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ABSTRACT

We experimentally study the impact of substantially larger enterprise loans, in collaboration with an Egyptian lender. Larger loans generate small average impacts, but machine learning using psychometric data reveals dramatic heterogeneity. Top-performers (i.e., those with the highest predicted treatment effects) substantially increase profits, whereas profits for poor-performers drop. The magnitude of this difference implies that an individual lender's credit allocation choices matter for aggregate income. Evidence on two fronts suggests large loans would be misallocated: top-performers are predicted by loan officers to have higher default rates; and, top-performers grow less than others when given small loans, implying that allocating larger loans based on prior performance is not efficient. Our results have important implications for credit expansion policy and our understanding of entrepreneurial talent: on the former, the use of psychometric data to identify top-performers suggests a pathway towards better allocation that revolves around entrepreneurial type more than firm type; on the latter, the reversal of fortune for poor-performers, who do well with small loans but not large, indicates a type of entrepreneur that we call a "go-getter" who performs well when constrained but poorly when not.

Keywords: Entrepreneurship; Enterprise credit; Heterogeneous treatment effects; Psychometric data; Small and medium enterprises

JEL Classification: D22, D24, L26, M21, O12, O16

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1 Introduction

When credit markets are characterized by asymmetric information, relational contracts dominate and a specific lender can become the defacto monopoly provider of credit to a set of firms wishing to access larger loans (Ghosh and Ray, 2016). In this circumstance, an individual lender's credit allocation choices can become important determinants of the efficiency of capital allocation, and hence aggregate productivity (Hsieh and Klenow, 2009). Further, if lender credit allocation is inefficient, then the average large loan will generate more default and less firm profit than it could, and equilibrium would be characterized by both misallocation and smaller than optimal loan sizes.

Despite the potential importance, little is known about the quality of lender decisions beyond that which can be inferred from aggregate exercises such as those presented in Hsieh and Klenow (2009) and Hsieh and Klenow (2014).¹ This dearth of knowledge likely stems from three difficulties that an analyst faces when attempting to understand the quality of lender credit allocations. First, if poor allocation of credit means large loans have high default rates or are unprofitable for borrowers, equilibrium loans may be too small to reveal heterogeneity. Second, to understand the quality of allocation decisions, one must collect appropriate data to estimate heterogeneous treatment effects and use methods that avoid over-fitting. Finally, there needs to be a credible identification strategy, one that generates both a sufficient quantity of loans to firms that would not normally be allocated credit, as well as determines which firms would have received loans in a business-as-usual loan size expansion.

We collaborated with the Alexandria Business Association (ABA), a large Egyptian lender, to design and implement an experiment that would overcome the above difficulties. ABA's senior management understood that there was demand for larger loans

¹Recent work has focused on a related question, whether loan officers can help choose firms that are likelier to repay and more profitable for the bank, as well as whether loan officer recommendations reveal bias (e.g., Dobbie et al. forthcoming, Fisman et al. 2017 and Cole et al. 2015). Particularly closely related to our motivating questions is Rigol and Roth (2021), which shows that contractual incentives for loan officer can easily be misaligned, even against lender profits. Specifically they show that loan officers incentivized to reduce average default in their client set do not recommend their lowest default clients to receive larger "graduation loans", which are provided by a separate department of the same lender. None of these papers considers the profitability of the borrowing firm, which is our focus and what matters for aggregate productivity.

but was concerned about risk, both for themselves and their clients. Our collaboration was designed to understand whether larger loans could be beneficial, and whether credit allocation decisions could help to mitigate risk.

ABA first worked to select a sample of firms that it believed might benefit from a larger loan. They then conducted a randomized experiment within this sample, in which treatment borrowers were offered loans four-times larger than their previous loans, and control borrowers were offered loans that were two-times larger.² The experiment meets all the challenges discussed above. Large loans were offered even to firms that would not normally qualify, and the size of loans offered to the large loan group extends well beyond normal lending practice for ABA. To measure heterogeneous treatment effects we collected novel psychometric data at baseline. These data were designed to capture characteristics of the owner relevant to entrepreneurial success. We combine these data with modern machine learning methods from [Chernozhukov et al. \(2020\)](#) to identify group average treatment effects for four quartiles. We call those in the top quartile “top-performers” and those in the bottom quartile “poor-performers”.

Having identified top and poor-performers we use two strategies to understand the likely quality of large loan allocations. First, we believe a reasonable theory of practice is that lenders target capital expansion toward firms that demonstrate success with small loans, believing these entrepreneurs to be of a type that will be consistently successful. This theory suggests preferential access to large loans would be given to firms that see the largest pre-post change in profits when assigned to the control group. We examine whether top-performers are more or less likely to fall into this category. Second, like many lenders, ABA relies heavily on loan officer opinions to determine credit allocation, and loan officers are strongly incentivized to avoid default. We asked a subset of loan officers to assess whether individual firms would see an

²Standard operations provided borrowers the ability to borrow at 1.5x their previous loan, until the point at which loan officers determined that larger loans would be too risky. The decision to provide the control group with 2x loans was made by the bank at the suggestion of loan officers because they believed this would make the randomization seem fairer. As we note below, this choice also has advantages for understanding allocation decisions.

increase in default if given a larger loan, and we look at whether loan officers perceive top-performers as more or less likely to increase their default rate.

Our results reveal the potential importance of credit allocation, even *within* the set of ABA borrowers. Specifically, we find mostly null average impacts of the larger loans, but dramatic heterogeneity in treatment effects, along with strong evidence of misallocation. Entrepreneurs in the top quartile of treatment effects for profits, i.e., the top-performers, increase profits by 55% (se=21%) of the control group mean. Poor-performers, on the other hand, are harmed, experiencing a 52% (se=23%) profit reduction. The same pattern holds for related and downstream outcomes. Top-performers increase their wage bill (122%, se=27%), productivity (6.3%, se=1.1%), and household expenditures (44%, se=10%). Poor-performers on the other hand lose 2.3 (se=0.6) employees and reduce their wage bill dramatically. To gauge the importance of these magnitudes, a simple thought exercise: Consider an intentional lending strategy that targets likely high performers rather than the set of firms identified as viable by the lender for larger loans. This would improve the average treatment effect for productivity from zero to about one-half of a standard deviation, and the treatment effect on monthly profits increase by about 46 percentage points. Thus on 1000 firms, this would increase aggregate profit by about 7 million EGP (~ 400 000 USD).

However, the top-performers are among the firms least likely to be offered large loans. First, relative to poor-performers, top-performers see a smaller increase (or larger decrease) in profits between baseline and endline when they are placed in control, and this difference is statistically significant. This suggests that loan officers would be unlikely to see top-performers as successful firms, and hence unlikely to recommend them for further loan expansion. Second, directly measured loan officer beliefs strongly militate against lending to top-performers. While loan officers believe that large loans will increase the chance of default by only 22% for poor-performers, this increases to nearly 50% for top-performers. Yet we find no evidence that top-performers are more likely to default.³

³Full loan default is very rare in our context, where failure to pay a loan could result in a prison term. There is, however, significant deviation from the precise repayment schedule, which can be costly to

Two points are worth noting about the heterogeneity results. First, using only “standard” data of the type that might be routinely collected by a lender (e.g. business performance & demographics), we do not discover any statistically significant heterogeneity.⁴ The heterogeneous treatment effects reported above are identified using a combination of psychometric and cognitive data.⁵ This suggests that (a) a lender seeking to better allocate larger loans will need to collect more data than usual, and (b) the characteristics of the *entrepreneur*, rather than the characteristics of the *firm*, are important for determining the impact of increased access to credit for small firms. While important details need to be worked out – for example, understanding the extent to which psychometric testing is manipulable – our results suggest the *possibility* of improving allocations through the use of better data collection.

Second, poor-performers not only perform *relatively* poorly with large loans, they in fact have lower profit than when restricted to smaller loans. This is a reversal of fortune, because poor-performers are among the firms that grow most when receiving small loans (i.e., in cross-sectional analysis within the control group). Our psychometric data are able to shed some light on why this is the case. We use a “stable” lasso to determine which psychometric variables are most predictive of being a poor-performer. Our results are suggestive of an entrepreneurial characteristic that we label being a “go-getter.” Go-getters appear to be quite driven, responding positively to statements like “in life, failure is not an option”. This characteristic perhaps explains, in part, why they do well with small loans. Go-getters are also more likely to agree with statements indicative of a gung-ho attitude, such as “I tend to act first and worry about consequences later” and “when I make decisions I usually go with my first, gut feeling”. We conjecture that, with low levels of credit, these individuals are able to grow their businesses relatively quickly, perhaps because they make faster decisions, but that when credit constraints are significantly relaxed they make overly risky and

ABA, and there are very strong costs for would be defaulters who only make full repayment due to the strict legal environment. ABA is very cognisant of these “triple bottom line” concerns.

⁴For a more detailed description of both the standard and psychometric data, see section 2.3 below.

⁵Cognitive data includes measures such as Raven’s matrices and also risk aversion measures. The main results reported include these as predictive variables, but heterogeneity is in fact stronger when we use just psychometric data.

perhaps poorly thought out choices. In essence “go-getters” are classic Schumpeterian entrepreneurs: they seek to disrupt but are not necessarily successful in doing so. In contrast, top-performers are entrepreneurs who appear cautious and shrewd. They expand slowly with their own capital or a modestly sized loan, and when given the opportunity of a larger loan, they continue to find ways to expand and increase profits. Thinking about business expansion in this way adds much needed nuance to the discussion on the role of credit constraints: the existence of “go-getters” suggests that expansion does not solely occur through the smooth movement along a Solow production function, but is instead (at least for some) characterized by risky jumps. This logic also helps explain why savings alone may be insufficient to remove misallocation on the intensive margin ([Banerjee and Moll, 2010](#)).

Our paper joins a growing literature that uses different indicators to document heterogeneous firm level returns to capital. [Hussam et al. \(Forthcoming\)](#) finds that individuals are able to identify which peers have the highest returns to capital. [Beaman et al. \(2020\)](#) finds that farmers that borrow have higher returns to capital than those do not. [Crépon et al. \(2020\)](#) shows that there is substantial heterogeneity in the returns to both cash drops and loans, and that this may help to explain the difference in impacts between cash drop experiments in the spirit of [De Mel et al. \(2009\)](#) and the more recent microcredit experiments. Also related is [McKenzie and Sansone \(2019\)](#), which finds that neither experts nor machine learning methods predict future entrepreneurial success using “standard” loan application and business data. This question differs from ours in that they are predicting future enterprise success not treatment effects, and they have more limited psychometric data.

We also contribute to the literature on randomized evaluations of credit interventions. The majority of studies in this literature look at the impact of expanding access to micro-size loans, and find modest effects with little evidence of large positive or negative impacts (see [Banerjee et al. 2015](#), [Meager 2019](#)). In contrast to these studies, we study a different margin of credit expansion – access to much larger loans⁶ – and we

⁶Appendix Table 1 compares loan sizes in our setting to those in the seven studies included in the [Meager \(2019\)](#) meta-study: Using PPP exchange rates, loans in our treatment group range from 2.5 to

concentrate on the importance of heterogeneity rather than average effects. Our work is also closely related to papers that look at alternative margins on which loan access can be altered in developing countries. In recent important work [Breza and Kinnan \(2021\)](#) studies the impact of the cancelling of all microcredit access in Andhra Pradesh due to the Krishna loan crisis. They find large impacts on household consumption. The margin on which this experiment alters access is, like our study, very different from the norm: cancelling borrowing for all, rather than marginal borrowers; removing credit rather than adding credit; and general-equilibrium rather than partial. Also related is [Banerjee and Duflo \(2014\)](#) which studies an Indian program that expanded preferential credit access to larger firms (with more than about 150,000 USD in capital stock). This expansion led to substantial investment and increased profits. Finally, [Bari et al. \(2021\)](#) examines providing in-kind loans to existing businesses, which like our treatment are four times the size of previous loans. They find statistically significant and positive average effects and do not concentrate on the allocation decision on which we focus here.

2 Study Setting and Sample Characteristics

2.1 Implementing Partner

We partnered with Alexandria Business Association (ABA), a nonprofit organization and the largest microfinance institution in the Middle East by number of clients. At the time of the study ABA had over 400,000 borrowers and fewer than 1% of those borrowers had loans over 1,000USD\13,000EGP.⁷ Senior management expressed interest in expanding the size of loans offered to small and medium enterprises (SMEs). Immediately prior to our project, ABA policy allowed for new loans to increase by up to 50% after successful repayment of a prior loan. Loan size expansion ceases when

15 times larger than the loan sizes in those studies.

⁷The average exchange rate during the disbursement of the loans was approximately 13EGP per 1 USD. The PPP conversion factor was about 2.9 during the study period. We use the exchange rate for all conversions unless stated otherwise.

the firm stops demanding more credit, the loan officer deems the loan to be too risky, or they reach 150,000EGP, which was the the regulatory maximum for MFI's in Egypt at the time of the study..⁸

At the time of our study, ABA provided both individual and group loans and our intervention focused on the individual lending side of the portfolio. Individual loans began at 115USD\1,500EGP and had a ceiling 100,000EGP. Annual interest rates varied slightly depending on market conditions, but ranged from 14% to 17%.⁹ Borrowers could take loans of various maturities, but the majority of loans were provided on 12 month terms. Borrowers could go to a branch office to apply for a loan, but many loans were initiated directly with loan officers who often visit businesses to recruit new borrowers. The application process required individuals to commit to repayment and to include a guarantor.¹⁰ ABA provided both household and enterprise loans, but loans over 20,000EGP were provided only to registered businesses. This requirement was relaxed for our study, allowing many unregistered enterprises to get loans larger than 20,000EGP.

In Egypt, as in many developing countries, there is a “missing middle” of credit availability that may contribute to the lackluster growth of small firms: MFI's typically offer loans up to a maximum of about EGP 5,000 (~USD 280) whereas banks typically start loan sizes at EGP50,000 (~USD 2,800) and have formality requirements that small enterprises often cannot meet. We conjectured that this gap in the lending market could, in part, be attributed to the combination of asymmetric information, which leads to relationship based lending starting from when firms are micro-sized, and poor credit allocation decisions reducing the profitability of larger loans. [Rigol and Roth \(2021\)](#) provides a related explanation.

⁸Borrowers could request a larger than 50% increase, but that required approval from the deputy CEO and COO, and only happened in extremely rare cases.

⁹In this context many borrowers may be concerned about the Islamic prohibition on paying interest, but a ruling by Egypt's main religious authority, Al Azhar, states that interest rates charged by non-profit lenders are not prohibited.

¹⁰The guarantor is a person who would be legally liable for the debt in the case of default.

2.2 Experimental Design

Existing clients who were interested and deemed eligible applied for a loan at least four times the size of their previous loan.¹¹ The loans were implemented under a program called *Tamouh*, which translates to “ambition”. To form an eligible cohort of borrowers, the bank first informed loan officers about the lending program and asked them to suggest clients who would be appropriate for a much larger loan. Loan officers then communicated the details of the program to the identified clients, telling them that if their application was approved they would be randomly allocated to either a 4x or 2x larger loan. It is important to note that this design implies the control group was a small deviation from prior policy, in which loan sizes increased by at most 50%, except in rare cases. The decision to provide the control group with 2x loans, rather than the existing policy of 1.5x loans, was made by the bank at the suggestion of loan officers who believed that this would make the randomization seem fairer. Since the selection into the experiment is endogenous, we cannot cleanly interpret a comparison of the 1.5x existing policy to the 2x in the control group.

Part of the capital for the Tamouh loans was provided by Silatech, a regional philanthropic foundation, who agreed to cover some of the risk of default. The partial guarantee was negotiated because of ABA’s concerns that the larger loans would lead to default. This fear of default is common among small and medium enterprise lenders with which we have interacted, and part of the purpose of this project was to understand whether this fear is well founded, and if so whether better credit allocation choices could alleviate risk. The existence of the guarantee was known to the Board of Directors of ABA but was intentionally kept from loan officers to avoid any change in enforcement effort. At the time of the experiment, the majority of loan officer compensation was an incentive payment that depended on the number of loans, not the size of loans, and also included a repayment condition. If a loan officer’s portfolio repayment rate was below 97%, they did not receive any incentive payment; for repayment rates

¹¹Although the plan had been to allow treatment loans to be up to ten times the size of the previous loan, in practice ABA let treatment loans be typically four times larger but not more

above 97% but at or below 98.5% they received 50% of their incentive payment, and for repayment rates above 98.5% they received their full incentive payment. Because repayment rates were based on default relative to overall portfolio size, loan officers expressed concern that the Tamouh loans could harm their overall compensation. To appease this concern senior management added an additional incentive for loan officers, which provided a fixed payment for each client that ended up in the experiment. The fact that ABA felt the need to make this payment reveals the importance of loan officer beliefs in determining credit allocations. Ultimately, all of the loans in the experiment, both treatment and control, were repaid, and thus had no adverse effect on the loan officer's portfolio repayment rates.

To apply, invited borrowers filled out a standard loan application as well as an in-person baseline research survey (conducted by ABA employees from the non-financial services division).¹² ABA surveyors informed borrowers about the goals of the survey and that their data would neither be shared with ABA's financial arm nor affect ABA's lending decision in any way. The baseline survey included detailed questions about the borrower's businesses, demographic questions, as well as non-standard types of data such as cognitive and psychometric questions. Afterwards, a central credit committee reviewed the borrower's application (without access to the baseline survey answers) and made a lending decision. In all cases the credit committee required that borrowers had successfully repaid at least three prior loans. Approved loans were grouped into batches for randomization. For the randomization, we worked closely with ABA to randomize 31 batches of applicants over 13 months. For each batch, ABA would send the research team a list of between one and 133 applicants. For each applicant, we were given the full application material but only used the identity of the loan officer for the purpose of stratification. To stratify, we employed a simple block randomization routine by loan officer. When there was an odd number of applicants with an individual loan officer, we assigned the additional applicant with an independent

¹²The data collection had to be implemented by employees of the organization due to data collection regulations in Egypt at the time of the study. They were accompanied by trained supervisors from Silatech.

50% probability to treatment or control. Our final sample consists of 1,004 borrowers.

Aside from the loan size, the loans adhered to ABA's normal loan terms, monthly repayments, and monitoring and enforcement protocols (more detailed description below, under description of the first stage results).

2.3 Data Collection

We use two data sources – in-person surveys, and administrative data on loan performance. We implemented three rounds of in-person surveys: a baseline implemented before firms were randomized into treatment and control groups; a first follow-up implemented on average 20 months after disbursement of the loans; and, a second follow-up implemented on average 30 months after the disbursement of the loans. The in-person surveys collected two types of data, (1) standard data on borrower characteristics and the business, and (2) cognitive data, risk preference data, and “psychometric data” collected through a set of 50 statements meant to characterize borrower personality traits.

Standard Data on Business and Borrower Characteristics

All three surveys included standard information on business and borrower characteristics. For business questions, we included profits, revenue, expenditures, and the number of employees and their wages. For borrower characteristics, we included age, experience and education. We also measured household expenditure using a survey question which asked for total expenditure on a set of commonly consumed food items with a one week recall, a second question asking total expenditure on a set of less regular expenditures such as water, electricity, and transportation on a one month recall and finally a question asking total expenditure on irregular purchases like clothes and mobile phones over the past year. We use baseline versions of these measures to check for balance across treatment and control, and as inputs in the machine learning algorithms. We use endline measures of these variables as our primary outcomes.

Psychometric, Cognitive Data, and Risk Preferences

We included 50 “psychometric” questions in our baseline survey. These data take the form of statements that respondents were supposed to assess on a scale from 1 to 5, with a “1” indicating that they disagree strongly with the statement and a “5” indicating that they agree strongly with the statement. The statements are meant measure which psychological traits are associated with the respondent’s personality. These include traits considered to be in the “Big 5” in the psychology literature, such as conscientiousness, extroversion and agreeableness (Digman, 1990). Examples of the statements include: “I am good at making last minute changes to plans” which is associated with conscientiousness; and “Before I go to sleep I think ‘what could I have done better today?’”. We also included statements that were shown to be associated with people’s proclivity for entrepreneurship. These statements include “In my group of friends I am the most creative person”, and “I have a strong desire to be successful in life” (Ahmetoglu et al. 2011, 2017). The 50 statements at baseline were a subset of a 140 statement list that was produced for this study. The remaining statements were included in the follow up surveys. The statements were split across the three surveys in an ad hoc fashion given survey time constraints and our lack of a clear theory to guide choices.¹³ We measure cognitive ability during the baseline survey using Raven’s matrices, digit span recall, and a set of questions testing financial literacy knowledge. We also ask questions at baseline to assess risk aversion asking both about overall perception of risk taking, and a question about a hypothetical risky investment.

A full list of the risk, financial literacy, psychometric and cognitive is included in the Survey Questions section of the Online Appendix.

¹³We included the questions in follow-up surveys with the hope that the psychometric measures would be time-invariant and treatment-invariant and thus enable us to treat them all as “baseline” measures. To test for this, we included some questions at both baseline and follow-up, but we find enough changes over time to eliminate the ability to use the questions asked at follow-up in the heterogeneity analysis.

Administrative Data & Loan Officer Perceptions

Administrative data from the lender provide a detailed account of every payment made by the borrower, including the amount of the payment, the date of the payment, proportion of the payment that went to principal, interest, and any associated late fees. These data cover the five loans prior to the experimental loan as well as any loans up to 30 months after the experimental period.

We also implemented a loan officer survey. The survey collected demographic information about the loan officers as well as information about the loan officers' expectations regarding business and loan performance for the borrowers in the case where the borrowers were allocated to treatment or to control. We asked loan officers to grade borrowers on their "ability to repay the loan" on a 1-10 scale. We asked them the question twice, once about their perception of repayment ability in the case that the borrower received the larger loan, and again in the case that the borrower received the smaller loan. In our analysis we score these as a binary variables, that combine the two responses, equal to one if the loan officer perceives the larger loan will be more likely to lead to default than the smaller loan. We have similar data for loan officer predictions on revenue increases due to the loans. Due to logistical constraints we were only able to collect these data before randomization for about a third of the sample (293/1004 borrowers), and we do not use the predictions from loan officers whose clients had already received a loan. On average, loan officers expect the likelihood of repayment to decrease with the larger loan relative to the smaller loan for 31% of borrowers and for 32% of borrowers to have a greater ability to increase revenue with the larger loan than with the smaller loan.¹⁴

Sample Characteristics

Table 1 reports sample summary statistics from the baseline survey and balance verification for the randomization. Borrowers are on average 40 years old with 9 years

¹⁴If the survey was conducted after randomization and loan provision, we find that treatment assignment affects loan officer perceptions; thus we only use the loan officer surveys that were completed prior to randomization and loan provision.

of education; about 20% of the sample are women. For the businesses, about a third are registered, the average tenure is 12 years, and the average number of employees is 0.65 (37% have any employees, and for those that have any employees, the average number is 1.75). Monthly profits average about 6,800 EGP, equivalent to USD 525. The average size of firm's previous loan from ABA was 7,540 EGP. At the time of the baseline survey 6% had borrowings from other sources, with an average outside debt of about 2,000 EGP.

Column 2 reports the baseline difference between the treatment group and control group, after controlling for the stratification variables (loan officer fixed effects). None of the differences is statistically significant, and a joint test of significance, reported at the bottom of the table, yields a p -value of 0.79.

Appendix Table 2 reports summary statistics and balance verification for a subset of the psychometric and cognitive variables. The table reports on six key psychometric variables that correlate strongly with treatment effects (we discuss below how we identify these six questions) as well as the cognitive and risk aversion questions. We find no statistically significant differences between treatment and control groups. In a joint test, we find that the entire set of 50 psychometric variables collected at baseline as well as the cognitive and risk questions do not predict treatment status (p -value=0.53).

We were successful in reaching most of our sample for the 20-month survey (96.3% response rate) and the 30-month survey (95.1% response rate). Column 1 in Appendix Table 3 shows that there is no evidence of differential attrition when we regress a binary for attrition on the treatment indicator directly. Columns 2-5 regress attrition on a large number of baseline covariates (columns 2 & 4) and those covariates interacted with treatment (columns 3 & 5). A joint test of significance on the coefficients of the interacted characteristics produces a p -value of 0.99, providing confidence that differential attrition is not an issue for our analysis.

3 Average Impacts: Intent to Treat Estimates

We use a standard ANCOVA regression framework to estimate average intent-to-treat effects, pooling our two rounds of follow-up data. Specifically, we estimate

$$Y_{it} = \beta_1 T_i + \beta_2 Y_{i0} + \delta_{LO} + \lambda_t + \varepsilon_{it},$$

where we have up to two observations per person (one for each of the two follow-up surveys), Y_{it} is the outcome of interest at time t and β_1 is the coefficient of interest on a binary variable that is equal to 1 for individuals assigned to the treatment group. We include the baseline value of the dependent variable as a control when available as Y_{i0} , loan officer fixed effects as δ_{LO} , and an indicator variable for the second survey round as λ_t . We include loan officer fixed effects since our randomization stratifies at that level, and we cluster standard errors at the individual level.

3.1 Borrowing at ABA (First Stage)

Table 2 reports how borrowing differed by treatment assignment. 76% of the control claimed their loans, while 85% of treatment did so. As intended, we find that the average loan size in the treatment group is more than double the loan size in the control group. Standard loan terms were 12 months, but borrowers were allowed to request longer to repay and requests were considered by the central credit committee. Treatment group borrower's loan terms were 50% longer on average (19.7 months versus 13.2 months on average). Thus while monthly payments for the treatment group were larger than for the control group, the gap is 40% rather than 100%.

Figure 1 shows how outstanding debt from the lender differs across treatment and control groups over time, extending three years after dispersal of the treatment loans. It shows how, in the year preceding the experiment, treatment and control had very similar levels of debt. After the experiment, outstanding debt climbs for the control group but climbs dramatically higher for the treatment group. Given the differences in the length of the loan, the figure shows how the control group's outstanding debt

falls around the 12 month mark as their experimental loan is repaid and then increases again, showing another small dip at 24 months. For the treatment group, outstanding debt is at its lowest level at around 22 months after disbursement after repayment of the experimental loan, and then shoots back up directly afterwards.

We consider what predicts take up in Columns 4 & 5 of Table 1. In control, women are more likely to take up the loan, as are those with a registered business, higher monthly profits and lower spending on labor. In treatment, women continue to take up the loan more often, as do people with some employees. Column 6 reports the p-value for equality of the coefficients across treatment and control. Appendix Table 2 repeats this analysis but with the cognitive and psychometric measures and finds limited evidence of any differences across treatment and control groups.

3.2 Average Impacts on Loan Repayment and MFI Profits

Using administrative data from the lender we are able to assess how borrower repayment behavior differed between the treatment and control groups. Table 3 reports that every individual eventually repaid their loan, implying that the concerns over higher default rates were far from realized. Despite full repayment many borrowers struggled to make all of their payments on time, with treatment firms faring worse. 76% of the control group had a perfect repayment record, while only 63% of the treatment group did. Similarly, the average number of days with a payment overdue was 12.5 for control group and 26.7 for treatment group¹⁵

The increase in late payments naturally leads to an increase in payment penalties, which allows us to assess the impact of these larger loans on the lender's bottom line. Table 3 calculates total penalties paid by borrowers in the first 24 months after disbursement. This timeframe is long enough to account for the fact that some control firms may have taken two loans in the time a treatment firm had only one. Over those two years control firms average 128 EGP in penalties while those in treatment aver-

¹⁵As discussed above, the treatment group had loans that had longer terms of maturity on average and so we also consider the average number of late days per month of the loan and find that it is 47% higher in treatment relative to control, p-value ; 1%

age 323 EGP, an increase of 195 EGP. This increase in penalties paid is much greater than the opportunity cost associated with the money that remains outside the lender during the time the borrowers are late. As indicated in the final row of Table 3, the treatment group on average has 29 EGP more outstanding on any given day. This is money that the lender could not lend out. Multiplying this number by a daily interest rate gives the total foregone revenue per day for ABA from loans outstanding. Even if the daily interest rate was 0.5% (which is far too high) that would mean only 0.15 EGP per day, or a total of 106 EGP over 24 months. In contrast the total late fees collected by ABA over 24 months was 195 EGP higher in the treatment group, indicating that ABA earned more in late fees than it lost in foregone lending revenue.

To determine whether or not the larger loans were more profitable from the lenders side we also need to consider the potential increased costs of loan officer time dedicated to following up with the borrowers to ensure eventual payment. Loans officers and senior management report that loan officer time did not change significantly due to the offsetting forces of decreased administrative load from fewer larger loans, and additional time spent focusing on following up with the borrowers of the larger loan. Both loan officers and senior management grew to view the program as a success from a business perspective and they expanded it throughout the entire organization after the completion of the experiment. Hence, we conclude that the larger loans were profitable for ABA.

3.3 Average Impacts on Primary Outcomes

We report average impact of treatment on six primary outcomes in Table 4, Column 2, Panels A and B. Profits (Panel A) increase by 1,448 EGP a month, a 9% increase (se=7%) relative to control, thus positive but not statistically significant. Impacts on revenues and expenses are similar, with an increase of 5,715 EGP (12.5% increase, se=4,415 EGP) & 5,251 EGP (18.6% increase, se=3,531) respectively, neither of which is statistically significant at conventional levels.¹⁶ We also consider impacts on em-

¹⁶Our profit measure asks business owners to directly report their aggregate profits, instead of asking expenditures and revenue separately and subtracting. This has been shown to be preferable due to the

ployment (“Wage Bill”) and do not find a statistically significant increase (144 EGP, $se=247$, a 6.9% increase relative to control). We also generate a measure of total factor productivity (TFP) utilizing endline revenues, and find an increase of 0.04 standard deviations which is also not statistically significant.¹⁷

Our final primary outcome is household expenditure. There we find an increase of 446 EGP ($se=211$), a 9.3% increase relative to the control group, $p\text{-value}=5\%$. All together these results provide suggestive evidence that the treatment led to increases in business performance on average, and stronger evidence that the treatment is changing household outcomes.

Table 4 Column 2 Panel C reports average impacts of the treatment on seven additional outcomes. Three are important business outcomes: whether the borrower still has a business, the total number of employees, and the value of assets. We find no statistically significant average impacts across any of these variables. We also consider two downstream measures of health, an index of mental health questions and a self-report on physical health and again find null average impacts. We also include two measures related to loan performance. We reproduce the impacts on total late fees in the 24 months after the experimental loan, which increases on average. We also consider whether or not individuals have an outstanding ABA loan at 30 months after the experimental loan and find a decrease of 8 percentage points in the treatment group.

4 Heterogeneous Treatment Effects

While the average treatment effects suggest a small positive effect of larger loans on business outcomes, it is possible that these average impacts hide important heterogeneity and hence that better allocation of credit could lead to larger average treatment effects. We collected the psychometric data to explore this possibility, given previous work that suggests that these types of data could be predictive of performance ([Klinger](#)

potential for revenues and expenditures to be timed differently in a given month ([De Mel et al., 2009](#)).

¹⁷We estimate TFP using a simple specification where we take the residual of a regression of log revenue on log assets and log wagebill and then standardize it. [Atkin et al. \(2019\)](#) shows that revenue based measures of productivity (TFPR) perform better than quantity based measures (TFPQ).

et al., 2013, Arráiz et al., 2017). To assess heterogeneity we follow Chernozhukov et al. (2020) which provides a strategy for determining whether there is significant treatment effect heterogeneity in randomized experiments where the set of covariates is high dimensional and there is no clear ex-ante hypothesis on which to base a pre-analysis plan.

Because the main aim of the experiment was to increase the profitability of firms, we first look at heterogeneity in the average treatment effect (ATE) for profits, in doing so we follow Chernozhukov et al. (2020) closely and we give a brief description of the method for completeness. We follow a slightly different approach for other outcomes, which we discuss below.

To estimate heterogeneity in the treatment effect for profits, we first split the sample into a “training set” and a “testing set”. Throughout we use 50/50 splits. Using the training set only, we train a machine learning (ML) method to generate a “control” effect $B(Z_i)$ (i.e. the expected outcome for firms with covariates Z if they were assigned to control) and predicted treatment effect $S(Z_i)$, where Z_i denotes the full set of covariates used to predict heterogeneity for subject i . Below we show results where we alter the set of covariates used. Any ML method could be used, but we use four options (elastic net, neural net, random forest, and gradient boosting) and then take the one with the highest prediction score.¹⁸ In all cases we use the implementation of these methods from the R package caret.

With the estimates $B(Z_i)$ and $S(Z_i)$ in hand we then undertake two analyses using only data from the testing set. First, we estimate the regression

$$Y_i = \alpha * X_i + \beta_1 * T_i + \beta_2 * T_i * S(Z_i) + \epsilon_i \quad (1)$$

where X_i is a set of covariates that includes $B(Z_i)$ and T_i is an indicator for treatment group.¹⁹ Our primary use for this specification is to test the null hypothesis of no

¹⁸This is defined as $|\hat{\beta}_2|^2 \widehat{Var}(S(Z))$ where β_2 is defined in equation (1) below.

¹⁹The treatment assignment is included as the treatment binary minus a propensity score associated with treatment assignment. The propensity score is constant due to the randomized treatment assignment. The individual treatment effect $S(Z_i)$ is included as a deviation from its mean.

heterogeneity $\beta_2 = 0$.²⁰ Second, we split the testing sample into quartiles of predicted treatment effect using $S(Z_i)$ and estimate the regression

$$Y_i = \alpha * X_i + \sum_{j=1}^4 \gamma_j * T_i * 1(S_i \in I_j) + \eta_i \quad (2)$$

where I_j is the set of firms in the j th quartile.²¹ γ_j measures the “sorted group average treatment effect” (GATES) for each quartile, and is the key measure that we use to understand how treatment effects differ across well defined groups.

The key contribution of [Chernozhukov et al. \(2020\)](#) is to show how to get theoretically correct inference for these analyses and, again, we follow their approach. We repeat the split into training and testing sets 100 times (each with a different randomly chosen split) and run the analyses in (1) and (2) for each split. This process produces estimates of the key parameters β_2 and γ_j for each of the 100 splits, as well as the associated confidence intervals, standard errors and p -values. For the parameter estimates we report the *median* from the 100 runs. For a $1 - \alpha$ confidence interval we report the median of each boundary of a $1 - \alpha/2$ confidence interval from each split. For hypothesis tests in equation (1), we state that a hypothesis is significant at the α level if the median p -value is less than $\alpha/2$. The use of $\alpha/2$ in the hypothesis tests and confidence intervals corrects for sample splitting. Furthermore, when estimating significance levels for the four quartiles in equation (2) we implement a Bonferroni correction by multiplying p -values by four.²²

Results are presented in Figure 2 and Table 4, Panel A, Columns (3) - (6). Figure 2 shows GATES for quartiles using three different definitions of Z_i : just the psychometric/cognitive data; just the standard data; and all data (both psychometric/cognitive data and standard data). The first point to note is that there is strong evidence of het-

²⁰ $\beta_2 = 0$ if there is no heterogeneity, or the ML prediction $S(Z_i)$ does not capture that heterogeneity. Hence, this test is of a joint hypothesis, that there is heterogeneity and that the ML methods can detect it using the covariates that we have.

²¹Again, the treatment assignment is included as the treatment binary minus a propensity score associated with treatment assignment.

²²We note that this procedure is quite conservative.

erogeneity. Using just the psychometric/cognitive data,²³ we reject the hypothesis of no heterogeneity in treatment effects ($\beta_2 = 0$) with a p -value of 0.002. Concentrating on the estimates using the psychometric/cognitive data we find in Table 4 Panel A Columns (3) - (6) that those in the most positively impacted group see about a 8,600 EGP increase in monthly profits, and that this impact is significantly different from zero at the 5% level. At the other extreme, those in the least impacted quartile *lose* around 8,200 EGP per month in profits because of the treatment, an effect that is also statistically significant at the 5% level. To put these coefficients in perspective, mean profits in the control group in our sample is about 15,700 EGP per month meaning that the positive gain for the top quartile is about 55% of the control mean, while the loss for the least effected group is about 52% of the control mean.

It is important to note is that the psychometric/cognitive data does a much better job of capturing heterogeneity in treatment effects than does the standard data, and in fact inclusion of the standard data adds noise. When we utilize all of our data the p -value associated with the heterogeneity is 0.237 and the difference in GATES between the top and bottom group is about 6700 EGP. In contrast when we restrict our data only to the psychometric/cognitive questions we rule out homogeneity with a p -value of 0.002 and a bottom vs. top group difference of over 16,000 EGP. Finally, when we use only the standard data the estimated p -value increases to 0.483 (so that we cannot reject the joint hypothesis of zero heterogeneity or that the standard data cannot detect the heterogeneity). This implies that primarily the psychometric data are allowing us to predict the heterogeneous treatment effects. This result also implies that these machine learning techniques cannot fully differentiate signal from noise, as evidenced by the decrease in performance when using all of the data relative to only the psychometric/cognitive data. While the algorithms do help deal with the high dimensionality of the data, there is still an important role for researchers to identify which variables to include, and in what form (Mullainathan and Spiess, 2017).

²³When we refer to “psychometric/cognitive data” we include all 50 psychometric measures, as well as our measures of risk aversion and cognitive ability. When we implement the analysis without the risk aversion or cognitive ability measures our estimates of heterogeneity are even stronger.

4.1 Conditional Group Average Treatment Effects

Having found heterogeneity with respect to profits, in this section we explore whether firms that saw an increase in profits also saw changes in other related outcomes. Our aim is to shed some light on mechanisms and to validate the plausibility of our results. For example, understanding whether the top performers, those with the highest ITEs on *profit*, also increased revenue, and wages, etc., can help validate the result and also build insight regarding the likely path towards increased profits. For example, do profits increase via an expansion of the business or via a shrinkage of unprofitable inputs? The former implies a likely increase in wage bill, the latter implies a reduction. While the method from [Chernozhukov et al. \(2020\)](#) allows for assessing heterogeneity on any variable, it does not directly allow for determining whether heterogeneity in profit treatment effects translate into heterogeneity in other variables. Hence, we extend the GATES procedure from [Chernozhukov et al. \(2020\)](#) into a method to estimate Conditional Sorted Group Average Treatment Effects, or “CGATES”.²⁴

The CGATES procedure follows the normal GATES procedure closely. For each of the sample splits (into training and testing) we train our ML method on the training data and calculate $S_i = S(Z_i)$, the predicted individual treatment effect for i , for each individual in the *testing* group. At the end of this procedure, we take the median of these individual treatment effects for each i and rank individuals to create quartile rankings according to the individual treatment effect *for profits*. We then run the same specification as in equation 2 above, but change the Y variable to be the other outcomes variables of interest. In particulate we estimate

$$Y_i = \alpha * X_i + \sum_{j=1}^4 \gamma_j * T_i * 1(S_i \in I_j) + \eta_i \quad (3)$$

where I_j is an indicator for individual i being in the N th quartile ITE group for *profits*, which we refer to as the N th CGATES group.²⁵

²⁴Parts of this method are also similar to those in [Bertrand et al. \(2021\)](#).

²⁵Again, the treatment assignment is included as the treatment binary minus a propensity score associated with treatment assignment, and the X vector of controls includes the predicted values of $B(\cdot)$ & $S(\cdot)$ for profits.

We are interested in γ_j , which is the average treatment effect for individuals who were allocated to the four different CGATES groups. The main difference between our method and the [Chernozhukov et al. \(2020\)](#) method is that the group assignment is based on profits and not on the other outcomes of interest that we will analyze. This allows us to assess how impacts differ for individuals who increased their profits in response to the larger loan and those who decreased their profits. We also take the median value of S_i from the 100 simulations and then allocate individuals to groups, instead of taking the median coefficient from regressions across the 100 splits of the data. We then apply a Bonferroni correction by multiplying p-values for each coefficient variable by four.

Columns (3) - (6) of Panels B and C in Table 4, report the results of these regressions. Panel B shows impacts on our primary outcomes other than profits. Column 3 reports the treatment effect for individuals who were in the first CGATES group (those in the lowest quartile of individual treatment effects for business profits). Columns 4-6 follow the same format, reporting the treatment effect estimates for individuals who were in the second, third and fourth CGATES groups. The individuals in each group are held constant across all of the regressions in Panels B and C of Table 4 since we are conditioning on the ITE group for profits, and not for the ITE groups optimized for the outcomes presented. Many of these outcomes are highly correlated, and so we expect results to be similar to the impact on profits, but this exercise allows us to better understand the mechanisms through which profits are increasing.

The first row in Panel B shows that those in the highest ITE quartile for profits also have a large increase in revenues, with an increase of 47,556 EGP (se=9481), while those in the lowest CGATES group see a revenue *decrease* of 51,463 EGP (se=10406). A similar pattern holds for the other business outcomes in the subsequent three rows, expenditures, spending on wages, and estimate TFP: there are large statistically significant gains for those in the top CGATES group and losses for those in the bottom CGATES group. For example, those in the top CGATES group increase their wage bill by nearly 2,400 EGP per month (se=532), while those in the bottom CGATES group de-

crease their wage bill by about 2,000 EGP ($se=628$).²⁶ We also find large differences in estimated TFP in the top and bottom quartiles. The final row in Panel B shows that the heterogeneous effects in business outcomes are also reflected in reported household expenditure. The top group experiences a statistically significant 2,077 EGP increase in expenditure, while the bottom group sees a decrease of 291 EGP, although this decrease is not statistically significant.

These estimates show that there is a subset of the sample who are using the loan to greatly expand their business, increasing revenues and expenditure and spending on labor. These individuals are also using the additional business profits to increase their expenditure at home. On the other side of the spectrum are individuals who were unable to turn the larger loan into business profits, and instead are dealing with a large decrease in the size of their business across revenue, expenditure and labor outlays, with suggestive evidence that the negative business impacts also extended to the home.

Critically these groups are not generated in a way that overfits the data to maximize heterogeneity, rather they are produced through a method that utilizes baseline data and split-sample validation. This means that the ITEs estimated for each person do not use any of the data on that own individual's performance. Hence, it is not equivalent to grouping individuals who may have realized a negative/positive shock in their business and splitting up the sample based on realized outcomes. Instead, this categorizes people based on their baseline characteristics and the algorithms' predictions about how they would perform with the larger loan based on the performance of other people who are observationally similar.

The results indicate that there is a "type" of borrower who will be able to grow their business with larger loans and a "type" of borrower who will actually shrink their business when provided a larger loan relative to a smaller loan. This is par-

²⁶The decrease in spending on labor is larger than the average value in the control group and midline and endline. This is likely due to non-linearities in the size of the control group wage bill in the follow up survey by treatment quartile, those in the highest and lowest quartile have the largest wage bill when in control, and it is greater than the 2,000 EGP reduction for the lowest quartile. It's worth noting that there are no differences in *baseline* values of wage bill spending between any of the quartiles. This is also true when we consider the number of employees.

ticularly striking given the several layers of review that were already built into the selection of the sample. In addition to the borrowers requesting the loan on their own behalf, the loan officers needed to approve of the individual getting a larger loan, the borrower had to have successfully completed three previous loans, and a central credit committee needed to review their case before they were randomized. Hence all of the links across that chain were intended to weed out individuals who would not benefit from the loan, but even in this highly selected sample there is significant heterogeneity and a group of borrowers who are negatively impacted. We explore this further in the following section.

Panel C continues our analysis of heterogeneous treatment effects showing estimate treatment effects for each CGATES group on additional outcomes. The table shows that for those in the bottom CGATES group the larger loan decreased the likelihood that they were able to keep their business open by 8 percentage points. The loan also led to an increase in the number of employees by 0.84 employees for the top group (although this increase is not statistically significant) and a decrease of 2.27 employees in the bottom group. The point estimates for changes in the value of assets are large but not precisely estimated. Estimates of the heterogeneous impacts on mental and physical health suggest a similar pattern, with increases for those in the top profits group and decreases for those in the bottom groups. It's worth noting that there is a decrease in reported mental health of 0.26 standard deviations for those in the bottom quartile. This decrease is both large and statistically significant and shows the mental toll that comes from a failing business.

We also explore heterogeneity in borrowing behavior. We find some evidence that those in the bottom group pay more in late fees, but this result is not statistically significant. We also find that those in the lowest group are less likely to be borrowing after 30 months, as are those in the third highest quartile, implying some non-linearities in impacts.

5 Who Benefits Most from Big Loans?

The previous section provides evidence of important heterogeneity in the impacts of providing big loans to small firms. Some individuals are able to use the loans to grow their business, while others are negatively affected. To better understand who benefits and who loses, Table 5 compares the baseline characteristics of top and poor performers. While the machine learning algorithms are non-parametric in nature, comparing average baseline values across groups can help us better understand what differentiates the two groups.

In Panel A we consider standard data collected at baseline, split into demographic characteristics and business characteristics. Those in the top group are less likely to be female and are more educated on average by one year. We find no statistically significant differences in baseline business characteristics including whether the business is registered, baseline profits, revenues, expenditures or the number of employees. There is also no difference in the size of their previous ABA loan, but those in the top group had about half the amount of loans outstanding with organizations other than ABA, perhaps indicating that those in the top treatment group may have been more credit constrained prior to the experiment.

In Panel B we consider our baseline psychometric measures, split into cognitive & risk aversion and then the more explicit psychometric measures. We find that those in the top group perform better on the digit span recall task, and on a battery of financial literacy questions. There are no statistically significant differences on their Raven's Matrices scores, and those in the top group exhibit higher levels of risk aversion as evidenced by a lower proportion of investment in a hypothetical risky asset relative to the control group.²⁷

It is less obvious how to compare the top and bottom groups in their responses to our psychometric questions, since we asked 50 of them at baseline and have no specific ex-ante theories about which are the most important. We deal with this chal-

²⁷We ask individuals to imagine that they had 10,000 EGP that they could invest in an opportunity that would either double their money or halve it, each with a 50% probability. They then report the amount of those funds they would invest in the risky asset.

lenge in two ways. Each method yields five measures for inclusion, four of which overlap, thus in Panel B we report the full set of six that are by-products of these two methods. First, we build a random forest model of the predicted individual treatment effects (which are generated using the method described above from [Chernozhukov et al. \(2020\)](#)) using all of the baseline psychometric questions and recover measures of “feature importance” ([Athey and Imbens, 2019](#)). In essence this measure tells us how often each variable is used when creating the set of decision trees in the model. Second, we run a lasso regression with all of the psychometric variables on the right hand side predicting the estimated individual treatment effect and chose the top five most predictive questions.²⁸

Both methods choose the following four statements as important predictors of the individual treatment effect: (i) “I tend to act first and worry about consequences later”, (ii) “I can think of several solutions to any problem”, (iii) “I prefer to have a flexible schedule - I don’t like being tied down”, (iv) “I feel anxious outside my comfort zone”. The Random Forest algorithm additionally chooses the statement (v) “When I make decisions I usually go with my first, gut feeling”, and the Lasso chooses (vi) “In life, failure is not an option”. Across all of these questions those who have high treatment effects are more likely to *disagree* with these statements. We consider those who agree with these statements to be “go-getters”: they are individuals who like to work hard, make changes, and engage in experimentation. Those who benefit most from the loans are those who are careful and shrewd.²⁹

We also show that the responses to these six questions alone are predictive of success. We run a regression of the predicted individual treatment effects (ITE) on the six variables and use that simple model to produce a measure of predicted ITE. Appendix

²⁸Selection of variables in lasso regressions can be sensitive to the inclusion of highly correlated potential explanatory variables. To overcome this limitation we utilize the “Puffer Transformation” as developed in [Jia and Rohe \(2015\)](#) and utilized in [Banerjee et al. \(2021\)](#) to generate stable lasso selections.

²⁹Those in the lowest treatment group, the go-getters, indicate stronger agreement with the several statements, our interpretations are: “I tend to act first ...” & “When I make decisions...” & “I prefer to have a flexible schedule...” indicates impetuosity; “In life, failure is not an option” & “I can think of several solutions ...” hard work, but also a lack of forethought and realism; and “I feel anxious outside my comfort zone” this one seems at odds with our basic theory although, based on the answers to the other questions, go-getters may have larger comfort zones.

Table 4 splits the sample into quartiles based on their value in this index. Panel B shows this index is able to identify the highest performers and the lowest performers, but performs better predicting the top group relative to the bottom. This suggests that it may be operationally feasible for lenders to use a small list of psychometric statements that could help them target their programs towards those they are most likely to help and away from those that they are least likely to help, although we note the potential for manipulability.

While largely speculative, the go-getter interpretation may have important implications for understanding the allocative role of credit markets. [Banerjee and Moll \(2010\)](#) argues that, in the presence of a neoclassical production function, misallocation on the intensive margin should quickly dissipate as firms save, and that this is true even with strong credit constraints. In Banerjee and Moll's model, credit constraints cannot explain static capital misallocation. In contrast, if production functions have convex regions, or expansion requires significant risk taking and lumpy choices as suggested by the go-getter interpretation, savings alone will be insufficient to ensure efficient allocations, and credit constraints may play an important role.

6 The Quality of Allocations

The heterogeneity of impacts discussed above suggest substantial scope for the allocation of large loans to affect the impact of credit availability and the aggregate profitability and productivity of firms borrowing from ABA. We now discuss whether, in the absence of psychometric data and machine learning techniques, ABA would be in a position to make efficient allocation decisions. As noted above, to study the allocation problem requires providing large loans to firms that would not normally receive loans in a "business as usual" credit expansion, and as a consequence we do not have a direct measure of which firms would have received loans in the absence of our intervention. We hence use two different proxies that we believe provide a good sense of which firms would likely have been allocated credit.

6.1 Firms that Perform Well with Small Loans

A natural theory of loan allocation is that the lender will perceive firms that perform well with smaller loans as high quality entrepreneurs, and hence will be more likely to extend larger loans to them. This would also be an optimal loan allocation strategy in models such as [Banerjee and Moll \(2010\)](#), which posits a constant firm specific productivity term that multiplies a decreasing returns to scale production function. According to this theory, the allocation of large loans is likely to be relatively efficient if top-performers are among those firms which see the greatest firm growth when given a small loan, and inefficient if top-performers perform relatively badly with small loans. Evaluating the quality of allocation in this way has the advantage that it moves beyond the specific allocation decisions of ABA to evaluate the effectiveness of this simple allocation rule on the firms within our sample, which we believe to be relatively representative of SME's in Egypt.

Table 6 presents evidence consistent with a propensity toward misallocation of larger loans, if our basic theory is correct. Each column in the table is a regression in which we regress a measure of firm performance on a standardized measure of our predicted individual treatment effect. The top-performers have high values for this index, and the go-getters discussed above have *lower* values for this index. Panel A has baseline to endline change in profits as the outcome measure of firm performance, while panel B has endline TFP.³⁰ Columns 1 and 2 show that, when they are placed in the control group, our top-performers do badly: they are the firms that see the smallest baseline to endline increase in profits, and also the firms that have the smallest endline TFP. In contrast, columns 3 and 4 show when the top-performers are placed in the treatment group, they see the largest increases in profits and have the highest endline TFP. The availability of credit leads to a strong reversal of fortune. Overall, these results suggest the entrepreneurs who benefit most from the loan gain because, in the absence of the loan, they would have done poorly and those who lose from the loan do so because they would have done well without it. It also implies that misallocation

³⁰We do not have the data necessary to compute baseline TFP.

will ensue if a lender pursues a strategy of targeting large loans at those firms who perform well with small loans.

6.2 Loan Officer Perceptions

Our second strategy for understanding likely misallocation is more strongly tied to ABA's institutional structure. As noted above, loan officer incentives strongly favour minimizing default, and loan officers have a great deal of control over which firms get loans. This implies that if loan officers believe that top-performers will see relatively low defaults then large loans will be well allocated, and that large loans will be misallocated if loan officers perceive top-performers to be relatively risky. In favour of the reasonableness of this assumption we also asked loan officers to list what were their most important considerations when deciding whether or not to provide a loan to a client. 70% listed repayment ability as the top reason, with another 20% listing it as the second most important reason.

Panel C in Table 5 presents results on loan officer perceptions using data collected before the randomization.³¹ We asked loan officers to grade borrowers on their "ability to repay the loan" on a 1-10 scale. We asked them the question twice, once about their perception of repayment ability in the case that the borrower received the larger loan, and again in the case that the borrower received the smaller loan. We score this as a binary variable that combines the two responses, equal to one if the loan officer perceives the larger loan will be more likely to lead to default than the smaller loan.

We find that loan officers believe that those in the top quartile of impacts are *more* likely to struggle to repay if provided the larger loan relative to those in the bottom quartile. Loan officers predict that a large loan will increase default for 22% of poor-performers and this increases by a statistically significant 24 percentage points for top-performer. This fact is strongly suggestive that in the absence of some alternative method to identify top-performers large loans would be misallocated.³² Panel C in

³¹As noted above, due to logistical constraints we were only able to start the loan officer survey towards the end of implementation, and only have loan officer predictions for the final 29% of the sample.

³²Panel C of Appendix Table 4 includes a related analysis. We split the sample by loan officer prediction

Table 4 also suggests a disconnect in observed repayment behavior, with those in the bottom quartile paying more in late fees than those in the top quartile, although these estimates are not statistically different.

While ABA makes its lending choices based on perceived default, an alternative way to allocate credit would be for loan officers to encourage loans to those firms that they believe will benefit most from them. To test whether this strategy would improve allocation we asked loan officers to predict which firms would see a revenue increase. Again Panel C in Table 5 presents results on how these perceptions correlated with treatment effects. We find no statistically significant difference between the top and bottom-performers although the sign is in favor of efficient allocation: the loan officers believe that 24% of poor-performers and 37% of top-performers will increase more revenue growth with the larger than with the smaller loan. While weak, this evidence suggests that allocation based on perceived revenue gains would be more efficient than current practice, but not as effective as allocation based on psychometric data.³³

7 Policy Implications & Conclusion

Taken as a whole our results suggest both that the within lender allocation of credit matters for firm profitability and productivity, and that standard approaches to determining how to allocate credit are likely to be inefficient. Our work also suggests the potential efficacy of psychometric data in improving allocation. Our six question index is predictive of treatment effects, but is potentially subject to gaming. Individuals were informed that their loan decision would not be based on their answers to these questions, and so our results do not reveal what would happen if lending decisions depended on the responses. Finding strategy-proof ways to detect which individuals

of the impact of the loan on repayment ability and estimate the impact on profits for each group. We find that loan officer perceptions about repayment ability are negatively correlated with impacts on profits.

³³Panel D of Appendix Table 4 again provides related analysis. It splits the sample based on loan officer perceptions and shows that loan officer perceptions are not very predictive of loan impacts on profits.

would benefit most from large loans is a fruitful avenue for future research.

Our results also suggest a reappraisal of the importance of credit expansion for supporting firm growth. Many policymakers consider supporting firm growth to be a primary objective, but previous efforts have shown that this is a difficult task. We show that a relatively large infusion of credit could be one tool to help firms grow. Yet, as is clear from the analysis of heterogeneous treatment effects, this is not an economy-wide prescription. While there are some firms that can benefit from a large expansion in borrowing, there are others that are harmed, even leading to firm exit. Making use of these findings therefore requires either a better understanding of how to improve the allocation of credit, or a belief that expanding larger loans to all firms will let bad firms exit, opening up additional room for the most productive firms to flourish. While plausible, this second line of thinking requires careful consideration of the human costs associated with failed businesses.

We also find that many borrowers choose to take out a loan that is larger than what they are able to handle. This could be due to several reasons that we are not yet able to empirically differentiate. One theory is that these borrowers are overly optimistic and more risk-loving, (as evidenced by their with reported ability to “think of several solutions to any problem”, and their greater reported risk taking preferences) and they arrive at a point in their firm’s production function that requires undertaking a risky investment to grow past their existing operations. This induces them to take on new investments that do not pan out on average. If this need to take risky investments to grow is common among firms, then misallocation may persist in the long run, even if firms are able to save. Further work that maps the path from beliefs to investment to outcomes, examining heterogeneity along the dimensions revealed here, could prove fruitful.

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Figure 1. Outstanding Debt at ABA Over Time

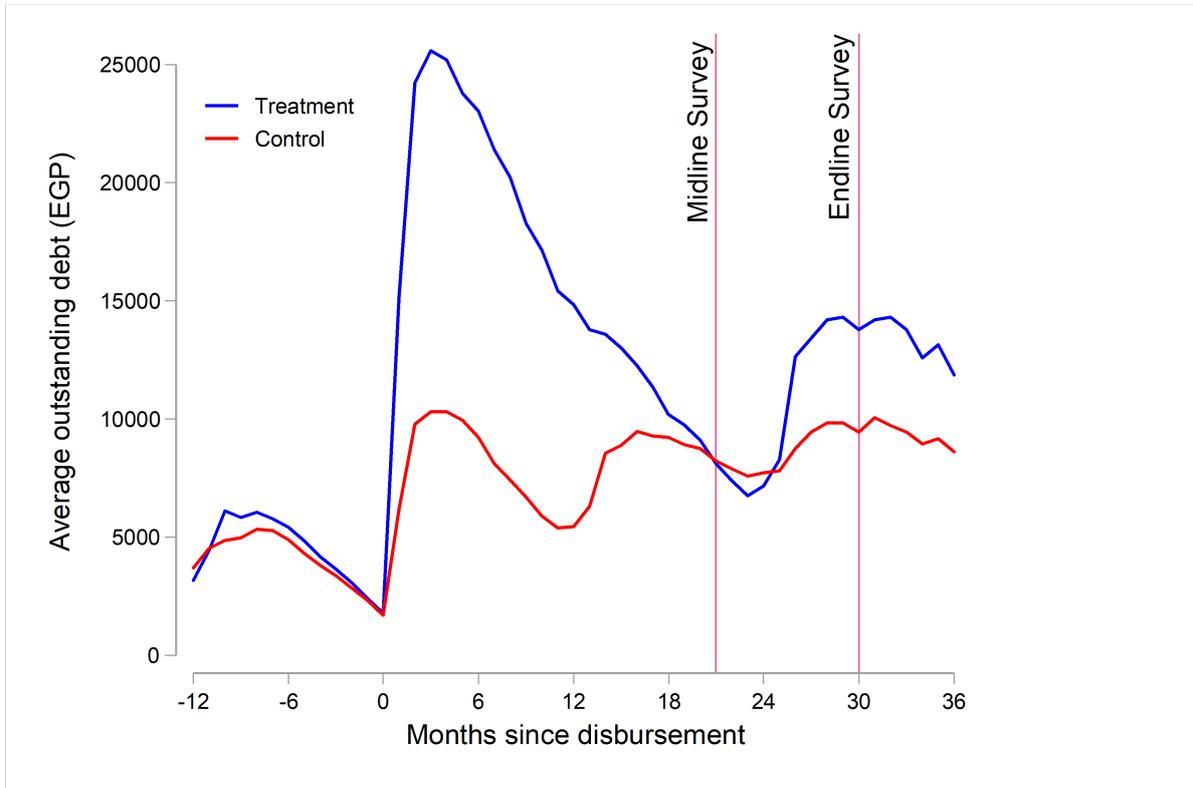


Figure 2. Heterogenous Treatment Effects for Profits

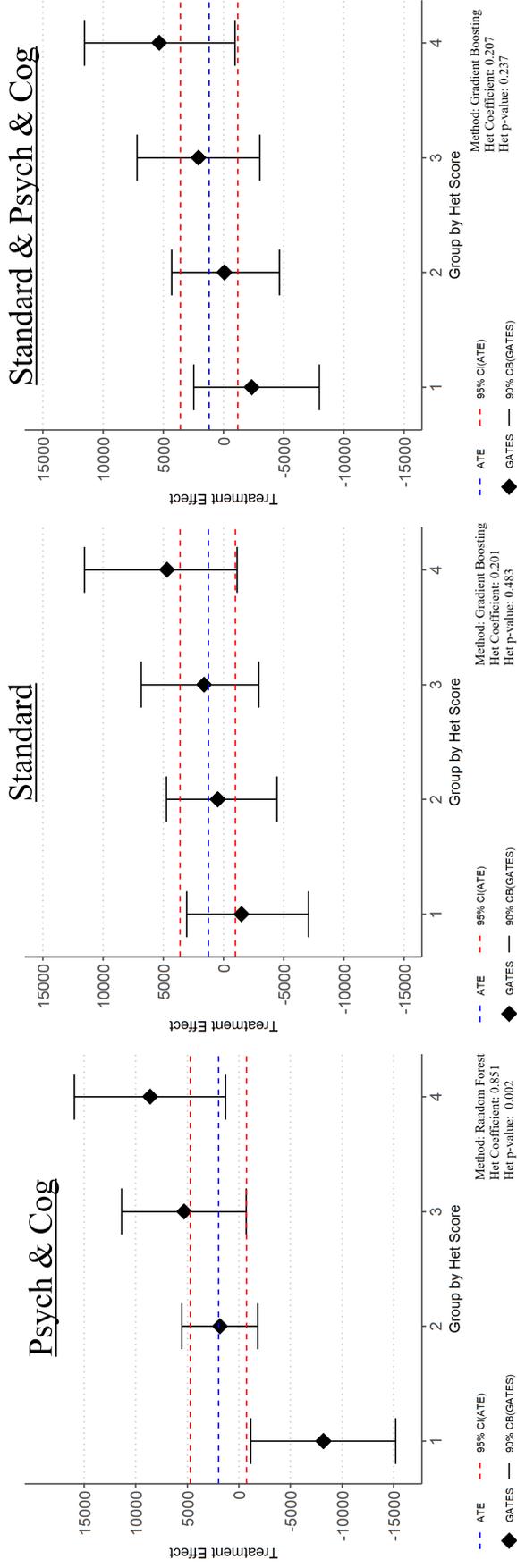


Table 1. Baseline Balance and Take-Up Composition

| | Control mean (1) | Control Difference (OLS) (2) | Number of Obs (3) | Predictors of Take Up in Control (4) | Predictors of Take Up in Treatment (5) | p-value for test of (4)=(5) (6) |
|-----------------------------------------------------|---------------------|---------------------------------------|-------------------------|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
| Baseline Value of Standard Variables | | | | | | |
| Age | 40.71 {10.0} | -0.49 (0.72) | 1003 | 0.00 (0.02) | 0.00 (0.02) | 0.81 |
| Female (=1) | 0.18 {0.39} | 0.03 (0.03) | 1004 | 0.10** (0.04) | 0.09*** (0.03) | 0.88 |
| Years of education | 8.75 {4.52} | 0.05 (0.28) | 996 | -0.02 (0.02) | -0.02 (0.02) | 0.90 |
| Business is registered | 0.35 {0.47} | -0.01 (0.03) | 1004 | 0.04** (0.02) | 0.01 (0.02) | 0.24 |
| Years of experience | 12.34 {10.1} | 0.50 (0.75) | 996 | -0.03 (0.02) | 0.01 (0.01) | 0.11 |
| Monthly profits | 6810 {9330} | -318 (615) | 993 | 0.05* (0.03) | -0.01 (0.07) | 0.47 |
| Monthly revenue | 34500 {74011} | -2270 (4260) | 993 | 0.11 (0.14) | 0.22 (0.43) | 0.80 |
| Monthly expenditures | 27800 {69526} | -2110 (4080) | 995 | -0.12 (0.13) | -0.21 (0.39) | 0.83 |
| Monthly wagebill | 1410 {3880} | 106 (280) | 1004 | -0.08** (0.04) | 0.00 (0.03) | 0.09 |
| Has employees (=1) | 0.37 {0.48} | 0.00 (0.03) | 1004 | 0.07 (0.05) | 0.11*** (0.03) | 0.47 |
| Number of employees | 0.65 {2.19} | -0.05 (0.11) | 995 | 0.03 (0.02) | -0.06* (0.04) | 0.03 |
| Size of Previous ABA Loan | 7540 {4239} | 5.6 (222) | 1004 | -0.02 (0.03) | 0.02 (0.02) | 0.15 |
| Have a loan other than ABA (=1) | 0.06 {0.24} | -0.03 (0.02) | 1004 | 0.08 (0.12) | -0.04 (0.09) | 0.46 |
| Value of other non-ABA loans | 2040 {12201} | -805 (936) | 1004 | -0.04 (0.04) | 0.01 (0.01) | 0.29 |
| p-value for Joint Test of standard variables | | 0.787 | 981 | | | |

Notes: Column 1 reports the control group mean with standard deviations in braces. Column 2 reports the coefficient on a treatment indicator from a regression of each row on a treatment indicator and strata fixed effects. Non-binary variables are winsorized at the top 1% level. Columns 4 & 5 report coefficients from a regression of a binary for take-up of the loan on each variable listed in the rows. For columns 4 & 5 non-binary variables are standardized to simplify interpretation. Standard errors in parentheses. Statistical significance * 0.10; **0.05; ***0.01.

Table 2. First Stage: Effect of Randomized Treatment Status on ABA Borrowing

| Borrowing Outcomes (First Stage) | Control | Treatment - | Number of Obs |
|-------------------------------------------------------|-----------------|------------------------------------|---------------|
| | mean (1) | Control Difference (OLS) (2) | |
| Loan take-up (=1) | 0.76 {0.43} | 0.09*** (0.03) | 1004 |
| Loan size (EGP) | 9735 {9423} | 10768*** (956) | 1004 |
| Loan term (sample: take-up=1), months | 13.20 {3.68} | 6.49*** (0.34) | 810 |
| Size of monthly loan installments | 821 {940} | 314*** (58) | 1004 |
| ABA outstanding debt ~20 Months after randomization | 6673 {11709} | 1076 (805) | 1004 |
| ABA outstanding debt ~30 Months after randomization | 5735 {8375} | 1299 (640) | 1004 |
| Took another loan after end of experimental loan (=1) | 0.48 {0.50} | -0.06** (0.03) | 1004 |

Notes: This table reports the intent to treatment estimates of the impacts of the larger loans. Column 1 reports the control group mean with standard deviations in brackets. Column 2 reports the coefficient on a treatment indicator from a regression that includes strata fixed effects. Standard errors in parentheses. Statistical significance *0.10; **0.05; ***0.01.

Table 3. Effect of Randomized Treatment Status on Repayments to ABA

| Repayment Behavior | Control | Treatment - | Number of Obs |
|-------------------------------------------------------|------------------|------------------------------------|---------------|
| | mean (1) | Control Difference (OLS) (2) | |
| Eventual Repayment | 100% | 0 | 1004 |
| | - | - | |
| Perfect repayment of each monthly payment | 0.76 {0.43} | -0.13*** (0.03) | 1004 |
| Total days late over the loan cycle | 12.47 {25.68} | 14.19*** (2.63) | 1004 |
| Total penalty within first 24 months | 128 {281} | 195*** (48) | 1004 |
| Daily value of late payments over the first 24 months | 37 {2.6} | 29*** (7.6) | 1004 |

Notes: This table reports the intent to treatment estimates of the impacts of the larger loans on repayment behavior. Column 1 reports the control group mean with standard deviations in brackets. Column 2 reports the coefficient on a treatment indicator from a regression that includes strata fixed effects. Standard errors in parentheses. Statistical significance *0.10; **0.05; ***0.01.

Table 4. Primary Impacts on Enterprise Outcomes: ITT and GATES Estimates

| | Control Group | Treatment - Control | Group Average Treatment Effects (GATES) | | | |
|----------------------------------------|---------------|---------------------|------------------------------------------------------|--------------------|---------------------|-----------------------|
| | Mean | Difference (OLS) | (3) | (4) | (5) | (6) |
| Panel A: Profits | | | | | | |
| Profits | 15,655 | 1,448 (1,174) | -8,180 ** (3,584) | 1,840 (1,872) | 5,325 (3,078) | 8,611 ** (3,742) |
| | Control Group | Treatment - Control | Conditional Group Average Treatment Effects (CGATES) | | | |
| | Mean | Difference (OLS) | (3) | (4) | (5) | (6) |
| Panel B: Other Primary Outcomes | | | | | | |
| Revenues | 45,626 | 5,715 (4,415) | -51,463 *** (10,406) | 9,453 (7,780) | 15,961 (8,035) | 47,556 *** (9,481) |
| Expenses | 28,191 | 5,251 (3,531) | -34,142 *** (8,755) | 8,199 (6,352) | 11,786 (6,216) | 33,940 *** (8,327) |
| Wage Bill | 1,951 | 144 (247) | -2,041 *** (628) | -561 (481) | 874 (545) | 2,388 *** (532) |
| Total Factor Productivity | -0.02 | 0.04 (0.05) | -0.47 *** (0.11) | -0.17 (0.10) | 0.22 (0.10) | 0.58 *** (0.10) |
| Household Expenditure | 4,770 | 446** (211) | -291 (493) | -868 (400) | 567 (408) | 2,077 *** (470) |
| | Control Group | Treatment - Control | Conditional Group Average Treatment Effects (CGATES) | | | |
| | Mean | Difference (OLS) | (3) | (4) | (5) | (6) |
| Panel C: Secondary Outcomes | | | | | | |
| Has a Business | 0.96 | 0.00 (0.01) | -0.08 *** (0.02) | 0.00 (0.02) | 0.03 (0.02) | 0.05 (0.02) |
| Number of Employees | 2.55 | -0.18 (0.35) | -2.27 *** (0.60) | -1.02 (0.74) | 1.27 ** (0.50) | 0.84 (0.88) |
| Value of Assets | 361,397 | -6,209 (53,336) | -293,152 ** (98,497) | 28,058 (93,244) | 69,942 (142,199) | 128,219 (112,482) |
| Mental Health Index | 0.01 | 0.00 (0.05) | -0.26 ** (0.10) | 0.04 (0.10) | 0.17 (0.11) | 0.05 (0.10) |
| Physical Health (out of 5) | 2.18 | 0.04 (0.05) | -0.17 (0.09) | 0.00 (0.10) | -0.07 (0.10) | 0.11 (0.10) |
| Total Penalty within 24 months | 128 | 195*** (48) | 304 (145) | 247 ** (94) | 171 * (69) | 74 (89) |
| ABA Loan at 30 Months | 0.21 | -0.08*** (0.02) | -0.16 *** (0.05) | 0.03 (0.05) | -0.22 *** (0.05) | -0.01 (0.06) |

Notes: Column 2 reports the ITT estimate from a regression of the outcome variable (row) at follow-up on a treatment indicator. The regression includes controls for strata, survey round (20-month or 30-month), and the baseline value of the outcome when available. Standard errors clustered at the individual level. Columns 3-6 reports results from a two-step process. First, using the random forest algorithm with psychometric, risk, cognitive data, and treatment status, we predict individual treatment effects on business profits. Second, we report the coefficients from a regression of the outcome variable (row) on treatment status interacted with indicator variables associated with which quartile of predicted individual treatment effects (columns) the borrower was assigned to in the first step. For Panel A, this 2nd step is done for profits, the same outcome used to estimate the individual treatment effects. For Panels B and C, this 2nd step is done for other outcomes, but still the quartile assignment is based on predicted individual treatment effects on profits. TFP is the standardized residual from a regression of profits on assets and labor costs. All regressions include controls for predicted profits if in treatment, predicted profits in in control, strata fixed effects, and survey round, and also cluster standard errors at the individual level. Statistical significance *0.10; **0.05; ***0.01 after multiplying all p-values by 4 as part of a Bonferroni correction.

Table 5. Differences in Baseline Characteristics Between Top and Bottom GATES Groups

| | Bottom GATES Group | Top - Bottom GATES Group | | Bottom GATES Group | Top - Bottom GATES Group |
|-------------------------------------------------|-----------------------|-----------------------------|-------------------------------------------------------------------|-----------------------|-----------------------------|
| | Mean {Std. Dev.} | Coeff (s.e.) | | Mean {Std. Dev.} | Coeff (s.e.) |
| Panel A: Standard Data | (1) | (2) | Panel B: Psychometric Data | (3) | (4) |
| Demographics | | | Cognitive & Risk Aversion | | |
| Age | 41.0 {9.8} | 1.72 * (0.89) | Digit Span Recall | 2.34 {1.91} | 0.88 *** (0.16) |
| Female | 0.24 {0.43} | -0.09 ** (0.04) | Ravens Matrices | 1.75 {1.54} | 0.18 (0.14) |
| Years of Education | 8.3 {4.7} | 1.06 ** (0.41) | Financial Literacy Score | 5.62 {3.42} | 1.49 *** (0.31) |
| | | | Hypothetical % allocated to risky investment | 0.71 {0.32} | -0.05 * (0.03) |
| Business Characteristics | | | Psychometric Measures | | |
| Registered Business | 0.36 {0.48} | -0.02 (0.04) | I tend to act first and worry about the consequences later | 4.32 {1.06} | -0.89 *** (0.09) |
| Monthly Revenues | 42526 {194315} | -396 (16147) | I can think of several solutions to any problem | 4.67 {0.62} | -0.76 *** (0.06) |
| Monthly Expenses | 49998 {197078} | -745 (16465) | I prefer to have a flexible schedule-I don't like being tied down | 4.45 {0.80} | -0.91 *** (0.08) |
| Monthly Profits | 7270 {12200} | -24 (1023) | I feel anxious outside my comfort zone | 4.11 {1.15} | -0.73 *** (0.10) |
| Number of Employees | 0.6 {1.8} | 0.11 (0.16) | When I make decisions I usually go with my first, gut feeling. | 4.07 {1.25} | -0.23 ** (0.10) |
| Size of Previous ABA Loan | 7725 {4781} | -145 (427) | In life, failure is not an option | 4.71 {0.56} | -0.70 *** (0.06) |
| Value of Other Loans | 5635 {18725} | -3087 ** (1329) | | | |
| Panel C: Loan Officer Perceptions | | | | | |
| Perceives Large Loan will increase default (=1) | 0.22 {0.61} | 0.24 *** (0.08) | Perceives Large Loan will increase firm revenue (=1) | 0.24 {0.62} | 0.13 (0.08) |

Notes: Column 1 reports the baseline averages of characteristics for the individuals who are in the bottom group of estimated impacts on profits based on the Chernozhukov (2020) method utilizing psychometric data, while Columns 2 & 4 report the coefficient on an indicator for being in the top group from a regression of the variable in each row and strata fixed effects. Regressions only include people in the top or bottom groups. Business profits, revenues, expenditures and value of other loans are winsorized at the top 1% level. Hypothetical risk investment question: Respondents asked to allocate 10000 EGP to either a risky (50% chance of doubling/halving) investment or risk-free zero-return investment. Psychometric questions are on a 1-5 scale, with 5=strongly agree & 1=strongly disagree. We report the 6 psychometric variables that were chosen by either a random forest model or a lasso regression of the estimated individual treatment effect on all psychometric variables. Panel C includes data from a loan officer survey conducted towards the end of implementation and covers 288 borrowers. Standard errors in parentheses. Statistical significance *0.10; **0.05; ***0.01.

Table 6. Correlates of Enterprise Profits and Total Factor Productivity

| Panel A: Business Profits | | | | | | |
|---------------------------------------|----------------------------|--------------|----------------------------|---------------|------------------|---------------|
| Sample Frame: Outcome (EGP/Month): | Control Only | | Treatment Only | | Full Sample | |
| | Endline - Baseline Profits | | Endline - Baseline Profits | | Baseline Profits | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Standardized Predicted | -10584*** | -10607*** | 15893*** | 15866*** | 608 | 526 |
| Treatment Effect | (1804) | (1810) | (2432) | (2516) | (454) | (453) |
| Years of Education | | 225 (193) | | -185 (298) | | 205* (117) |
| Years of Experience | | -98 (77) | | 229 (170) | | 23 (74) |
| Number of Observations | 906 | 906 | 917 | 917 | 936 | 936 |

| Panel B: Total Factor Productivity (Follow-up Surveys Only; Asset Information not Collected at Baseline) | | | | | | |
|----------------------------------------------------------------------------------------------------------|--------------|---------------------|----------------|------------------|-----------------|----------------------|
| Sample Frame: Outcome = TFP: | Control Only | | Treatment Only | | Full Sample | |
| | (7) | (8) | (9) | (10) | | (11) |
| Standardized Predicted | -0.284*** | -0.283*** | 0.220*** | 0.213*** | Treatment | 0.026 |
| Treatment Effect | (0.044) | (0.044) | (0.039) | (0.038) | | (0.054) |
| Years of Education | | 0.001 (0.008) | | 0.013 (0.008) | Index | -0.284*** (0.044) |
| Years of Experience | | 0.009*** (0.004) | | 0.002 (0.004) | Treatment * ITE | 0.499*** (0.058) |
| Number of Observations | 908 | 908 | 920 | 920 | | 1828 |

Notes: Panel A reports results from regressions of profit outcomes on a standardized measure of the predicted individual treatment effect. Regressions include a control for survey round, and cluster standard errors at the borrower level. Panel B reports results from a similar regression but with total factor productivity in the 20-month and 30-month surveys as an outcome. Statistical significance *0.10; **0.05; ***0.01.

Appendix Table 1. Loan Size Compared to 7 Other Credit Studies

| | Egypt (1) | Bosnia and Herzegovina (2) | Ethiopia (3) | India (4) |
|-------------------------------------------------------------|----------------|----------------------------------|-----------------|--------------------|
| Currency | EGP | BAM | ETB | INR |
| Year of Implementation | 2016 | 2011 | 2006 | 2007 |
| Range of loan sizes in local currency | 3000-100,000 | 300-3,000 | | 10,000 |
| Average loan size in treatment group | 20,430 | 1,653 | 1,200 | 10,000 |
| PPP conversion factor | 2.92 | 0.71 | 2.4 | 11.3 |
| PPP value of the average loan size | \$6,997 | \$2,328 | \$500 | \$885 |
| Annual Value of International Poverty Line (Local Currency) | 4,490 | 1,654 | 1,500 | 13,678 |
| Loan size as % of annual poverty line | 455% | 100% | 80% | 73% |
| | Mexico (5) | Mongolia (6) | Morocco (7) | Philippines (8) |
| Currency | MXN | MNT | MAD | PHP |
| Year of Implementation | 2010 | 2008 | 2007 | 2006 |
| Range of loan sizes in local currency | 1,500-27,000 | 100,000 - 2,000,000 | 1,000 -39,000 | 5,000-25,000 |
| Average loan size in treatment group | 6,462 | 502,063 | 10,571 | 10,000 |
| PPP conversion factor | 8.9 | 472.5 | 4.2 | 16.6 |
| PPP value of the average loan size | \$454 | \$1,063 | \$2,517 | \$602 |
| Annual Value of International Poverty Line (Local Currency) | 21,420 | 794,836 | 4,514 | 17,880 |
| Loan size as % of annual poverty line | 30% | 63% | 234% | 56% |

Notes: Table reports data on the loan size in this study (column 1) and compares it to the loan sizes in seven other randomized experiments on access to credit (columns 2-8). Loan sizes in columns 7 & 8 are medians. PPP conversion rates sourced from the World Bank. Studies sorted alphabetically by country. Set of studies chosen based on inclusion in recent meta-analysis in Meager (2019). Citations, in order by column, are as follows: Augsburg et al (2015); Tarozzi et al (2015); Banerjee et al. (2015); Angelucci et al. (2015); Attanasio et al (2015); Crépon et al (2015); Karlan & Zinman (2011).

Appendix Table 2. Balance on Psychometric Variables

| | Control mean (1) | Treatment - Control Difference (OLS) (2) | Number of Obs (3) | Predictors of Take Up in Control (4) | Predictors of Take Up in Treatment (5) | p-value for test of (4)=(5) (6) |
|---------------------------------------------------------------------|---------------------|------------------------------------------------------|-------------------------|-----------------------------------------------|-------------------------------------------------|------------------------------------------|
| Baseline Value of Psychometric and Cognitive Variables | | | | | | |
| Digit Span Recall | 2.79 {1.8} | -0.06 (0.11) | 981 | -0.03** (0.01) | 0.00 (0.01) | 0.08 |
| Raven's Matricies Score | 1.76 {1.50} | -0.02 (0.10) | 981 | 0.01 (0.01) | 0.01 (0.01) | 0.99 |
| Hypothetical % allocated to risky investment | 0.70 {0.29} | 0.01 (0.02) | 973 | 0.04 (0.07) | 0.02 (0.05) | 0.88 |
| Financial Literacy Score | 6.04 {3.4} | 0.17 (0.20) | 981 | 0.01* (0.01) | 0.01 (0.01) | 0.54 |
| In life, failure is not an option | 1.68 {0.8} | -0.05 (0.04) | 972 | -0.01 (0.03) | 0.00 (0.02) | 0.61 |
| When I make a decision I usually go with my first, gut feeling. | 2.03 {1.0} | -0.02 (0.07) | 971 | 0.02 (0.02) | 0.00 (0.02) | 0.28 |
| I can think of several solutions to any problem | 1.75 {0.7} | -0.09* (0.05) | 972 | -0.01 (0.03) | 0.01 (0.03) | 0.39 |
| I prefer to have a flexible schedule - I don't like being tied down | 1.98 {0.9} | 0.01 (0.06) | 970 | -0.01 (0.03) | 0.00 (0.02) | 0.48 |
| I tend to act first and worry about the consequences later | 2.12 {1.1} | -0.01 (0.07) | 972 | 0.00 (0.02) | -0.01 (0.01) | 0.69 |
| I feel anxious outside my comfort zone | 2.28 {1.2} | 0.01 (0.07) | 972 | 0.00 (0.02) | 0.00 (0.01) | 0.88 |
| p-value for Joint Test of 50 psychometric & above questions | | 0.527 | 978 | | | |

Notes: Column 1 reports the control group mean with standard deviations in braces. Column 2 reports the coefficient on a treatment indicator from a regression of each row on a treatment indicator and strata fixed effects. Columns 4 & 5 report coefficients from a regression of a binary for take-up of the loan on each variable listed in the rows. Standard errors in parentheses. Statistical significance * 0.10; **0.05; ***0.01.

Appendix Table 3. How Survey Attrition Differs by Treatment

| | Coefficient (1) | Main Coefficient (2) | Interacted Coefficient (3) | | Main Coefficient (4) | Interacted Coefficient (5) |
|---------------------------------------------------------------------|--------------------|----------------------------|----------------------------------|---------------------------------|----------------------------|----------------------------------|
| Treatment | 0.000 (0.008) | 0.007 (0.005) | | Age | -0.002 (0.003) | 0.006 (0.005) |
| Digit Span Recall | | -0.004 (0.004) | 0.008 (0.005) | Female (=1) | 0.002 (0.004) | -0.002 (0.006) |
| Raven's Matrices Score | | 0.005 (0.003) | -0.001 (0.004) | Years of education | 0.006 (0.004) | -0.004 (0.005) |
| Hypothetical % allocated to risky investment | | 0.001 (0.005) | -0.002 (0.005) | Years of experience | -0.002 (0.003) | 0.002 (0.004) |
| Financial Literacy Score | | -0.001 (0.004) | -0.004 (0.005) | Monthly profits | -0.001 (0.003) | 0.001 (0.004) |
| In life, failure is not an option | | -0.004 (0.004) | 0.008 (0.006) | Monthly expenditures | -0.013 (0.015) | 0.014 (0.018) |
| When I make a decision I usually go with my first, gut feeling. | | -0.003 (0.004) | 0.003 (0.006) | Monthly revenue | 0.012 (0.016) | -0.012 (0.019) |
| I can think of several solutions to any problem | | -0.001 (0.003) | 0.000 (0.003) | Monthly wagebill | -0.002 (0.003) | 0.001 (0.003) |
| I prefer to have a flexible schedule - I don't like being tied down | | 0.000 (0.004) | -0.001 (0.005) | Business is registered | -0.003 (0.003) | 0.001 (0.004) |
| I tend to act first and worry about the consequences later | | 0.000 (0.003) | 0.001 (0.005) | Has employees (=1) | 0.016* (0.008) | -0.018** (0.009) |
| I feel anxious outside my comfort zone | | 0.000 (0.004) | -0.001 (0.004) | Number of employees | -0.001 (0.002) | 0.005 (0.003) |
| Size of Previous ABA Loan | | 0.009 (0.008) | -0.011 (0.007) | Value of other non-ABA loans | -0.010* (0.006) | 0.011* (0.006) |
| | | | | Have a loan other than ABA (=1) | 0.029 (0.022) | -0.032 (0.023) |
| p-value for joint test on treatment interactions for attrition | | | | 0.986 | | |

Notes: Column 1 reports the coefficient from a regression of attrition in either survey on the treatment dummy while controlling for survey round and strata (loan officer) fixed effects. Columns 2-5 report the coefficients from one regression. We regress attrition in either survey on a treatment indicator as well as all of the variables in each row (Columns 2 & 4) and an interaction of that variable with treatment (Columns 3 & 5), along with round and strata dummies. All non-binary control variables are standardized to aid in interpretation of the estimates. The last row reports the p-value of a joint test of significant for all the interacted variables in the regression. Standard errors in parentheses. Statistical significance * 0.10; **0.05; ***0.01.

Appendix Table 4. Heterogeneity Using Different Prediction Measures

| Heterogeneity Using Different Prediction Measures | | | | |
|----------------------------------------------------------------------------------|-----------------------------------------|----------------------------------|---------------------------------|----------------------------|
| Panel A: Groups Determined ITes (repeat of Table 4 Panel A) | | | | |
| | Group Average Treatment Effects (GATES) | | | |
| | (1) | (2) | (3) | (4) |
| Treatment Effects on Profits | -8180** (3584) | 1840 (1872) | 5325 (3078) | 8611** (3742) |
| Panel B: Groups Determined Using 6 Component Psychometric Prediction of ITes | | | | |
| | Group Average Treatment Effects (GATES) | | | |
| | (1) | (2) | (3) | (4) |
| Treatment Effects on Profits | -4571* (2744) | -487 (2319) | 2033 (2372) | 6800** (3108) |
| Panel C: Heterogeneity based on Loan Officer (LO) Perceptions of Repayment | | | | |
| LO thinks Default will: | Increase with Larger Loan | Stay same with Larger Loan | Decrease with Larger Loan | p-value for (1)=(2)=(3) |
| Treatment Effects on Profits | 880 (2932) | -3127 (3234) | -3365 (13984) | 0.65 |
| Treatment Effects on Loan Penalties | 20 (59) | 48 (62) | 314 (225) | 0.48 |
| Panel D: Heterogeneity based on Loan Officer (LO) Perceptions of Revenue Changes | | | | |
| LO thinks Revenue will: | Increase with Larger Loan | Stay same with Larger Loan | Decrease with Larger Loan | p-value for (1)=(2)=(3) |
| Treatment Effects on Profits | 4939 (3232) | -7574* (4140) | 3116 (4047) | 0.08 |
| Treatment Effects on Loan Penalties | 37 (72) | 103 (70) | -28 (56) | 0.26 |

Notes: Columns 1-4 in Panels A & B reports the coefficients from a regression of the outcome variable on indicator variables associated with which quartile of the estimated individual treatment effect for profits. Panel A reproduces the estimates from Table 5, which uses all of the psychometric data. Panel B uses the quartiles a 6 component prediction of the individual treatment effects produced in Panel A. The 6 components are described in Table 5. Panels C & D utilize loan officer perceptions collected at baseline on a subset of the sample (N=559 from 288 individuals). Panel C looks at treatment effects split by how the loan officer graded repayment chances in the case of the large loan relative to the small loan. Panel D splits by loan officer grades on how revenues will increase with the large loan relative to the small loan. The regressions also include a survey round dummy and strata fixed effects. Monthly profits in the control group are 8673EGP. Standard errors clustered at the individual level. Statistical significance *0.10; **0.05; ***0.01.

Appendix Table 5. Correlations between 6 Psychometric Variables

| | 1 | 2 | 3 | 4 | 5 | 6 |
|-------------------------------------------------|--------|--------|--------|--------|--------|---|
| 1 I prefer to have a flexible schedule -I don't | 1 | | | | | |
| 2 I tend to act first and worry about the | 0.2479 | 1 | | | | |
| 3 I can think of several solutions to any | 0.3005 | 0.1927 | 1 | | | |
| 4 I feel anxious outside my comfort zone | 0.1258 | 0.183 | 0.1043 | 1 | | |
| 5 In life, failure is not an option | 0.2142 | 0.1668 | 0.345 | 0.157 | 1 | |
| 6 When I make a decision I usually go with my | 0.1353 | 0.1677 | 0.1925 | 0.1103 | 0.1608 | 1 |

Notes: 16% of respondents answered the same for all of these questions.

Appendix Table 6. What Predicts Performance? Correlates of Individual Treatment Effects

| | 6 Variable ITE Prediction (1) | Individual Treatment Effect (2) | Individual Treatment Effect (3) |
|------------------------------|-------------------------------------|------------------------------------------|------------------------------------------|
| Age | -0.028 (0.037) | -271.594 (198.376) | -205.017 (177.243) |
| Female (=1) | -0.100 0.083 | -433.910 440.623 | -185.534 393.662 |
| Years of Education | 0.032 (0.035) | 247.518 (186.276) | 165.727 (166.863) |
| Years of Experimence | 0.061 (0.036) | 133.091 (188.775) | -15.110 (169.300) |
| Monthly Profits | 0.032 (0.052) | -186.928 (274.434) | -264.055 (245.180) |
| Business is Registered | -0.015 (0.034) | 35.005 (177.574) | 64.319 (158.758) |
| Has employees (=1) | -0.032 (0.037) | 182.366 (196.860) | 261.962 (175.907) |
| Value of other non-ABA loans | -0.037 (0.031) | -376.801* (161.468) | -287.399 (148.223) |
| Size of Previous ABA Loan | 0.016 (0.037) | 560.564** (195.927) | 532.114** (175.743) |
| Monthly Expenses | 0.236 (0.242) | 1121.960 (1281.910) | 548.064 (1144.510) |
| Monthly Revenue | -0.229 (0.258) | -1075.130 (1367.320) | -520.397 (1220.630) |
| Monthly Wagebill | -0.059 (0.040) | -395.709 (211.181) | -248.890 (190.548) |
| 6 Variable ITE Prediction | | | 0.984*** (0.062) |
| Number of Observations | 976 | 936 | 936 |
| p-value on joint test | 0.687 | 0.000 | 0.000 |

Notes: Outcomes and non-binary dependent variables standardized. 6 variable ITE prediction utilizes the questions outlined in Table 5. Statistical significance *0.10; **0.05; ***0.01.

Online Appendix

Ethics Appendix

We have developed this appendix in an effort to describe the ethical considerations of this experiment, and clarify the nature of the collaboration between the researchers and ABA. We follow the framework put forth in [Asiedu et al. \(2021\)](#), for the sake of comparability within economics.

1. **Equipoise** As we describe in the paper, there was significant hesitancy from bank management in providing these larger loans to clients. We used the evaluation to provide the lender an opportunity to test whether or not these loans would be beneficial to their clients as well as to the bank's bottom line.
2. **Role of Researchers with Respect to Implementation:** Bryan, Karlan and Osman are not active researchers in the project. Bryan, Karlan and Osman designed the randomization and evaluation protocols and managed the data collection activities and all of the data analysis. ABA, and not the researchers, designed and implemented the treatments (i.e., the loans).
3. **Potential Harms to Research Participants from the Interventions:** We designed the study to limit the potential harms to participants. In particular participants voluntarily applied for a larger loan, and were approved by their loan officer and the bank's credit committee. All participants expected to benefit from the intervention, and all the bank staff also expected participants to benefit. Our results show that some did not benefit, leading to decreases in business profits and related outcomes.
4. **Potential Harms to Research Participants from Data Collection or Research Protocols** We do not believe participants were subjected to any harms from data collection. Participants were able to refuse to answer any questions they wanted to and were told they could stop the interview at any time.
5. **Financial and Reputational Conflicts of Interest:** Bryan, Karlan and Osman did not receive any form of financial compensation as part of this study (nor did any assistants or staff associated with the research team). No employee of ABA was named as a PI or participant in any research grant that provided funding for this project.

The research questions pursued in this study and the results described in this study are novel and different form of prior work conducted by the authors. We perceive no reputational conflicts of interest.
6. **Intellectual Freedom:** This study was conducted through a collaboration between PIs and the Alexandria Business Association. The study was conceived and designed by the PIs, who maintained full intellectual freedom throughout all stages of the project. At no point did the partner have undue influence on the analysis or interpretation of results.
7. **Feedback to Participants or Communities:** We intend to share our results with participants via email after our work is subject to peer-review.

8. **Foreseeable Misuse of Research Results:** The authors recognize that the results are relevant for public policy and regulatory activities in credit markets. While misinterpretation or deliberate mischaracterization of the results could have implications for individuals, communities and firms, we are unaware of any set of outcomes or analyses that ex-ante would be predicted to favor advantaged parties. In fact, our search for heterogeneity is partly motivated by this kind of concern regarding studying merely the “average” impact of credit for firms, since average results may mask the presence of both winners and losers.

Survey Questions

Risk Questions

R1: How do you see yourself? Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please select one number on the scale, where 0 equals “unwilling to take risks” and 10 equals: “fully prepared to take risks”

R2: Imagine you have EGP 10,000 to invest. You may choose to “invest” all or a portion of your money. There is a 50% chance to double the amount of money you choose to “invest”. It is equally possible that you could lose half the investment. For example, if you choose to invest EGP 1,000, there is a 50-50 chance of getting EGP 2,000 or EGP 500. How much of the EGP 10,000 do you invest?

Financial Literacy Questions

FL1: As the demand for a good or service rises, all other things being equal, its price is likely to:

Fall; Rise; Stay the same; There is not enough information to know; I don't know; Refused to answer

FL2: The amount by which revenue from sales exceeds costs in a business is known as:

The profit margin; The cost of capital ; Owner's equity; Gross sales; I don't know; Refused to answer

FL3: As the price of raw materials used to produce a product fall, all other things being equal, the profit margin on sales of that product will:

Fall; Rise; Stay the same; Remain unchanged ; I don't know; Refused to answer

FL4: Monies that go in and out of business over a period of time are known as:

Cash flow; Sales; Assets; Liabilities ; I don't know; Refused to answer

FL5: A sum of money that is owed or due is known as:

A credit; Equity; A debt; A grant; I don't know; Refused to answer

FL6: Annual sales net of all discounts and sales taxes is known as:

Profit; Turnover; Gross sales ; Cash flow; I don't know; Refused to answer

FL7: A sum of money paid regularly (typically annually) by a company to its shareholders out of its profits (or reserves) is known as:

Interest; Profit; A loan; A dividend; I don't know; Refused to answer

FL8: You export the majority of the goods you sell. All other things being equal, if the value of your own currency falls (depreciates) relative to the currency of the market you export to, the goods you sell to that market will be:

More expensive; Cheaper; The same price as before; There is not enough information to know; I don't know; Refused to answer

FL9: You import raw materials to produce the goods you sell. All other things being equal, if the value of your own currency rises (appreciates) relative to the currency you import raw materials from, the cost of producing the goods you sell will:

Rise; Fall; Stay the same; There is not enough information to know; I don't know; Refused to answer

FL10: Debts or financial obligations incurred during business operations are known as:

Equity; Credit; Assets; Liabilities ; I don't know; Refused to answer

FL11: A financial report summarizing a company's assets (what it owns), liabilities (what it owes) and owner's equity at a given time is known as:

The Bought Ledger; The Balance Sheet; The Cash flow Statement; The Profit & Loss Statement; I don't know; Refused to answer

FL12: A financial statement summarizing a company's performance and financial position by reviewing revenues, costs and expenses during a specific period of time is known as:

The Bought Ledger; The Balance Sheet; The Cash flow Statement; The Profit & Loss Statement; I don't know; Refused to answer

FL13: The total assets of a company, minus its total liabilities represent the capital available for distribution to its shareholders. This is known as:

Profit; Owner's equity; Loss; Debt; I don't know; Refused to answer

FL14: The risk of a customer not paying for goods they have received is an example of:

Financial risk; Operational risk; Strategic risk; Compliance risk; I don't know; Refused to answer

FL15: Which of the following is not included in a cash flow control statement?

Cash coming in; Assets; Cash going out; Cash balance; I don't know; Refused to answer

FL16: Which of the following is not an operating expense?

Payroll; Taxes; Supplies; Dividend payments ; I don't know; Refused to answer

Psychometric Questions

Baseline

At work, I need to be in control

I always say what I think

I don't follow, I lead

I will do anything to get what I want

When I make a business decision it is almost always the right decision

I have always believed I am going to be successful

Deep inside, I know I am better than most people

I don't get the recognition I deserve
People often tell me how great I am at what I do
I've got a great sense of humour
It is always better to be in the background than in the centre of attention
Modesty gets you nowhere
When I make decisions I usually go with my first, gut feeling
I prefer to focus on opportunities rather than risks
Without risk there is no reward
I tend to act first and worry about the consequences later
It's always good to question authority
I find it difficult to take orders from other people
I only trust myself
People often struggle to understand my ideas
I see patterns and connections where other's don't
I always know when to give up, and move on to something else
I would work seven days a week if I could
I can't wait to get out of bed in the morning - there is always so much to do
In life, failure is not an option
I am critical of myself
I feel anxious outside my comfort zone
Success is never down to luck
Whenever I cross something off my "to-do list", I add something new straight away
You should never take shortcuts in life
I stay calm even during a crisis
I can think of several solutions to any problem
I prefer to have a flexible schedule - I don't like being tied down
I always get things done ahead of time
When I need to, I act quickly without thinking too much
I plan everything
I am more concerned about getting the job done than following office rules
I can concentrate well even when my office is messy
I always check and double check my work
I can leave work unfinished and move on
I am more concerned about the big picture than the details
I keep my promises
I see business opportunities where others don't
It is not that I don't see profitable business opportunities, I just don't have the
motivation to do anything about them
I spend a lot of time planning for my future
I have a strong desire to be successful in life
I am a results oriented person
I am a very competitive person
Some people think I am lazy
I am always trying to improve my performance, whatever I am doing

Follow Up 1

Discussion is fine, as long as I make the final decision

I don't like being told what I can and cannot do
People think twice before confronting me
In years time, I want people to still be talking about the great work I have done
As a child I always kept my parents on their toes
I am a very easy person to get along with
I am a dreamer
I often have too many ideas in my head at once
I get annoyed when people do not take their work seriously
I like it when people are straight with me and give honest feedback
I feel in complete control of my life
I hate letting people down
I have practical skills that others don't
People often ask for my opinion on business matters
I know that others may be better at a task than I am
I create my own path in life
I choose my words carefully
I like being spontaneous
I make decisions quickly and move on
I do my best work when I leave things to the last minute
If I disagree with someone, I tell them what I think
I am good at making last minute changes to plans
When working in teams, I tend to come up with more ideas than others
I am always trying to find new ways of doing things
People who believe in a better future are just naive
Great business ideas change the world
When it comes to exploiting business opportunities, I am often too cautious
Even if I know how to do something, I would always try to do it in a different way
Every decision I make is part of my long-term career plan
I don't have any big plans for the future
I need to do my work exactly right
I get annoyed when plans fall through
I have a brain for business
I always know when there is a gap in the market for a new product
In my group of friends I am the most creative person
I am always willing to take financial risks
When investing my money, I would rather be safe than sorry
I am someone who likes to win at whatever I do

Follow Up 2

Status is the most important thing in life
I would love to be famous
People are jealous of me
I am naturally impatient
I rarely recognize valuable business openings unless they are really obvious
I am a natural risk taker
I was in trouble a lot at school
I was in trouble a lot when I was a kid

I do things my way
I often hesitate to act on valuable business opportunities
I don't like following rules
I sometimes feel overwhelmed by my own creativity
I am an 'ideas person' details bore me
Being different is necessary for success
Before I go to sleep I think, "what could I have done better today?"
I like to live dangerously
As a child, I was never interested in school
It's my way or the high way
I do not let other people's opinions affect me
I am excellent at what I do
I handle difficult tasks well
There is no challenge I feel I can't overcome
I can easily deal with unexpected events
I am more optimistic than most people I know
I prefer to do things in ways that are well established
My judgements can be wrong
I always stick to the rules
I am so busy I sometimes forget things
I need everything to be just right
I change and update my plans constantly
I act exactly according to plan
I will risk making mistakes to get things done
I am always looking out for new business opportunities
I think my decisions through carefully
I feel great after organising my workspace
I always follow directions
I see commercial opportunities in everything
I don't like rushing into things
Some people think I am risk averse
I like to be prepared at all times
I am quick to spot ways of making money
Other people think I am highly creative
If there is a profitable business opportunity, I rarely miss it
I prefer to solve problems in novel ways
It is always best to follow rules and social norms
I am always trying to make things better
I find it easy to apply my creativity in everyday life
I rarely see good business opportunities, even in my area of expertise
My aim in life is to find new ways to make money
Even when I spot a profitable business opportunity, I rarely act on it
I am not afraid to take business risks
I often solve problems in unusual ways

