literature, we also find that male managers significantly out-perform female managers on the CRT. Our statistical tests further show that CR is positively related to the tendency to pick a lottery option in the domain of gain, and inversely linked to a higher likelihood of choosing a risky gamble in the domain of loss and a preference for a smaller but immediate reward. Notably, we find that CEOs are more likely to seek risks in the gain domain and are less likely to be impatient than non-CEOs. Further, we observe that risk-taking in the domain of loss is positively correlated with (female) gender, age and tenure (i.e., the number of

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years an individual has been in the current position), and is negatively correlated with academic major in accounting, finance or both accounting and finance.

Findings of this study are relevant for the development of better theories of human decision-making as well as for the formation of managerial policies. For example, our findings suggest that CR is an important predictor of economic preferences. Therefore, for firms, boosting CR can assist key decision-makers to improve their financial decision process. In fact, Sala and Gobet (2017) document that our "cognition is extraordinarily malleable to training." Thus, firms can provide reflective (and reasoning) training (Willis et al., 2006; Zhang et al., 2017) to their managers to boost their CR, which will help them in making better financial decisions (Ball et al., 2002; Donovan, Güss and Naslund, 2015; Kulason et al., 2018). Another implication of the study is for the human resources of organizations. They can hire managers with higher CR because our findings together with other similar studies (e.g., Benjamin et al. (2013); Cueva et al., 2016; Dohmen et al., 2010; Frederick, 2005; Oechssler et al., 2009) show that more reflective individuals are less responsive to short-run TP and RP in the negative domain. Consequently, these high-CR managers can potentially promote firm's growth and financial success by efficiently reducing the effects of risk aversion and impatience. Finally, evidence relating to CR and risk and time preferences advocates that managers with higher CR might save more, through patient behavior and get higher expected returns, through greater risk-seeking behavior in the gain domain, which possibly leading them to perform a more successful role in financial decision making than those with poor CR.

This work has a number of limitations that may influence the interpretations of the obtained findings. For instance, the data employed in the present study is cross-sectional, which is gathered through questionnaires from a single set of respondents at one specific point in time. A longitudinal study by other researchers could provide useful insights into the relationships between CR and decision-making traits. Besides, the questions used to measure the study variables are one measurement method, while there are other proxies which can be used to measure CA [such as GPA, SAT scores, Raven's Matrices and WAIS[8] (Burks et al., 2009; Kirby et al., 2005; Monterosso et al., 2001; Slonim et al., 2007)], RP [like "multiple price list" approach (Miller, Meyer and Lanzetta, 1969; Holt and Laury, 2002) and the "ordered lottery selection" method (Binswanger, 1980,, 1981; Barr, 2003)] and TP [e.g., the "convex time budget" method (Andreoni & Sprenger, 2012), the "double multiple price list" approach (Andersen et al., 2008), "time-tradeoff" sequences (Attema et al., 2010) and the "risk-free" intertemporal choice task (Laury, McInnes & Todd Swarthout, 2012)]. Therefore, future research using alternative measures of these variables can verify and validate the findings of the present research. Finally, we evaluate RP (both in the domains of gain and loss) and TP through single-item scales. Single-item measures are simple, quick, and useful to target busy participants and easy to administer to large samples (Bowling, 2005; Loo, 2002; Waltz, Strickland & Lenz, 2010); however, methodologists advocate the use of multi-scale instruments (Loo, 2002; Nunnally, 1978) because they are more stable, reliable and precise (Bowling, 2005; Loo, 2002). Consequently, we encourage other researchers to examine the relationships between CR and decision-making using multi-item measures of RP and TP, such as the multiple price list (Miller et al., 1969) and double multiple price list (Andersen et al., 2008) approaches.

[8]WAIS = Wechsler Adult Intelligence Scale.

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Appendix: Literature Review[9]

Risk Preferences (RP) and Cognitive Reflection (CR)

A number of publications are available in the literature that discuss the link between RP and various facets of CA, though findings are mixed and also no one has focused on the managerial population. For instance, Monterosso et al. (2001) find that intelligence quotient (IQ) estimate is positively correlated with performance on the gambling task. Frederick (2005) reports that subjects with higher CRT scores are more willing to gamble in the domain of gains. He further documents that high-CRT subjects are less willing to seek risks for items involving loss and they prefer to accept a sure loss to avoid playing a gamble with a lower or negative expected value. However, Frederick also reveals that low-CRT subjects are more willing to seek risks in the domain of loss. Nofsinger and Varma (2007) observe that intuitive planners are more risk-averse (in the gain domain, but not in the loss domain) than analytical planners. Oechssler et al. (2009) find that, in the positive domain, individuals in the higher CA group are significantly more willing to take risks. While, in the negative domain, they report that low-ability individuals are significantly more likely to gamble. Burks et al. (2009) conclude that participants with higher cognitive skills are more willing to take risks in the gain domain. However, they report that participants with worse cognitive skills are more willing to take gambles for the items involving loss than those with better cognitive skills. Similar to Frederick (2005), Burks et al. (2009) also find that subjects with greater cognitive skills are more willing to accept a small sure loss to avoid a lottery with a lower or more negative expected value. Dohmen et al. (2010) report that higher CA is associated with a greater willingness to take risks. In the gain domain, Campitelli and Labollita (2010) observe positively significant correlations between CRT and risky choice items. Boyle et al. (2011) reveal that a lower level of CA is associated with greater risk aversion among older persons without dementia. Benjamin et al. (2013) reveal that higher cognitive skills are correlated with less small-stakes risk aversion. James et al. (2015) note that more rapid cognitive deterioration predicts higher levels of risk aversion in community-based older adults. Recently, Noori (2016) states that participants with low CRT scores are more (less) likely to reveal risk aversion in the domain of gain (loss). In a related study, Cueva et al. (2016) document that reflective decision-makers are less risk-averse than impulsive ones. Another related work, by Park (2016), concludes that subjects with low cognitive skills being risk-averse when facing the high (low) probability of gain (loss), however being risk-seeking when facing the low (high) probability of gain (loss).

[9]See Table A1 for a summary of the studies on risk and time preferences and cognitive ability.

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Similarly, Kirchler et al. (2017), in the loss domain, indicate that scoring high in the CRT is linked to risk-neutral behavior, whereas in the gain domain, risk aversion is independent of participants' CRT scores. Rather recently, Dohmen et al. (2018) suggest that CA is related to risk-taking behavior.

However, Brañas-Garza et al. (2008) find no relation between students' scores on a GRE-like math test and risk attitudes. Booth and Katic (2013) display no effect of CA on RP. Albaity et al. (2014) also document no relationship between individuals' CRT scores and RP. Similarly, Thomson and Oppenheimer (2016) observe no relationship between CR and RP (both in the domains of gain and loss). Recently, Ioannou and Sadeh (2016) conclude no relationship between subjects' risk aversion and their cognitive abilities. In a more recent research, Campos-Vazquez et al. (2018) reveal that CA has no effect on RP.

Besides, Campitelli and Labollita (2010) observe a positive (but insignificant) correlation between CR and risky choices (in the loss domain). Andersson et al. (2016) suggest both a negative and a positive correlation between risk aversion and CA. Taylor (2013) finds that greater CA is related to lower risk aversion when individuals make choices in the hypothetical context, but CA is unrelated to risk aversion in the real-choice context. Likewise, Taylor (2016) reveals that the (inverse) relationship between risk aversion and CA is not robust. He further states that CA is not significantly correlated with RP when choices are real and are characterized by uncertainty, but it is significantly correlated when choices are hypothetical and the safe option is certain.

Collectively, the above-cited studies imply that various measures of CA and RP are connected with each other. Thus, it is expected that, as in most of past studies, subjects with higher CR will take more (less) risks in the positive (negative) domain.

Time Preferences (TP) and Cognitive Reflection (CR)

The relationship between different measures of RP and CA has been tested in several empirical studies, although, again, results are mixed and most of the previous research have targeted the convenient university population. Melikian (1959), for example, reports that subjects with higher "Goodenough" intelligence test scores tend to prefer a larger delayed reward rather than a smaller immediate one. Frederick (2005) finds that greater CR results in favoring the later larger reward. Slonim et al. (2007) find that subjects with higher Scholastic Assessment Test (SAT) scores are significantly more likely to be patient. Nofsinger and Varma (2007) document that high-CRT financial advisors are more patient than the low-CRT ones. Shamosh et al. (2008) reveal that delay discounting[10] is negatively linked to general intelligence (g), as well as to working memory. In a meta-analysis, Shamosh and Gray (2008) report that higher intelligence is associated with lower delay discounting. Hirsh, Morisano and Peterson (2008) observe a significant negative relationship between discounting and CA. Oechssler et al. (2009) report that individuals with lower cognitive abilities are more impatient. Burks et al. (2009) state that subjects with better cognitive skills are more patient (in both short- and long-run). Hirsh et al. (2010) conclude that preferences for immediate gratification are negatively associated with CA. Dohmen et al. (2010) reveal that greater CA is associated with increased patience. Boyle, Yu, Segawa, et al. (2012) indicate that a lower level of CA is associated with greater temporal discounting. Benjamin et al. (2013) report that discounting over short-time horizons is more common among those subjects having a low CA. Albaity et al. (2014) document that subjects' higher test scores on the CRT are significantly linked to a lower likelihood of being impatient. In a related study, James et al. (2015) observe that cognitive decline significantly predicts temporal discounting among older adults. Also, Basile and Toplak (2015) demonstrate that preference for a larger delayed reward is associated with higher cognitive abilities. Similarly, in a more recent work, Białek and Sawicki (2018) conclude that high-CRT individuals discount less strongly than low-CRT ones.

However, Monterosso et al. (2001) find no relationship between cocaine dependents' IQ scores and their performance on delay discounting procedure (i.e., choosing between smaller-sooner and later-larger rewards). Noori (2016) also finds no relationship between TP and CRT scores. Likewise, Ioannou and Sadeh (2016) do not find any support of the hypothesis that TP are associated with subjects' cognitive abilities. In addition, Thomson and Oppenheimer (2016) report no consistent relationships between measures of CR and TP. In a more recent paper, Campos-Vazquez et al. (2018) find an insignificant relationship between CA and TP.

Besides, Kirby et al. (2005) document a negative correlation between students' grades and delay-discount rates. Similarly, Campitelli and Labollita (2010) observe a negative (but insignificant) correlation between intertemporal choice and CRT. In a related research, Shenhav et al. (2017) demonstrate that subjects who prefer smaller sooner to later larger monetary payoffs are more likely to give intuitive, but wrong responses, on the CRT.

Collectively, the above-cited research indicate that different proxies of CA and TP are related to each other. Hence, it is expected that, as in much of earlier work, managers with higher cognition level will be more patient.

[10]Delay discounting is the tendency to prefer smaller, sooner payoffs to larger, later ones.

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Table A1: A summary of the studies on risk and time preferences and CA.

Author/s (year)	Country/ies	Data collection	Sample source/s	Sample size	CA measure/s	Analysis method/s
Melikian (1959)	Lebanon	Paper & Pencil	(Refugee) Children	172	Draw-A-Man test	χ^2-test
Monterosso et al. (2001)	USA	Test battery	Cocaine addicts	32	WAIS-III	Pearson
Frederick (2005)	US	Questionnaire	Students + General public	3,428 (35 studies)	CRT	χ^2 + *t*-tests
Kirby et al. (2005)	US	Questionnaire	Students	247	GPA + SAT scores	Correlation
Slonim et al. (2007)	US	Questionnaire	Students	137	SAT scores	OLS regression
Nofsinger and Varma (2007)	US	Questionnaire	Financial planners	108	CRT	χ^2 + *t*-tests
Brañas-Garza et al. (2008)	Spain	Questionnaire	Students	192	GRE-like math test scores	Kruskal-Wallis, OLS, and Median
Hirsh et al. (2008)	Canada	Questionnaire	Students	97	Brief cognitive measure	Correlation + Regression
Shamosh et al. (2008)	USA	Questionnaire	Not clearly stated	103	*G*	Correlation
Oechssler et al. (2009)	Germany	Questionnaire	General public	564	CRT	χ^2 + MWU
Burks et al. (2009)	US	Questionnaire	Trainee tractor-trailer drivers	1,066	Raven's matrices + Hit 15 task + Numeracy test	Correlation + Regression
Dohmen et al. (2010)	Germany	Interview + Questionnaire	Adults	1,012	Symbol-digit + Word fluency	Spearman + Interval regression
Campitelli and Labollita (2010)	Argentina	Questionnaire	General population	157	CRT	Pearson
Hirsh et al. (2010)	Canada	Questionnaire	Students	137	Wonderlic Personnel Test	Regression
Boyle et al. (2011)	USA	Interview	Older persons	369	Global cog. function + 5 cog. domains	Correlation, *t*-test, & Mixed effects model
Boyle, Yu, Segawa, et al. (2012)	USA	Interview	Older adults	388	Global cog. function + 5 cog. domains	Correlation + Mixed effects model
Benjamin et al. (2013)	US	Questionnaire	Students	210 (from 3 studies)	Standardized math scores + GPA	Ordered probit model
Booth and Katic (2013)	Australia	Interview + Questionnaire	Young people	Not stated	Percentile ranking for university entrance	Ordered probit model
Taylor (2013)	US	Questionnaire	Students	97	CRT + Numeracy test	Maximum likelihood
Albaity et al. (2014)	Malaysia	Questionnaire	Students	880	CRT	Correlation
Basile and Toplak (2015)	Canada	Lab experiment	Students	99	Intelligence + Executive functions	Spearman + Hierarch. regression
James et al. (2015)	USA	Interview	Older adults	445	Global cognitive function	Spearman + Mixed effects model
Noori (2016)	Iran	Questionnaire	Students	395	CRT	MWU + Fisher's Exact
Cueva et al. (2016)	Spain & Italy	Questionnaire	Students	1,180 (from 8 studies)	CRT	Structural estimation
Andersson et al. (2016)	Denmark	Questionnaire	General population	3,663 (from 2 studies)	CRT + Standard intelligence test	Spearman, OLS, and Interval regression
Ioannou and Sadeh (2016)	UK	Lab experiment	Students	118	CRT	Mixed-effects ordered probit
Park (2016)	South Korea	Paper-based Experiment	Adult financial consumers	243	CRT	*t*-test
Taylor (2016)	US	Questionnaire	Students	184	CRT + CA test	Logit and Poisson regressions
Thomson and Oppenheimer (2016)	US	Questionnaire	Students	143	CRT, CRT-2, & Belief Bias	Spearman
Kirchler et al. (2017)	Austria, US, Swe.	(Lab and web) survey	Students + US adults	1,709 (from 4 experiments)	CRT	Correlation + Logit model
Shenhav et al. (2017)	US	(Online and laboratory) survey	Volunteers, Local residents, Students, & MTurk[1] workers	8,293 (from 12 survey samples)	CRT, Shipley Vocab. & WAIS Matrix Reasoning	Correlation + Mixed-effects regression
Campos-Vazquez et al. (2018)	Mexico	Interview + Questionnaire	Teenagers + Adults	3,020 (from 2 types of data)	Raven's Progressive Matrices test	OLS regression
Białek and Sawicki (2018)	Canada, UK, US & Poland	Questionnaire	Workers on MTurk and ORSEE[2]	266 (from 2 experiments)	CRT	Pearson

[1] Amazon Mechanical Turk. [2] Online Recruitment Software for Economic Experiments.

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