Behavioral Biases and Firm Behavior: Evidence from Kenyan Retail Shops

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Many subjects in lab experiments show considerable risk aversion in small-stakes gambles.[1] This is counter to the predictions of expected utility theory for any reasonable degree of risk aversion (Rabin 2000), but is consistent with loss aversion in prospect theory. Benjamin et al. (2013) show that math skills reduce small-stakes risk aversion, consistent with broader evidence that mathematical skills can help debias decision making (Burks et al. 2007).

In this paper, we show that acceptance of small risky gambles and scores on math tests is associated with inventory accumulation among Kenyan shopkeepers. More broadly, we argue that loss aversion may be one factor helping explain the broader puzzle of why high rates of return on capital among small firms in developing countries are not arbitraged away, and do not lead to the high growth rates of consumption that the Euler equation would predict.

The development literature has documented that, across a wide range of contexts, small business owners in developing countries often leave profitable investments unexploited.[2] This seems to be true not only for large, lumpy investments, such as investments in machinery that might expose firm owners to substantial risk, but also for divisible investments where standard dynamic optimization theory would not predict poverty traps, and expected utility theory would suggest that risk should play a relatively small role in investment decisions. For example, many

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[1] See, for example, Tversky and Kahneman (1991), Kahneman et al (1990), Thaler et al (1997).

[2] See, for example, de Mel et al. (2008), McKenzie and Woodruff (2008), Fafchamps et al. (2011), Udry and Anagol (2006), and Banerjee and Duflo (2012).

farmers fail to invest in any fertilizer despite apparently large returns and despite the availability of fertilizer in small quantities (Duflo et al. 2011).[3]

In Kremer et al. (2013) we show that many Kenyan shopkeepers fail to make small inventory investments with high expected returns. In this paper, we examine the determinants of inventory investments and show that shopkeepers who invest one standard deviation more into a risky asset in a laboratory-style game have 10-16% larger inventories. Consistent with the view that math skills may be useful in de-biasing, those with one standard deviation higher math scores have 14-18% larger inventory levels.

Section I provides background, while Section II reports on credit constraints and departures from standard models of entrepreneurial decision making as determinants of inventory investment. Section III discusses broader implications, arguing that loss aversion may be an important part of the puzzle of why many small businesses in developing countries do not take advantage of high expected return investment opportunities. In particular, we argue that loss aversion may help explain: 1) why capital injections to small businesses yield high estimated returns, and why they are neither spent down over time nor generate further capital accumulation (as some poverty trap stories would suggest); 2) why many firm owners do not take advantage of micro-credit despite high unrealized returns to investment; 3) why many of those who do borrow do not invest in their businesses; 4) why weather insurance programs stimulate investment by farmers; and 5) why business training based on simple heuristics can induce firm owners to change their behavior.

I. Background and Data

[3] Of course, in this example, returns to fertilizer are positively correlated with returns on overall agricultural output so this could be considered a relatively high beta investment.

We study small-scale owner-operated rural Kenyan retail shops selling fast moving consumer goods (FMCG). The FMCG manufacturing industry is highly concentrated, with manufacturers setting retail prices, and a single supplier holding a very high market share in most goods. These shops are typically located in clusters in market centers serving the surrounding rural population, with several competing shops in close proximity.

Three features of the industry and the environment restrict the ability of firm owners who maximize expected profits to displace competitors whose decision making departs from expected profit maximization. First, rural shops face competition from only a limited number of competitors, since customers will walk only a limited distance. Second, manufacturers fix retail prices, precluding price competition that could allow well-stocked, high-traffic shops to lower prices, driving out competitors. Third, whether due to labor market imperfections, moral hazard with employees, regulatory issues, or other factors, owners who manage inventory optimally are not able to manage multiple shops in different locations. A potential policy implication of these factors is that prohibiting retail price maintenance could allow efficient retailers to displace less efficient ones. With a smaller number of larger retailers, it might also be easier for new manufacturers to enter the market because building a distribution network would be a less daunting barrier to entry.

In a companion paper (Kremer et al. 2013) we use administrative data from a distributor to calculate bounds on returns to inventory. The distributor offers progressively greater bulk purchase discounts for purchases above a set of thresholds. While many purchases are just above the thresholds, there is a considerable mass below each threshold as well, and we find that the median shop misses at least some opportunities to earn rates of return in excess of 100% (e.g., by increasing one purchase slightly to meet the bulk discount threshold and correspondingly

reducing the next purchase). Returns are highly heterogeneous across firms. That paper also calculates bounds on rates of return to holding marginally greater inventories of phone cards based on a survey of lost sales due to stockouts. This method likely yields much looser bounds since it does not factor in the long-run costs of losing customers due to stockouts, but nonetheless it still suggests that more than 18% of firms still have rates of return over 50% per year to an additional unit of phone card inventory, based only on the short-run sales lost to stockouts. The correlation of bounds on returns across products is low, suggesting that shopkeepers may not be equating the marginal return to inventories across items.

This paper examines the determinants of inventory investment based on a survey of shop owners served by the distributor within a particular geographic area in Western Kenya. Background surveys included standard demographic questions, as well as questions on the shop owner's access to savings and credit; ownership of land, durable goods, and other assets; transfers given and received, other sources of income, and self-reported credit constraints. The survey included vocabulary and reading tests in English and Swahili, a math problem solving test, a digit recall memory test, Raven progressive matrices, and a maze completion speed test. Respondents were also asked to divide a portfolio of 100 Ksh (approximately $1.33) between a safe asset and a risky asset that paid zero with 50% probability and 2.5 times the amount invested with 50% probability.

We collected inventory data for a subset of 380 of these shops, approximately 1.5-2 years after the background surveys. We asked respondents to estimate the total value of their inventory (at both wholesale and retail prices) with the enumerator's assistance. In addition, the respondent, together with the enumerator, calculated the value of the thirteen most common items stocked by shops. We follow de Mel, McKenzie, and Woodruff (2008) in measuring

profits by asking respondents to report their income less expenses and wages to other employees over the previous 30 days.[4] This question was only included in the latter part of the data collection, so we have profit data for 188 firms.

Summary statistics are shown in Table 1. Shopkeepers are substantially more educated than the typical rural resident in the area. About 13% of owners or their spouses have formal sector jobs, many more than the typical rural resident. In addition, 82% of shopkeepers in our sample have bank accounts, 73% own land, and 42% participate in a merry-go-round cooperative (ROSCA). Inventory value and income distributions among shopkeepers are skewed, but even at the 25th percentile shopkeepers have high incomes and wealth in an area where typical agricultural wages are approximately $1 a day.

On average, shopkeepers invested just over half of the portfolio in the risky asset. One-third invested exactly one-half of the assets in the portfolio, consistent with the behavior of many US workers who have retirement plans that allow them to divide their assets between multiple investments and follow the "1/n rule" heuristic of dividing assets evenly across all options, (Benartzi and Thaler 2007). The mass at the 50-50 division suggests that not all subjects are expected utility maximizers.

[4] This measure of profits thus includes returns to owner labor and family labor.

Table 1. Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)
			Quantiles			
	Mean	Std.	25th	50th	75th	90th
Inventories, Profits, and Credit to Customers						
Total Inventory	26.52	29.67	8.00	15.00	30.00	70.00
Inventory in Top 13 Items	9.42	11.34	2.80	5.16	10.81	24.93
Profits in past month	2.39	2.70	0.80	1.20	3.00	5.60
Gives out credit to customers	0.92	-	-	-	-	-
Amount given out in credit in past month	1.12	5.75	0.10	0.20	0.50	1.50
Background Characteristics						
Years of Education	10.80	3.33	8.00	11.50	12.00	16.00
Years Shop Open	7.47	5.60	3.16	6.41	9.90	14.56
Male	0.56	-	-	-	-	-
Married	0.79	-	-	-	-	-
Age	33.36	9.48	27.00	32.00	38.00	46.00
Can Read and Write (Swahili)	0.97					
Small Stakes Risk Aversion						
Percentage Invested in Risky Asset	0.56	0.20	0.50	0.50	0.70	0.80
Asset Ownership and Formal Sector Income						
Owner or spouse has a formal sector job	0.13	-	-	-	-	-
Acres land owned	1.95	2.64	0.00	1.00	2.50	4.50
Value of durable goods and animals owned	11.70	15.32	4.20	7.00	11.91	25.50
Financial Access						
Has bank account	0.83	-	-	-	-	-
Participates in ROSCA	0.42	-	-	-	-	-
Would you like to borrow more money but are unable to get it (percentage "yes")	0.37	-	-	-	-	-

Notes: All monetary values in 10,000 Kenyan shillings. Exchange rate was roughly 75 Ksh to $1.

II. Credit Constraints, Entrepreneurial Decision Making, and Inventory Investment

Table 2 reports regressions of inventories on indicators of credit constraints as well as factors that could cause entrepreneurial decision-making to depart from the predictions of standard economic models. The dependent variable in Columns 1-2 of Table 2 is log total inventory, while the dependent variable in Columns 3-4 is log inventory of the top thirteen items (both in Kenyan shillings). We start with a sparse specification, including only covariates that are

most plausibly exogenous to business performance. In the second specification, we add various measures of financial access, asset ownership, and formal sector income. The general pattern of results is robust to the specific list of included covariates.

There is some evidence that could be interpreted as indicating that credit constraints affect inventories. Shopkeepers with higher levels of other assets have bigger inventories. However, there is no significant correlation between inventories and self-reported credit constraints, land ownership, or formal sector employment. There is some evidence that those with bank accounts have greater inventories while members of Rotating Savings and Credit Associations, or ROSCAs, have smaller inventories. It is difficult to interpret this as a causal effect of ROSCA membership, but this could indicate lower inventories among those who have more trouble saving or are more subject to "taxes" on saving from family members, and therefore turn to ROSCAs.

With or without the credit constraint variables in the regression, there is evidence that small stakes loss aversion is associated with lower inventories. Shopkeepers who invested 10% less of a 100 Ksh portfolio in an asset yielding a 0% return for sure and 10% more in the risky asset had 7.9-8.1% greater inventories. Note that a movement of 10 Ksh is equivalent to about 0.014% of the value of the median respondent's stock of animal and consumer durables, or to 0.007% of the median respondent's inventory.

Table 2. Correlates of Inventories and Profits

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Total Inventory		Log Inventory on Top 13 Products		Log profits in past month			
Background Characteristics								
Years of Education (tens of years)	-0.06	-0.09	0.04	-0.01	0.17	0.12	0.29	0.23
	(0.20)	(0.20)	(0.21)	(0.21)	(0.27)	(0.28)	(0.21)	(0.22)
Years Shop Open (tens of years)	0.16	0.12	0.20	0.17	0.06	0.08	-0.02	-0.05
	(0.10)	(0.10)	(0.11)*	(0.11)	(0.14)	(0.14)	(0.11)	(0.12)
Age	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01
	(0.01)**	(0.01)***	(0.01)***	(0.01)***	(0.01)**	(0.01)*	(0.01)	(0.01)
Cognitive Measures								
Math score (standardized)	0.18	0.18	0.14	0.14	0.32	0.32	0.15	0.22
	(0.06)***	(0.06)***	(0.06)**	(0.06)**	(0.09)***	(0.09)***	(0.07)**	(0.07)***
Raven's matrix (standardized)	0.07	0.05	0.15	0.13	-0.13	-0.13	-0.07	-0.16
	(0.07)	(0.06)	(0.07)**	(0.07)**	(0.09)	(0.09)	(0.07)	(0.07)**
Digit recall (standardized)	-0.02	-0.03	-0.04	-0.05	0.13	0.11	0.00	-0.02
	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)	(0.09)	(0.07)	(0.07)
Seconds to finish mazes	0.03	0.03	0.03	0.03	0.15	0.15	0.10	0.07
(standardized)	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)	(0.09)	(0.07)	(0.07)
Combined language score	0.02	0.04	0.01	0.03	0.08	0.11	0.06	0.09
(standardized)	(0.07)	(0.07)	(0.07)	(0.07)	(0.09)	(0.09)	(0.07)	(0.07)
Small Stakes Risk Aversion								
Percentage Invested in Risky Asset	0.79	0.81	0.51	0.54	0.79	0.80	0.21	0.29
(out of 100 Ksh)	(0.23)***	(0.23)***	(0.24)**	(0.24)**	(0.32)**	(0.32)**	(0.24)	(0.26)
Asset Ownership, and Formal Sector Income								
Owner or spouse has	-0.04	0.00	-0.15	-0.12	0.17	0.18	0.15	0.27
a formal sector job	(0.18)	(0.17)	(0.18)	(0.18)	(0.24)	(0.24)	(0.18)	(0.19)
Log (acres land owned + 1)	0.03	0.07	0.02	0.05	0.07	0.10	0.07	0.06
	(0.08)	(0.08)	(0.09)	(0.09)	(0.11)	(0.11)	(0.08)	(0.09)
Log (value of durable goods and	0.25	0.22	0.21	0.17	0.16	0.11	0.01	0.05
animals owned + 1) (in 10,000 Ksh)	(0.13)*	(0.13)*	(0.13)*	(0.13)	(0.16)	(0.17)	(0.13)	(0.13)
Financial Access								
Has bank account		0.19		0.27		0.25	-0.03	-0.10
		(0.13)		(0.14)**		(0.18)	(0.14)	(0.15)
Participates in ROSCA		-0.48		-0.50		-0.20	0.08	0.01
		(0.12)***		(0.12)***		(0.16)	(0.12)	(0.13)
Would like to borrow more money but		0.00		-0.02		-0.13	-0.13	-0.09
is unable to get it		(0.11)		(0.12)		(0.15)	(0.11)	(0.12)
Log Total Inventory							0.61	
							(0.06)***	
Log Inventory on Top 13 Items								0.56
								(0.06)***
Mean of dependent variable	11.97	11.97	10.89	10.89	9.62	9.62	9.61	9.61
Std. dev. of dependent variable	1.06	1.06	1.09	1.09	1.00	1.00	0.97	0.97
Observations	380	380	380	380	188	188	184	184
R-squared	0.10	0.14	0.09	0.14	0.17	0.19	0.53	0.47

Notes: Dependent variables in (log) Kenyan shillings. To avoid dropping observations, we create dummy variables for having missing information for a given variable and code the underlying variable as a 0 when it is missing. Regressions also include for gender, marital status, and literacy. Standard errors in parentheses. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

A one standard deviation increase in the math score is robustly associated with 14-18%

higher inventories (Columns 1 and 3, Table 2).[5] The estimated effect is not affected by including measures of credit constraints (Columns 2 and 4, Table 2). Raven's matrix scores are significant in some specifications.

Of course, it is possible that the decision of how much to allocate to a risky portfolio is endogenous to business performance, and that difficulty in their business causes shopkeepers to invest less in the risky asset. However, since stakes are small, expected utility maximizers should still take a positive expected value, zero-beta gamble. Moreover, reverse causality would not explain the math results, since math scores are largely determined by education that antedates establishment of the business.

Shopkeepers who invest more in the risky asset have higher profits. The data are consistent with this working through the inventory channel (see Columns 5-8, Table 2). A one standard deviation increase in the math score is associated with 32% higher profits, unconditional on inventories. Columns 7 and 8 suggest that much of the math score effect on profits works through inventories, but that other channels also play a role.[6]

Several factors suggest entrepreneurial decision-making is not an immutable inherent characteristic. Math scores are highly correlated with educational attainment. Kremer et al. (2013) find that the more shopkeepers are interviewed about stockouts, the less they stockout and present some evidence that shopkeepers increase purchase size after receiving information on profits lost by missing bulk discount thresholds. Similarly, Beaman, Magruder and Robinson (2012) report evidence that regularly surveying small business owners about lost sales from

[5] The math test was adapted from standard psychometric and personnel IQ tests, including the Wonderlic Test and Cognitive Reflection Test. All modules were refined for the local context, and were extensively pre-tested.
[6] Note that unlike Benjamin et al. (forthcoming) we do not find that higher math scores are associated with lower small-stakes risk aversion in a lab-experiment type game, but we do find that higher math scores are associated with higher inventories. This may be because the small-stakes lab experiment gambles are highly in our context, while inventory investment is a decision that shopkeepers confront every week and have had more opportunity and incentive to think through.

inadequate supplies of small change and providing information on the lost sales costs reduces lost sales as they increase their supply of change. Firm owners' willingness to change their behavior in response to interventions implies they were not perfectly optimizing initially

III. Discussion

Loss aversion can potentially help explain a series of puzzles related to the persistence of unrealized high-return investment opportunities. Since a loss-averse firm owner may turn down small, highly positive expected return investments if they carry risk, loss aversion offers a potential explanation for several puzzles and recent empirical findings: 1) why shop-owners with high unrealized returns to divisible investments do not have the high growth rates of consumption and assets predicted by the Euler equation even for credit-constrained agents; 2) why many small business owners do not take up micro-credit and why many of those who do borrow do not use the loans for business investment;[7] 3) the finding in de Mel, McKenzie and Woodruff (2008) that when small business owners are given an infusion of new capital, they neither spend it down (as they would if they were simply impatient) nor do they break out of a poverty trap and accumulate more assets; 4) recent findings that insuring farmers against adverse weather shocks can increase their willingness to invest (i.e. Karlan et al. 2012; Cole et al. 2011; Mobarak and Rosenzweig 2012); and 5) recent literature on business training that suggests that training based on "rules of thumb" or simple heuristics can induce firm owners to change their behavior (e.g., Drexler et al. 2012).

Our findings that small business owners behave as if they are loss averse raise the possibility that social safety nets might increase investment among small business owners more generally. Our work also suggests that at least some of the heterogeneity in returns to capital

[7] See Banerjee et al. (2010), Karlan and Zinman (2010), Crépon et al. (2011), and Attanasio et al. (2011) for some recent evidence on the effects of expanding microcredit access.

identified by Hsieh and Klenow (2009) may be due to differences in management quality across firms, as opposed to the impact of tax and regulatory distortion across firms.

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