The Importance of Numerical Abilities, Conscientiousness and Financial Literacy in Financial Decision-Making: An Empirical Analysis in the Andean Region

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Motivation: Cognitive characteristics

- Importance of cognitive characteristics in explaining socioeconomic behaviors: educational attainment, health, criminality and labor market outcomes.

- Cognitive characteristics or intelligence are related to abstract thought and are commonly defined as the rate at which people learn.

- Scores on intelligence tests (IQ tests)

Cognitive characteristics and financial decisions

Higher levels of cognitive characteristics positively affect financial habits in different ways (Bucher-Koenen and Ziegelmeyer, 2010; Grinblatt *et al.,* 2011; Chritelis *et al.,* 2010; Agarwal and Mazumder, 2012; Cole *et al.;* 2013, among others):

- Fewer financial mistakes are made, there is less probability of default, a greater range of more sophisticated financial products are used, etc.

- Primarily suggest that **numeracy abilities** are strongly related to making appropriate financial decisions.

Motivation: Personality Traits

- These terms are used to describe personal attributes that are not measured by cognitive test.

- Psychologists have sketched a relatively commonly accepted taxonomy of personality traits known as the '*Big Five'*:

Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism.

- Personality traits could be as useful as cognitive characteristics in predicting socioeconomic behaviors (Heckman and Kautz, 2013; Borghans *et al.,* 2011; Almlund *et al.,* 2011).

Personality traits and financial decisions

- There is a connection between the presence or absence of certain sub-facets related to *Conscientiousness* – propensity to plan and perseverance - in explaining:

    - Indebtedness and default (Klinger *et al.,* 2013; Di Giannatale *et al.,* 2015),
    - Good management of finances (Kaufmann, 2012),
    - Investment biases (Jamshidinavid *et al.,* 2012)
    - Savings (Kausel *et al.,* 2016).
    - Etc.

Motivation: Financial Literacy

- Financial literacy is another element that has come to be considered a relevant determinant of financial decisions.

- Existence of a positive correlation between financial literacy and appropriate financial decision-making (Lusardi and Mitchell, 2014); others have not found any relevant correlation.

- This difference in perspective could stem from two factors:

  - Cognitive characteristics and education seem to be strongly related to financial literacy (McArdle *et al.,* 2009).

  - There seems to be a problem of endogeneity between financial literacy and financial decision-making (Klapper *et al.,* 2012; Van Rooij *et al.,* 2011; Lusardi and Mitchell, 2014).

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Objective

- The present study aims to analyze the effects of cognitive characteristics, personality traits, and financial literacy on financial decision-making.

- Our analysis is based on the *Financial Capabilities Survey*, applied in Bolivia, Colombia, Ecuador and Peru (CAF, OECD toolkit).

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Methodology: Survey

Based on the questions of the survey, we elaborated indicators of:

- ***Sociodemographic variables.***

- Temporal and risk preferences.

- ***Cognitive characteristics:*** Numerical abilities.

- ***Financial Literacy:*** based on a group of standard questions related to the concepts of inflation, risk diversification, and compound interest (Lusardi and Mitchel, 2008, 2011).

Financial Literacy

	Perú	Bolivia	Colombia	Ecuador	Total
	%	%	%	%	%
A. Inflation					
Correct answer	39.1	43.2	47.1	43.6	44.7
Incorrect answer	34.4	39.6	35.1	45.3	37.1
Do not know	21.9	15.4	16.1	10.5	16.2
Irrelevant response	0.5	0.2	0.2	0.1	0.2
Did not answer	4.0	1.7	1.5	0.6	1.8
B. Simple interest (NUMERACY)					
Correct answer	16.4	26.8	13.2	25.0	16.8
Incorrect answer	30.3	29.5	38.1	44.3	36.6
Do not know	46.9	40.2	46.0	29.1	43.1
Irrelevant response	1.5	1.0	0.0	0.3	0.5
Did not answer	4.9	2.5	2.7	1.3	3.0
C. Compound interest					
Correct answer	29.7	33.3	34.3	40.7	33.6
Incorrect answer	27.6	35.4	27.9	37.0	30.3
Do not know	36.2	28.6	35.9	21.4	33.4
Did not answer	6.5	2.7	2.0	0.9	2.8
D. Risk diversification					
Correct answer	60.0	62.7	69.9	66.3	67.4
Incorrect answer	26.5	26.3	24.7	29.3	25.3
Do not know	10.9	9.7	4.4	4.3	6.1
Did not answer	2.6	1.4	1.0	0.3	1.3
Total					
F. Total percentage of financially literate adults					
At least 3 correct answers	16.2	21.9	19.9	23.0	19.6

Note: Sampling weights are used.

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Methodology: Survey

- ***Financial Literacy:*** more sophisticated two-step weighting indicator, PRIDIT (Berham *et al.,* 2012).
  - In the first step, each question is weighted **by difficulty**, applying a greater penalty for incorrectly answering a question that most of the population answered correctly, and vice versa.
  - The second step applies principal components analysis to take into account correlations across questions in an **attempt to measure how informative each question is.**

- ***Personality traits:*** sub-facets of ***Conscientiousness***

  - *Propensity to plan or establish long term goals;*
  - *Perseverance;*
  - *and Scrupulosity.*

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Saving and Credit Decisions

Finally, we elaborated binary variables related to five savings and credit decisions, which were the endogenous variables of the econometric analysis:

- **V1. Holding formal saving products**. If answered affirmatively (at least one product) codify as 1, if not then codify as 0.

- **V2. Saved in the last year** (formal or informal mechanisms). If answered affirmatively codify as 1, if not then codify as 0.

- **V3. Saved in the last year** (at least one formal mechanism). If answered affirmatively codify as 1, if not then codify as 0.

- **V4. Saved in the last year** (only informal mechanisms). If answered affirmatively codify as 1, if not then codify as 0.

- **V5. Holding formal credit products**. If answered affirmatively (at least one product) codify as 1, if not then codify as 0.

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Empirical exercise: OLS estimation

To identify the potential influence of personality traits, cognition, and financial literacy on financial decision-making, we first estimate a **Linear Probability Model by OLS:**

$$y_{i,j} = \beta_{0,j} + \beta_{1,j} cog_i + \beta_{2,j} con_i + \beta_{3,j} fl_i + X_i' \Theta_j + u_{i,j} \qquad (1)$$

where $y_{i,j}$ represents a binary variable of the j financial decision $j \in \{V1, V2, V3, V4, V5\}$, made by the i respondent, and X_i' is a vector of controls that includes: gender, age, educational level, marital status, income group, unemployment, income stability, and country-specific dummies; u_i is the stochastic residual.

Results

- Numerical abilities and Conscientiousness increase the probability that an individual will save, as well as the probability that they will hold both formal credit and formal savings products.

- Financial literacy have a significant effect on saving informally and borrowing through formal instruments.

- It plays a minor role, or no role at all, in whether an individual has held formal savings products or saved during the previous twelve months.

- The non-significance of financial literacy coefficients might be related to the presence of endogeneity.

Instrumented Generalized Method of Moments

The first step consists in estimating the potential endogenous regressor $-(fl_i)-$ as a function of the set of controls used for the financial decision variables, adding a set of instruments:

$$fl_i = \varphi_0 + \varphi_1 cog_i + \varphi_2 con_i + \boldsymbol{X'_i\gamma} + \boldsymbol{Z'_i\vartheta} + v_i \qquad (2)$$

where $\boldsymbol{Z'_i}$ is a vector of instruments and v_i is random noise that follows a binomial distribution.

In the second stage the (fl_i) is substituted in equation (1) by its first stage predicted value $(\widehat{fl}_i)$:

$$y_{i,j} = \pi_{0,j} + \pi_{1,j} cog_i + \pi_{2,j} con_i + \pi_{3,j}\widehat{fl}_i + \boldsymbol{X'_i\tau_j} + \omega_{i,j}$$

Instrumented Generalized Method of Moments

In the case that *i)* Z_i' is correlated with the financial literacy index, $Cov(fl_i, Z_i') \neq 0$, and *ii)* Z_i' is independent of $y_{i,j}$, then the orthogonality condition is satisfied, $Cov(u_{i,j}, Z_i') = 0$. Errors from equation (2) and (3) would thus not be correlated with each other, $Cov(u_{i,j}, v_i) = 0$, and **we may consider the set of included instruments as valid for the financial literacy index**.

If the validity of the instruments is verified according to the above conditions, **the estimators obtained by the second stage will be consistent.**

Instruments

- Number of universities by region: **exposure to financial information or to peers with higher financial knowledge** (Klapper *et al.*, 2012).

- Questions related to an individual's exposure to sophisticated financial information: *i)* if the individual is aware of the concept of **Deposit Insurance Funds**; *ii)* if the individual has heard about **mutual funds or investments in the stock markets**; and *iii)* if the individual has heard about any **insurance products** at all. In the countries under consideration, the majority of the population is simply not aware of these concepts.

- The number of financial crises that individuals had experienced in their lifetime (Reinhart and Rogoff, 2009).

Results

GMM-IV: 1st step estimates, using PRIDIT as the measure of FL

Two-stage feasible GMM estimates using sampling weights and aggregated by the total population from 18 years old in each country, and robust standard errors adjusted for 131 clusters (urban y rural by region/department). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The F-Test of excluded instruments has as null hypothesis that the set of instruments are jointly nonsignificant to estimate financial literacy. The Chi-squared Kleibergen-Paap rk LM test of underidentification has as null hypothesis that the reduced-form matrix is underidentified (vs. the alternative hypothesis of exact identification). The Kleibergen-Paap Wald F-test reflects the maximum relative bias of the IV estimates when compared to OLS estimators (critical values for this test were tabulated by Stock and Yogo (2005)).

	PRIDIT
Conscientiousness	0.561**
	(0.249)
Cognition (numeracy)	0.233***
	(0.0634)
Instruments: No. of universities, No. of cumulated banking crises, Knowledge: Deposit insurance fund, Knowledge: Mutual funds and/or stock markets, Knowledge: Insurances, Risk preferences; Constant.	
Observations	4709
Controls	Yes
F-test of excluded instruments (6,130)	9.11
P-value (F-test of excluded instruments)	0.0000
Kleibergen-Paap rk LM stat (χ^2) – Test of underidentification	32.10
P-valor (Kleibergen Paap rk LM)	0.0000
Kleibergen-Paap Wald stat (F) – Weak instruments	9.11
Stock-Yogo (2005) Critical values	
10% maximum IV relative bias	11.12
20% maximum IV relative bias	6.76

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Results

GMM-IV: 2nd step estimates, using 1st-stage predicted PRIDIT

Note: Two-stage feasible GMM estimates using sampling weights and aggregated by the total population from 18 years old in each country, and robust standard errors adjusted for 131 clusters (urban y rural by region/department). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Hansen-j overidentification test evaluates as the null hypothesis that the set of instruments is valid, i.e., the instruments are not correlated with the error term, and therefore, orthogonality conditions are satisfied. The endogeneity test shows the probability of treating PRIDIT as exogenous (Baum *et al.*, 2007).

	Holding formal savings products (V1)	Saving through any mechanism (V2)	Saving formally (V3)	Saving only informally (V4)	Holding formal credit products (V5)
PRIDIT	0.101*	0.0215	0.0846*	-0.0884*	0.109***
	(0.0569)	(0.0594)	(0.0464)	(0.0487)	(0.0395)
Conscientiousness	0.478***	0.612***	0.477***	0.245***	0.284***
	(0.0854)	(0.0730)	(0.0678)	(0.0711)	(0.0563)
Cognition (numeracy)	0.0913***	0.0519**	0.00220	0.0559**	0.0384*
	(0.0266)	(0.0216)	(0.0238)	(0.0252)	(0.0197)
Constant	-0.254**	0.255**	-0.0362	0.168*	-0.102
	(0.108)	(0.110)	(0.0952)	(0.0990)	(0.0830)
Observations	4709	4709	4709	4709	4709
Controls	Yes	Yes	Yes	Yes	Yes
Hansen-j	18.54	4.172	5.122	6.249	6.520
P-value (Hansen-j)	0.00234	0.525	0.401	0.283	0.259

Results

- **Numerical abilities and personality traits related to conscientiousness** – propensity to plan, perseverance, and scrupulosity – **increase the probability that an individual will save (formal and informal mechanisms), as well as the probability that they will hold both formal credit and formal savings products.**

- Propensity to save with informal mechanisms positively depends on conscientiousness and cognition. This result might be linked to the fact that in the surveyed countries, **formal and informal savings mechanisms coexist across all socioeconomic levels.**

Results

- **Higher level of financial literacy** decreases the probability that an individual will use exclusively short-term **informal savings mechanisms.**

- **Financial literacy is important in the case of more complex financial products** -- such as medium and long-term credit products -- **and for simpler products, such as a deposit.**

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Results

- Income and education **increase the probability that an individual will save, as well as the probability that they will hold both formal credit and formal savings products.**

- Women and less educated people are more likely to participate in informal financial markets.

Policy recommendations

- Our results could contribute to financial institutions and governments designing financial education programs that segment the population according to a criteria that goes beyond sociodemographic variables.

- Empirical methodologies that measure personality traits and cognition could be used to identify those individuals who are more likely to fail to meet repayments, fail to save, or fail to participate in the formal financial sector.

- For these individuals some specific interventions could be designed -- such as the products based on planning, or a system of reminders for individuals with low levels of conscientiousness.

- More research is nevertheless needed…

¡Gracias!
Thank you!

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