Risk Aversion and Barriers to Firm Growth: Experimental Evidence from Small Retailers

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The experiments in this study were pre-registered:
AEARCTR-0012886 (Learning experiment)
AEARCTR-0014812 (Insurance experiment)

Motivation

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  - Over 99% of firms
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- **Does risk aversion prevent firms from pursuing profitable but risky investments?**

Setting: The market for a profitable new product

- Examine if risk aversion affects **retailers' decision to adopt and sell a new product**
  - One of the most common firm upgrading decisions in developing countries (de Mel et al., 2009)
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    - **Uncertainty** about sales is strongly (negatively) predictive of subsequent stocking

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     - Temporary buyback option to encourage experimentation

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     - Temporary buyback option to encourage experimentation
  - Experimental designs are robust to **potential confounds**
     - Credit constraints, biased beliefs, signaling effects of offering treatments, learning by doing

Preview of results

1. Risk aversion affects product stocking
   - Methodology: Offer an insurance contract that is **strictly dominated** under risk neutrality
     $\longrightarrow$ Doubles short-run helmet stocking rate $(p < .01)$

2a. Inducing firms to try stocking helmets leads to permanent adoption

2b. Firms understand the learning value of experimentation

2c. Returns cause risk averse firms with uncertain beliefs to stock, resolving uncertainty

3. Firms can also learn from their neighbors (not today)

Preview of results

1. Risk aversion affects product stocking

2a. Inducing firms to try stocking helmets leads to permanent adoption

- Methodology: Offer a return policy in phase one, then offer helmet stock without returns in phase 2
- **Key test:** Examine effects on stocking in **phase 2**
  - $\longrightarrow$ ITT: Shops 7pp (70%) more likely to stock in phase 2 ($p = .03$)
  - $\longrightarrow$ TOT: 72pp increase in stocking ($p = .02$)
  - $\longrightarrow$ Permanent adoption: 100% increase ($p = .01$)

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2b. Firms understand the learning value of experimentation

- Methodology: Ensure ability to resupply from the manufacturer after the study
  $\longrightarrow$ When long-run potential for profits goes up, firms ≈2x as likely to experiment today $(p = .03)$

2c. Returns cause risk averse firms with uncertain beliefs to stock, resolving uncertainty

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$\longrightarrow$ Effects of returns concentrated among firms with optimistic but uncertain beliefs in phase 1

$\longrightarrow$ Treatment does **not** change beliefs about mean profits in phase 2, but **does** reduce uncertainty ($p = .03$)

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3. Firms can also learn from their neighbors (not today)
   - → Information externalities help rationalize why competition doesn't drive risk averse firms out of business
   - → Spillovers are geographically local (3 city blocks) → doesn't ensure diffusion

Contributions and literature

1. Firm growth and risk aversion

   - Constraints to firm growth in LMICs
     Bloom et al. (2013); de Mel et al. (2008); Fafchamps et al. (2014); Banerjee et al. (2022); Pelnik (2024); Bloom et al. (2020); Atkin et al. (2017b)
   - Evidence of risk aversion and separation failures among farmers
     Karlan et al. (2014); Dercon and Christiaensen (2011); Giné and Yang (2009); LaFave et al. (2020); Benjamin (1992)
   - Debate about whether risk aversion could rationalize findings of existing studies
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   → Direct evidence that risk aversion is a barrier to firm growth

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   → Direct evidence that risk aversion is a barrier to firm growth

   → Raises questions about the common practice of modeling small firms as risk neutral
      - ⋄ Relevant to tests of misallocation, collusion, etc.

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2. Firm upgrading and product diffusion

   - Evidence manufacturers inefficiently adopt new technologies in LMICs
     Atkin et al. (2017a,b); Cirera et al. (2022); Verhoogen (2021); Besley and Case (1993)
   - Slow adoption of farming and health technologies in households
     Conley and Udry (2010); Dupas (2014); Cohen and Dupas (2010)
   - Slow diffusion of goods and technologies is an important barrier to growth
     Comin and Mestieri (2018); Saxonhouse et al. (2010); Hall and Jones (1999)

   → Risk aversion + demand uncertainty can undermine the retail adoption of goods

     ◇ Reduces incentives for manufacturers to introduce products in the first place

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3. Learning about demand
   - Theoretical models studying learning about demand
     Rothschild (1974); Bolton and Harris (1999); Keller et al. (2005); Brezzi and Lai (2002)
   - Evidence of learning + social learning in other contexts
     Doraszelski et al. (2018); Conley and Udry (2010); Atkin et al. (2017b)
   - Firms in LMICs can hold inaccurate beliefs about demand
     Bai et al. (2025)

   → Risk aversion can undermine firm learning ⇒ uncertain or incorrect equilibrium beliefs
   - ⋄ Model: Uncertainty about profitability is costly to firms since may stock the wrong items
   - ⋄ This causes risk neutral firms to experiment and learn the truth
   - ⋄ Model + Results: Risk aversion can undermine experimentation → firms don't learn demand

   → Experimental evidence that firms learn about demand from neighbors

Outline

1. Introduction
2. Model
3. Does risk aversion affect firms' stocking decisions?
4. Does risk aversion prevent retailers from adopting new products?
5. Conclusion

Model Setup Lagrangian Learning

- Model of a (possibly) risk averse firm learning about demand
- Goals:
  - Produce a test for risk aversion (robust to forces like capital constraints)
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Beliefs about θ (demand)
$\theta \sim \mathcal{N}(\mu_t, \Sigma_t)$

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$\longrightarrow$

stochastic demand shocks ν_{nt} realized

$\downarrow$

Demand realized;
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Gain signal $x(I_{nt})$
about demand (θ)

beliefs update according to Bayes' rule

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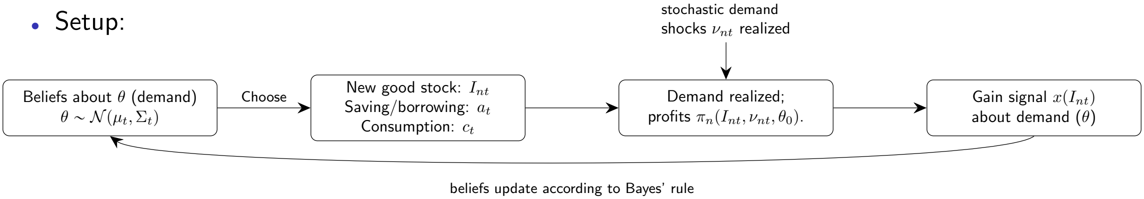

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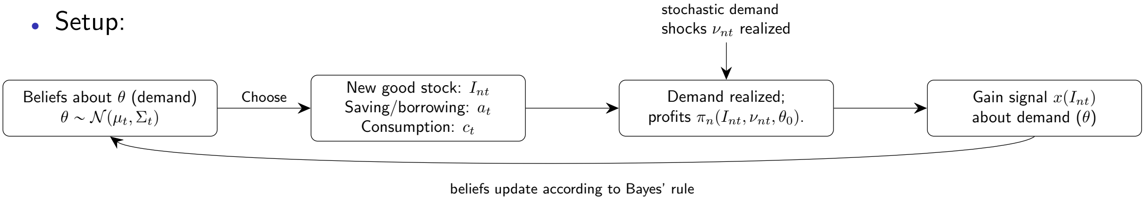

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- In future, firm must pay transaction cost Γ to continue stocking the new product
  - Parameter can be manipulated to affect continuation value of learning
- Paper extends model to allow for investment in good with known demand + info spillovers

Objective Lagrangian

Agents solve

$$\max_{\{c_t, a_t, I_{nt}\}} \mathbb{E}_0 \sum_{t=1}^{\infty} \delta^{t-1} u(c_t)$$

Subject to:

- Budget constraint: $a_t + c_t + w_n I_{nt} \leq (1+r)a_{t-1} + \pi_n(I_{nt-1}, \nu_{nt}, \theta_0)$
- Minimum order size: $I_{nt} = 0$ or $I_{nt} \geq \chi$
  - Search, transport costs can generate a similar discrete learning cost
- Borrowing limit (capital constraints): $a_t \geq \underline{a}$

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Expectations are over:

- ν_{nt} due to true uncertainty in demand
- θ due to uncertain beliefs, which is mitigated by learning (as fn of I_{nt})
  - I_{nt} increases expected utility in future periods since allows better decisions
  - Predictions about how learning value affects investment → won't focus on process details

Optimal (interior) investment

$$\delta\Bigg\{ \overbrace{\mathbb{E}\left[\frac{u'(c_{t+1})}{u'(c_t)}\Big|\mathcal{I}_t\right]}^{\text{Capital constraints}} \overbrace{\mathbb{E}\left[\frac{\partial \pi_n(I_{nt},\nu_{nt+1},\theta)}{\partial I_{nt}}\Big|\mathcal{I}_t\right]}^{\text{Expected marginal profits}} + \overbrace{Cov\left(\frac{u'(c_{t+1})}{u'(c_t)}, \frac{\partial \pi_n(I_{nt},\nu_{nt+1},\theta)}{\partial I_{nt}}\Big|\mathcal{I}_t\right)}^{\text{Risk aversion: } <0 \text{ iff } u() \text{ concave}}$$

$$\underbrace{+\frac{1}{2}\sum_{\tau=t+2}^{\infty}\delta^{\tau-2}Cov\left(R_\tau(\theta),(\theta-\mu_\tau)'\Sigma_n^{-1}(\theta-\mu_\tau)\Big|\mathcal{I}_t\right)\Bigg\}}_{\text{Learning value: } R(\cdot) \text{ ``regret'' or optimization error } \nearrow (\theta-\mu_t)^2} = \underbrace{w_n - \frac{1}{u'(c_t)}\kappa_{\chi t}(2I_{nt}-\chi)}_{\text{Stocking costs}}$$

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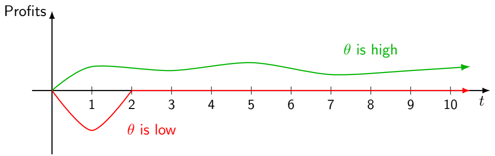

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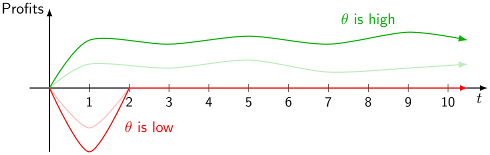

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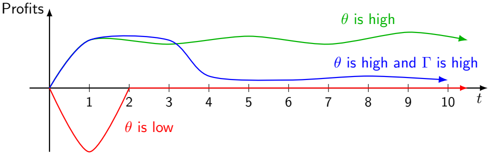
    - Upside mitigated by Γ → less experimentation if future stocking is uncertain/costly



Optimal (interior) investment

$$\delta\Bigg\{\underbrace{\mathbb{E}\left[\frac{u'(c_{t+1})}{u'(c_t)}\Big|\mathcal{I}_t\right]}_{\text{Capital constraints}}\underbrace{\mathbb{E}\left[\frac{\partial\pi_n(I_{nt},\nu_{nt+1},\theta)}{\partial I_{nt}}\Big|\mathcal{I}_t\right]}_{\text{Expected marginal profits}}+\overbrace{Cov\left(\frac{u'(c_{t+1})}{u'(c_t)},\frac{\partial\pi_n(I_{nt},\nu_{nt+1},\theta)}{\partial I_{nt}}\Big|\mathcal{I}_t\right)}^{\text{Risk aversion: } <0 \text{ iff } u() \text{ concave}}$$

$$\underbrace{+\frac{1}{2}\sum_{\tau=t+2}^{\infty}\delta^{\tau-2}Cov\left(R_\tau(\theta),(\theta-\mu_\tau)'\Sigma_n^{-1}(\theta-\mu_\tau)\Big|\mathcal{I}_t\right)\Bigg\}}_{\text{Learning value: } R(\cdot) \text{ “regret” or optimization error } \nearrow (\theta-\mu_t)^2}=\underbrace{w_n-\frac{1}{u'(c_t)}\kappa_{\chi t}(2I_{nt}-\chi)}_{\text{Stocking costs}}$$

- **Core friction:** risk aversion deters stocking under uncertain demand; risk neutral firms stock more
  - **Value of learning:** Uncertain beliefs about demand $\rightarrow$ chance the good is very profitable
    - Stock to learn demand, restock only if profitable
    - Upside mitigated by $\Gamma \rightarrow$ less experimentation if future stocking is uncertain/costly
  - **Risk aversion:** utility cost from uncertain demand $\rightarrow$ can flip stocking-uncertainty relationship
  - u is concave, then bad realization of $\pi_{n,t+1} \rightarrow u' \uparrow$
    - $Cov\left(\frac{u'(c_{t+1})}{u'(c_t)},\frac{\partial\pi_n(I_{nt},\nu_{nt+1},\theta)}{\partial I_{nt}}\Big|\mathcal{I}_t\right)<0 \Leftrightarrow$ the firm is risk averse

Predictions: Does risk aversion affect stocking? MPC Definition

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    - ↓ profit variance without changing expectations → in practice actuarially fair insurance
    - Need **1 period** change so learning value is unaffected

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Consider a *return* policy ($\equiv p_{nt+1} \geq w_n$) and reduction in supply chain uncertainty, Γ.

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iii.) is unchanged when future supply chain uncertainty falls if the firm can return unsold stock.

- Returns essentially eliminate loss risk
  - Optimal to stock if perceive *any chance* the product is profitable
  - So $\Delta\Gamma$ shouldn't affect stocking with returns, all uncertain firms should already stock
- Helps to rule out alternative forces (e.g. learning by doing) that could generate ii.)

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- Suppose that offering returns in period t increases stocking in $t+1$
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  1. Firms are risk averse, and experience resolves uncertainty (targeted mechanism)
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$\uparrow \mathbb{E}$*[profits] among risk neutral firms*	$\downarrow$ *uncertainty among risk averse firms*

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Outline

Insurance experiment: generating a mean-preserving contraction

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    - Test if *insurance* increases helmet uptake

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Details of the insurance contract

Control

	Sell out	Don't sell out
Don't stock	P_i	
Stock	$\pi_{\text{helmets}} + P_i$	$\pi_{\text{helmets}} + P_i$

Insurance

	Sell out	Don't sell out
Don't stock	P_i	
Stock (no insurance)	$\pi_{\text{helmets}} + P_i$	$\pi_{\text{helmets}} + P_i$

- Promise unconditional payment of P_i to all shops at a follow-up

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Stock (insurance)	π_{helmets}	$\pi_{\text{helmets}} + 1,000$

- Offer *insurance* shops the option to forego P_i for hedging contract:
  - Stock and sell out: receive nothing
  - Stock and don't sell out: receive KSH 1,000

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Stock (insurance)	$\pi_{\text{helmets}} + \mathbf{0}$	$\pi_{\text{helmets}} + \mathbf{1,000}$

- Need to pick a value of P_i such that insurance is a mean-preserving contraction
  - Calibrate P_i based on the respondent's subjective belief $so_i \equiv Pr(\text{sell out}|\text{stock})$
  - $P_i = 1000 \cdot (1 - so_i) \Rightarrow$ insurance is a mean-preserving contraction
  - Increase P_i by $\approx 10\%$ so that insurance is **strictly dominated** if firms are risk neutral Details
    - Creates robustness against measurement error in so_i

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- Two remaining concerns:
    1. Strategic manipulation of the offer
        - Prohibit restocking if collect insurance payout, audit 1/5 shops $\rightarrow$ **manipulation proof**
        - Empirically shops choose to decline payout to restock
        - Makes strict dominance stronger
    2. Measurement error in beliefs
        - Ex post, insurance adopters would have been better off declining the contract on average
          $\Rightarrow$ Strict dominance holds under rational expectations
        - Elasticity selling out wrt beliefs 0.4 among insurance adopters, 0.2 overall $(p < .05)$

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Insurance experiment context: $N = 350$ firms in West Kenya Timeline Balance

- Sample **350 firms** across **70** large markets in West Kenya
  - Recruit permanent retailers not selling helmets
  - 25% of shops have employees; relatively large and permanent for the context
    - Median monthly profits: $365
    - Median firm age: 3 years
- Offer all shops helmet stock after baseline and at a single follow-up
  - Order size 3 (same as manufacturer), allow larger orders at follow-up
  - Studied helmets rare in West Kenya → subsidize shipping (KSH 736 or $16 per helmet; price at the factory)
- Offer *insurance* to $N = 175$ shops selected at random (stratified by market)

Results: firms are risk averse Insurance uptake CRRA

	(1) Stocked ($\leq$ 24H)	(2) Stocked
Offered insurance	0.075***	0.092**
	(0.029)	(0.044)
Observations	345	345
Control mean	0.046	0.207

$* \; p < 0.1, \quad ** \; p < .05 \quad *** \, p < .01.$ Robust standard errors in parenthesis.

- Offering insurance $\rightarrow$ large and statistically significant increase in helmet adoption
  - Adoption within 24 hours: 2.5x as high $(p < .01)$
  - After 2 weeks: 1.5x as high $(p = .03)$
- Implies a **rejection of risk neutrality**

Results: firms are risk averse

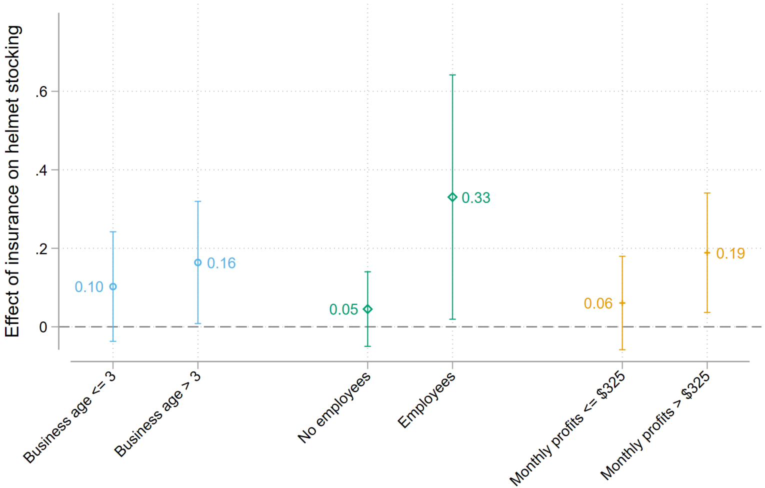
Insurance uptake | CRRA

	(1) Stocked ($\leq$ 24H)	(2) Stocked	(3) Stocked ($\leq$ 24H)	(4) Stocked
Offered insurance	0.075***	0.092**	0.002	-0.028
	(0.029)	(0.044)	(0.046)	(0.066)
High risk aversion			-0.066	-0.171***
			(0.045)	(0.065)
Offered insurance × High RA			0.168**	0.267***
			(0.075)	(0.102)
Observations	345	345	327	327
Control mean	0.046	0.207	0.046	0.207

$* \ p < 0.1, \quad ** \ p < .05 \quad *** \ p < .01$. Robust standard errors in parenthesis.
Firm owners' risk aversion was measured at follow-up using the lottery choice game presented in Strobl (2022).

- Effects concentrated among firms owned by more risk averse shopkeepers
- Consistent with lack of separability between consumption preferences and business decisions

Even larger and older firms respond to insurance Table Firm age



- Suggests effects not driven by struggling enterprises
  - When firms have resources to invest, many don't unless insured against risk

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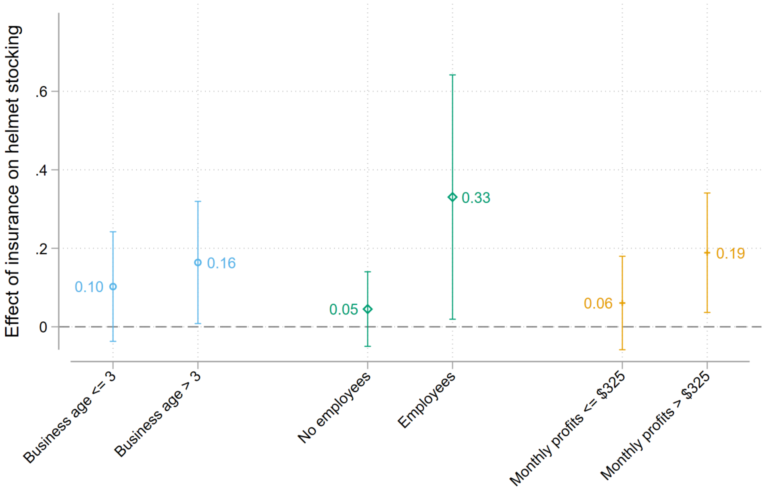

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  → May reduce returns to cash transfers to firms

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The learning experiment

- The learning experiment examines whether risk aversion prevents experimentation needed to learn
  - Traces out the effects of risk aversion on stocking decisions over a longer period

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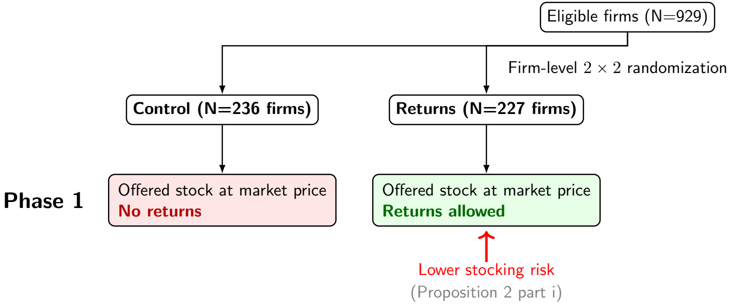
  - Shops had access to helmets for 2+ years from the manufacturer → other barriers to adoption limited
  - Limited retail adoption (under 3% of screened shops) → setting where natural adoption was slow
- Offer helmets at **prevailing market prices**
- Implement 2 treatments to test if risk aversion prevents learning about helmet profitability
  1. Temporarily lower risk → persistent effects?
  2. Raise **future** value of information → increase in upfront experimentation?

Learning experiment design Installments



Learning experiment design

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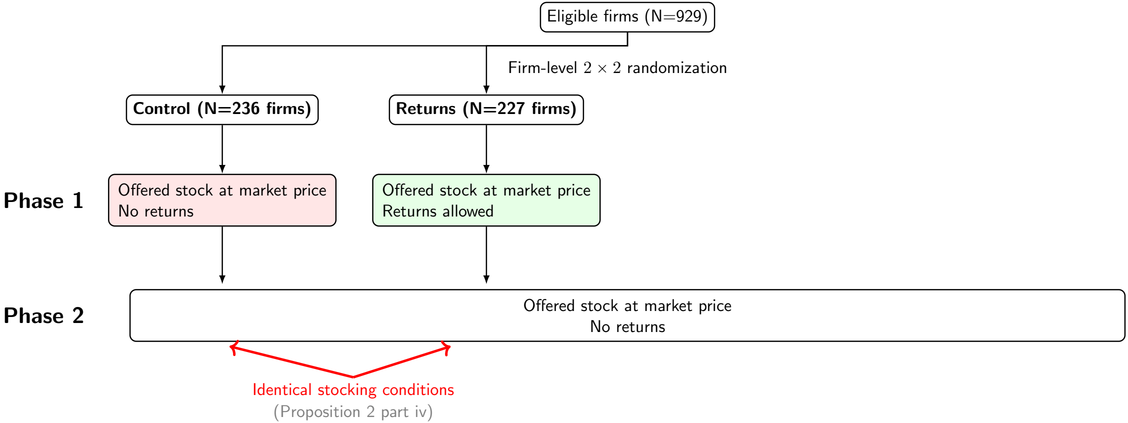

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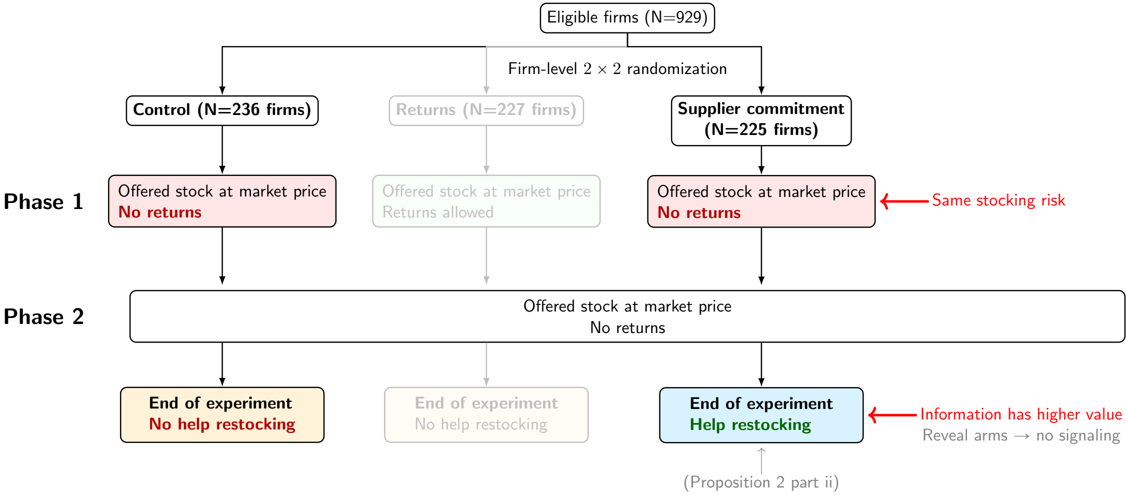

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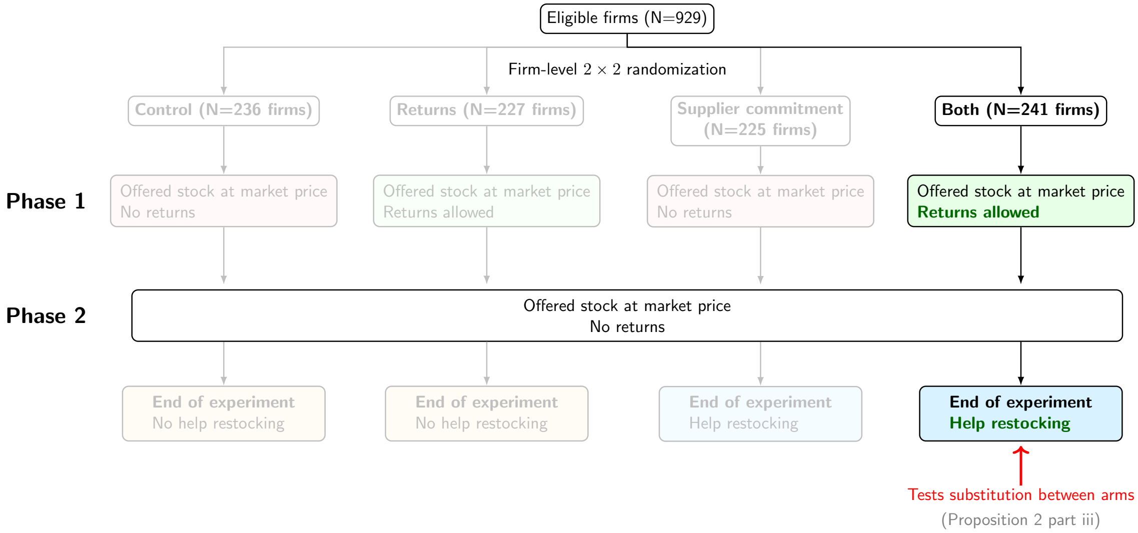

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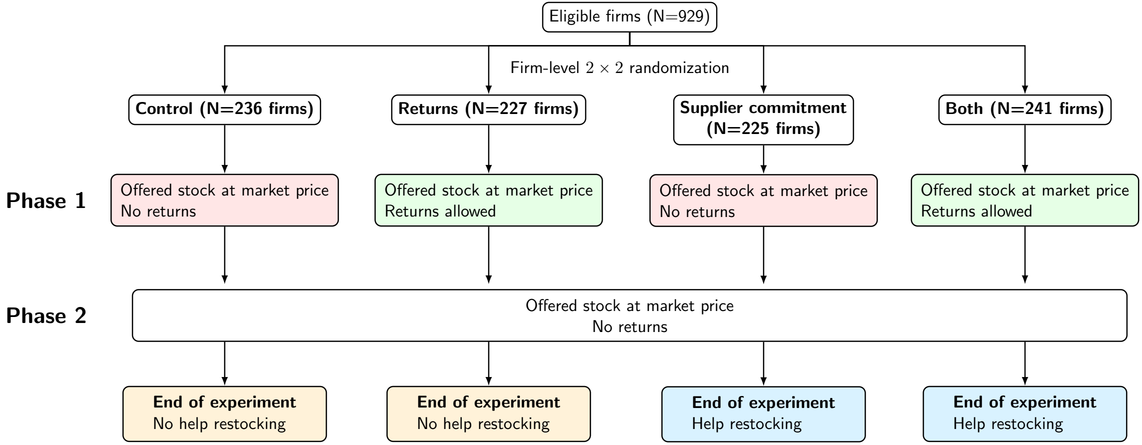


Outline

Do firms learn about demand? Selling costs

Test predictions i-iii of the Learning Proposition by estimating

$$\text{Stocked}_i = \alpha + \beta_1 Returns_i + \beta_2 Commitment_i + \beta_3 Returns_i \times Commitment_i + X_i'\gamma + \mu_k + \epsilon_i$$

Stocked$_i$: shop purchased helmet stock during phase 1, X_i controls, μ_k strata FE

Model predictions:
Experimentation:

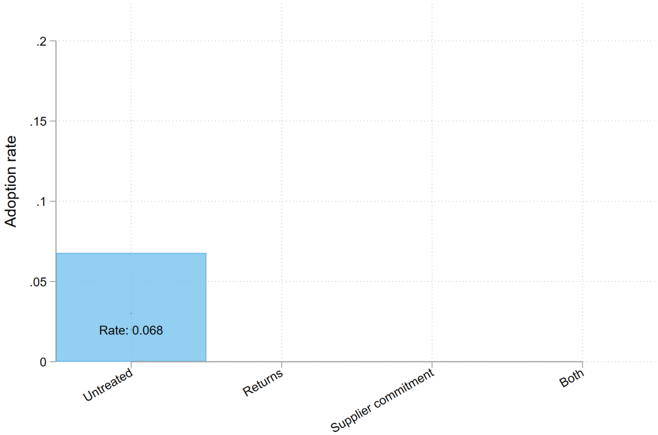
1. $\beta_1 > 0$: *returns* increase expected utility from stocking if uncertain about demand
2. $\beta_2 > 0$: the *supplier commitment* raises the value of learning if uncertain about demand
3. $\beta_3 = -\beta_2 < 0$: no effect of *supplier commitment* if offered *returns*

Experimentation $\rightarrow$ learning: Test part iv (persistence) with the outcome **stocked in phase 2**

4. $\beta_1 > 0$: firms learned about demand, overcame risk aversion or positively updated beliefs

Phase 1 effects match experimentation predictions

Het Table Costs Existing seller



Phase 1 effects match experimentation predictions

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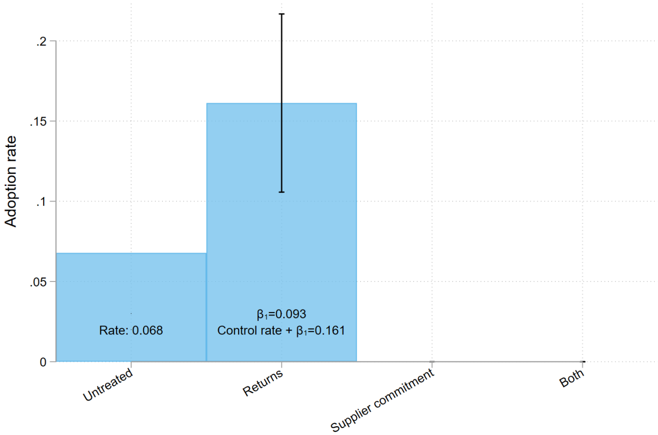
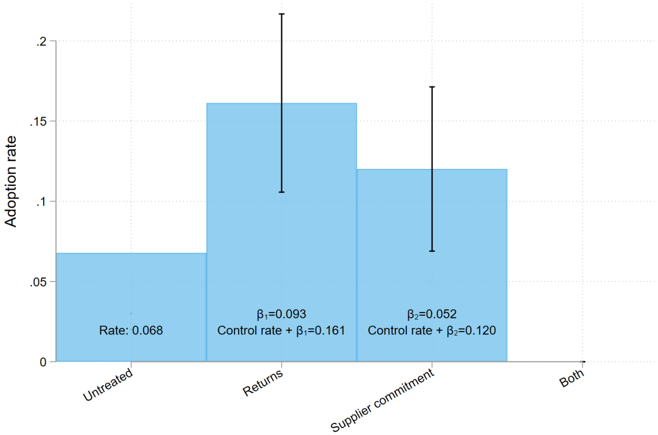


- *Returns* → 2.4x (✓Proposition 2.i)

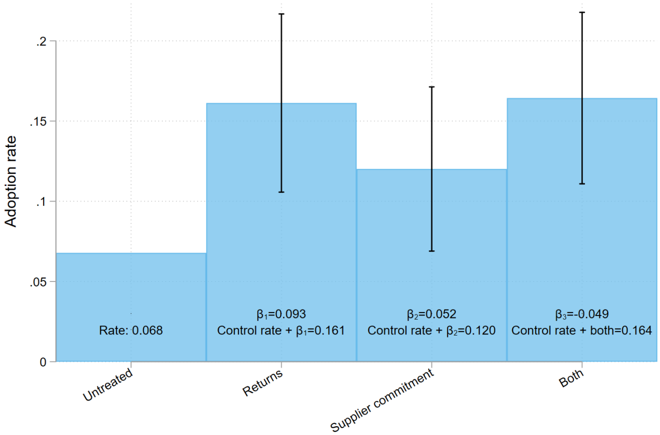
Phase 1 effects match experimentation predictions

Het Table Costs Existing seller



- *Returns* $\rightarrow$ 2.4x (✓Proposition 2.i)
- *Supplier commitment* $\rightarrow$ 1.8x (✓Proposition 2.ii)

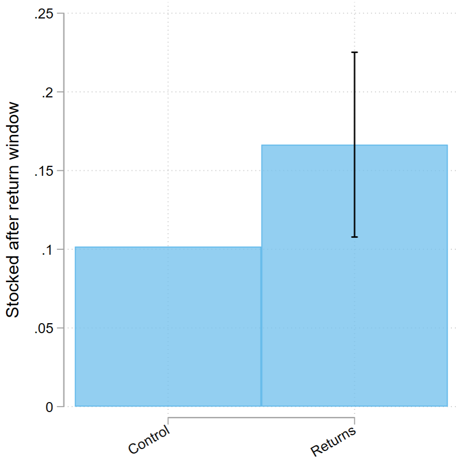
Phase 1 effects match experimentation predictions Het Table Costs Existing seller



- *Returns* → 2.4x (✓Proposition 2.i)
- *Supplier commitment* → 1.8x (✓Proposition 2.ii)
- No effect of *supplier commitment* given access to *returns* (✓Proposition 2.iii)

Effects of returns are persistent

Table | Reported Profits | Capital Constraints



- Effects of *returns* **persist after the treatment ends** (✓Proposition 2 part iv)
- 70% increase in phase 2 stocking (ITT 7pp, TOT 72pp)

Effects of returns are persistent

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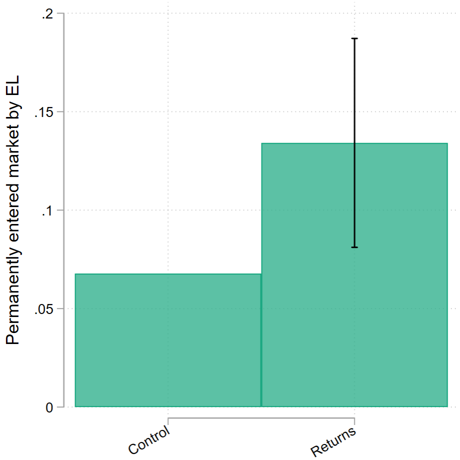
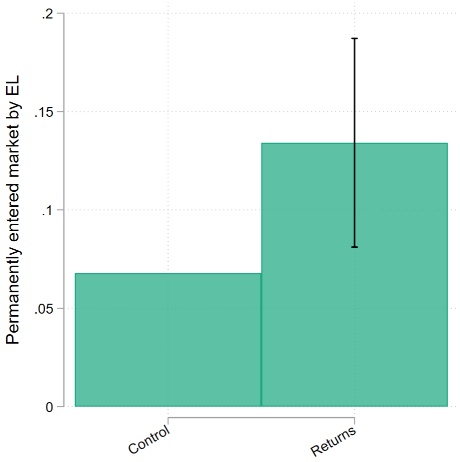


- Effects of *returns* **persist after the treatment ends** (✓Proposition 2 part iv)
- 70% increase in phase 2 stocking (ITT 7pp, TOT 72pp)
- Revealed preference evidence + firm reports → **unlocked growth opportunity for many firms**
  - Returns → twice market entry rate ($p = .013$)

Effects of returns are persistent Table Reported Profits Capital Constraints



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  - Only 5 shops returned any helmets
  - Helmets → 10% of entrants' business, plan to expand to 20%

Effects of returns are persistent

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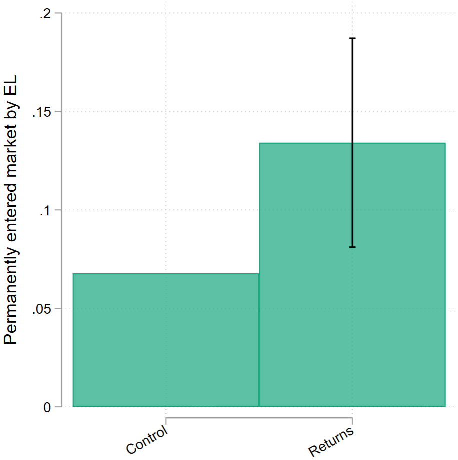

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  - Only 5 shops returned any helmets
  - Helmets → 10% of entrants' business, plan to expand to 20%
- Contributed to shift in manufacturer's equilibrium strategy
  - Minimum order size 10 → 3 near midline

  ⇒ Estimates likely lower bounds on true *returns* effects

Outline

Do returns correct pessimistic priors or smooth risk aversion?

- Inducing shops to try selling helmets with *returns* leads most firms to discover they are profitable
- This could be rationalized by two stories
  1. *Returns* caused risk neutral firms with incorrect (pessimistic) beliefs to stock → positively updated beliefs
  2. *Returns* caused risk averse firms with uncertain priors to stock → resolve uncertainty
- Use belief measures to test
  1. What type of firms the *returns* caused to try stocking
  2. How the beliefs of adopters evolved
- Beliefs measured with a frequentist approach with visual aids details
  - Censoring issue with variance given high expectations → restrict sample when V(sales) on RHS

Do returns correct pessimistic priors or smooth risk aversion?

The Learning Mechanism Proposition predicts the following under the two alternatives:

	Returns $\uparrow$ expectations	Returns $\downarrow$ uncertainty
Control relationship between uncertainty, stocking	$\uparrow$	$\downarrow$

Control firms uncertain about demand stock less DPLASSO

Dependent variable: Stocked helmets

	(1) LPM	(2) Logit	(3) LPM
Returns	-0.032	0.290	0.232
	(0.077)	(1.339)	(0.185)
E[sales]	0.021	0.479	
	(0.015)	(0.311)	
$\sigma(sales)$	-0.052**	-0.933**	-0.053**
	(0.023)	(0.406)	(0.024)
Returns × E[sales]	0.013	-0.145	
	(0.034)	(0.394)	
Returns × $\sigma(sales)$	0.058	0.984*	0.096**
	(0.055)	(0.586)	(0.048)
Observations	304	271	304
Control mean	0.068	0.068	0.068
Controls	Full	Full	Full
Expected Sale x Returns FEs	No	No	Yes

$* \, p < 0.1, \quad ** \, p < .05 \quad *** \, p < .01$

Robust standard errors in parenthesis. All estimates include controls for storage space, education, baseline profits, respondent characteristics, and firm characteristics.

Do returns correct pessimistic priors or smooth risk aversion?

The Learning Mechanism Proposition predicts the following under the two alternatives:

	Returns $\uparrow$ expectations	Returns $\downarrow$ uncertainty
Control relationship between uncertainty, stocking	$\uparrow$	$\downarrow$ ✓
Shops affected by returns	Low $\mathbb{E}$[profits]	High V(profits)

Returns cause firms with uncertain priors to stock DPLASSO

Dependent variable: Stocked helmets

	(1) LPM	(2) Logit	(3) LPM
Returns	-0.032	0.290	0.232
	(0.077)	(1.339)	(0.185)
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Robust standard errors in parenthesis. All estimates include controls for storage space, education, baseline profits, respondent characteristics, and firm characteristics.

- *Returns* primarily affect shops with optimistic but uncertain beliefs
- Results similar without sample restriction to avoid censoring Details

Do returns correct pessimistic priors or smooth risk aversion?

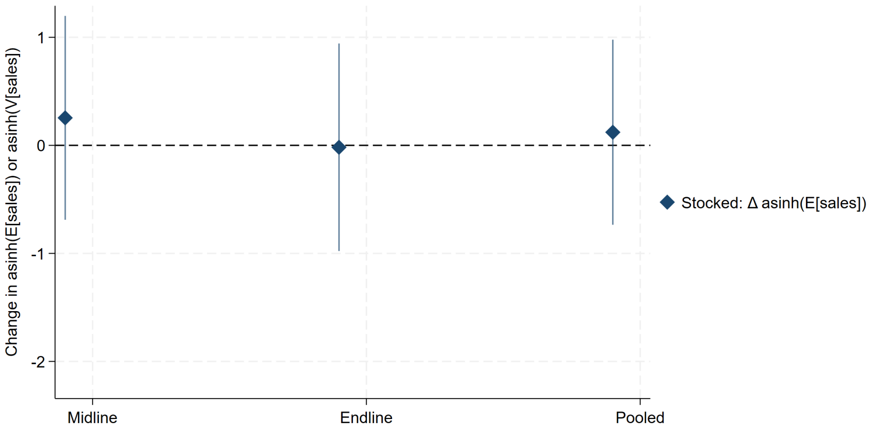
The Learning Mechanism Proposition predicts the following under the two alternatives:

	Returns $\uparrow$ expectations	Returns $\downarrow$ uncertainty
Control relationship between uncertainty, stocking	$\uparrow$	$\downarrow$ ✓
Shops affected by returns	Low $\mathbb{E}$[profits]	High V(profits) ✓
Change in beliefs with experience	$\uparrow$ $\mathbb{E}$[profits]	$\downarrow$ V(profits)

Experience doesn't affect expected profits

Tables Histograms Validation Levels

- Estimate regression of Δ beliefs from baseline $\rightarrow$ midline/endline on phase 1 stocking
  - Instrument for phase 1 stocking with treatment assignment
  - Estimates LATE of experience on beliefs among compliers
    - $\longrightarrow$ Group with *uncertain* and relatively *optimistic* beliefs



Experience does reduce uncertainty

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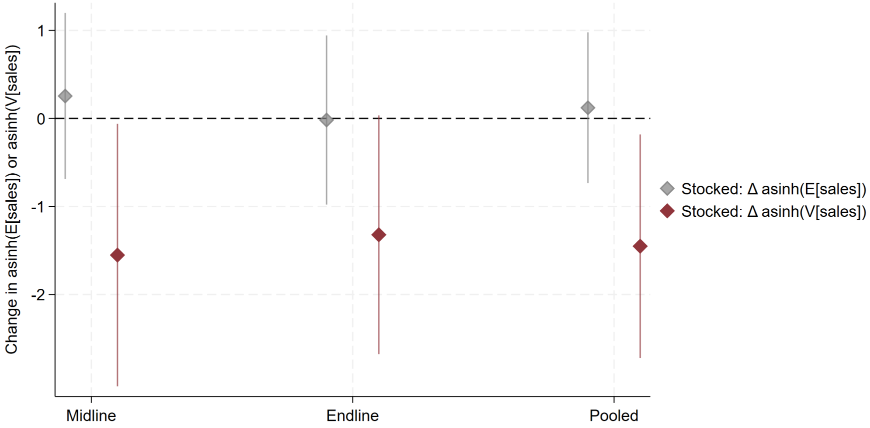

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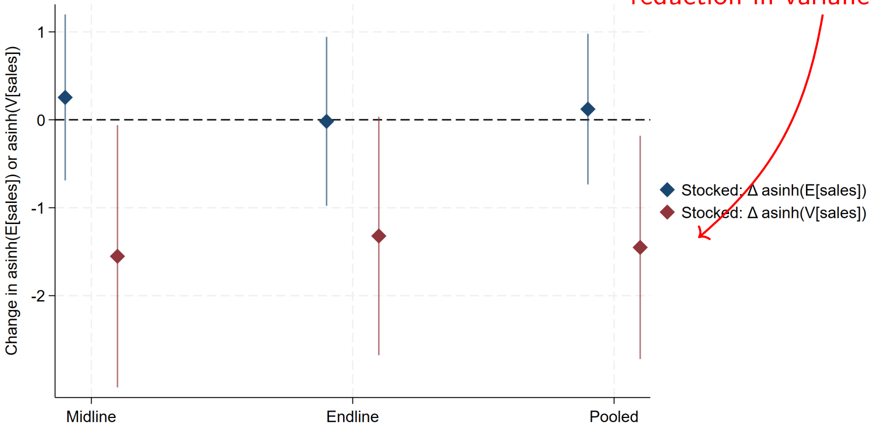
  - Estimates LATE of experience on beliefs among compliers

    $\longrightarrow$ Group with *uncertain* and relatively *optimistic* beliefs

Pooled point estimate: $\exp(0.13 - 1.45) \approx 0.27 \Rightarrow 73\%$ reduction in variance of beliefs



Evidence indicates learning resolves uncertainty Spillovvers

- Beliefs match predictions if risk aversion explains persistent stocking effects
- Violate **all three** conditions required to rationalize the results based on mean beliefs changing

$\rightarrow$ Risk aversion caused a breakdown in firm learning, preventing discovery of a profitable product

	Returns $\uparrow$ expectations	Returns $\downarrow$ uncertainty
Control relationship between uncertainty, stocking	$\uparrow$	$\downarrow$ ✓
Shops affected by returns	Low $\mathbb{E}$[profits]	High V(profits) ✓
Change in beliefs with experience	$\uparrow$ $\mathbb{E}$[profits]	$\downarrow$ V(profits) ✓

Outline

1. Introduction
2. Model
3. Does risk aversion affect firms' stocking decisions?
4. Does risk aversion prevent retailers from adopting new products?
5. Conclusion

Conclusion

- Two experiments indicate Kenyan firms are risk averse, preventing new product experimentation
    1. Insurance experiment: risk aversion affects firms' stocking decisions
    2. Learning experiment: this can undermine discovery of profitable products

Conclusion

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    1. Insurance experiment: risk aversion affects firms' stocking decisions
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- The slow retail adoption of products may harm incentives for upstream firms to innovate
    - Slows or prevents adoption $\rightarrow$ undercuts manufacturers' profits

Conclusion

- Two experiments indicate Kenyan firms are risk averse, preventing new product experimentation
    1. Insurance experiment: risk aversion affects firms' stocking decisions
    2. Learning experiment: this can undermine discovery of profitable products
- The slow retail adoption of products may harm incentives for upstream firms to innovate
    - Slows or prevents adoption → undercuts manufacturers' profits
- Risk aversion may matter for many areas of small firm growth
    - Unknown returns to machines → less manufacturing adoption?
    - Avoid risk by selling what neighbor does → too little differentiation?
    - Invest in safe + low return opportunities → lower investment in firms?
    - Employees known costs + uncertain returns → less hiring?

Thank you!

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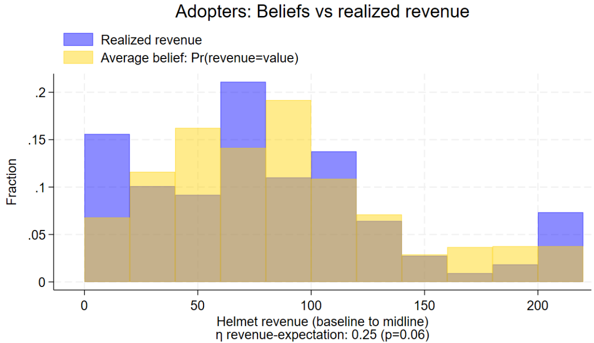
Beliefs vs realized revenue Back



Model Setup: Learning Back

- True value of θ is θ_0, unknown. Priors $\theta \sim \mathcal{N}(\mu_1, \Sigma_1)$
- Information set $\mathcal{I}_t(I_{n0}, \ldots, I_{nt-1})$
  - Agents get a signal if they stock
  - Signal from neighbors w.p. φ each period
- Beliefs update according to Bayes' Rule
- Regret: $R(y_t, \mathcal{I}_t, \Gamma, \theta) \geq 0$, lost utility due to optimization error because of unknown demand if $\theta_0 = \theta$
- Bayesian (expected) regret: $\bar{R}(y_t, \mathcal{I}_t, \Gamma)$, agent's expectation about how much utility they would gain if they knew θ_0

Regret Back

- $y_t = (1+r)a_{t-1} + \pi_s(I_{st-1}, \nu_{st}) + \pi_n(I_{nt-1}, \nu_{nt} + \theta_0)$ denotes cash on hand entering t
- Taking a given θ, define the conditional value function

$$V^*(y_t, \theta) = \max_{\{c_\tau, a_\tau, I_{s\tau}, I_{n\tau}\}} \sum_{\tau=t+1}^{\infty} \delta^\tau \, \mathbb{E}[u(c_{t+\tau})|\theta]$$

- This is the maximum attainable expected utility if θ governs profits
- Now consider the agent's planned set of actions given their information set $\mathcal{I}_t$. If θ is the truth, then their expected utility from this set of actions is $V(y_t, \mathcal{I}_t, \theta) = \sum_{\tau=1}^{\infty} \delta^\tau \, \mathbb{E}[u(c^p_{t+\tau}(\mathcal{I}_t))|\theta]$
- **Regret** is defined as $R(y_t, \mathcal{I}_t|\theta) \equiv V^*(y_t, \theta) - V(y_t, \mathcal{I}_t, \theta) \geq 0$
- Integrating over the distribution of θ one may define the agent's **Bayesian regret**

$$\bar{R}(y_t, \mathcal{I}_t) \equiv \mathbb{E}_\theta \left[R(y_t, \mathcal{I}_t, \theta) | \mathcal{I}_t \right]$$

- This is the agent's expected lifetime utility loss due to incomplete information about θ

$$
\begin{aligned}
\theta_t &\sim \mathcal{N}(\mu_t, \Sigma_t) \\
\mu_t &= \Sigma_t \left(\Sigma_1^{-1} \mu_1 + \sum_{\tau=1}^{t-1} (I_{n\tau}^{-1} \Sigma_x + \Sigma_n)^{-1} x(I_{n\tau}) \right) \\
\Sigma_t &= \left(\Sigma_1^{-1} + \sum_{\tau=1}^{t-1} (I_{n\tau}^{-1} \Sigma_x + \Sigma_n)^{-1} \right)^{-1}
\end{aligned}
$$

Lagrangian Back

$$
\begin{aligned}
\mathcal{L}_1 = u(c_1) &+ \lambda_1 \left[(1+r)a_0 - c_1 - a_1 - w_s I_{s1} - w_n I_{n1}\right] \\
&+ \kappa_{a1}\left[a_1 - \bar{a}\right] + \kappa_{\chi 1}\left[I_{n1}\cdot(I_{n1}-\chi)\right] + \iota_{s1} I_{s1} \\
&+ \delta\, \mathbb{E}_{\theta,\nu_{s2},\nu_{n2}} \{u(c_2) + \lambda_2 \left[\pi_s(I_{s1},\nu_{s2}) + \pi_n(I_{n1},\nu_{n2},\theta)\right. \\
&\left. +(1+r)a_1 - c_2 - a_2 - w_s I_{s2} - w_n I_{n2}\right] \\
&+ \kappa_{a2}\left[a_2 - \bar{a}\right] + \kappa_{\chi 2}\left[I_{n2}\cdot(I_{n2}-\chi)\right] + \iota_{s2} I_{s2} | \mathcal{I}_1\} \\
&+ \delta\, \mathbb{E}_{\nu_{s2},\nu_{n2},\theta}\left[V^*(x_2,\theta) - \bar{R}(x_2,\mathcal{I}_2(I_{n1}),\theta)|\mathcal{I}_1\right]
\end{aligned}
$$

Learning setup Posteriors Back

- Agents begin with priors

$$\theta \sim \mathcal{N}(\mu_1, \Sigma_1)$$

- $\pi_n(I_{nt-1}, \nu_{nt}, \theta)$ is differentiable and monotonic wrt θ

Learning setup Posteriors Back

- Agents begin with priors

$$\theta \sim \mathcal{N}(\mu_1, \Sigma_1)$$

- $\pi_n(I_{nt-1}, \nu_{nt}, \theta)$ is differentiable and monotonic wrt θ
- Stocking yields the following signal about demand:

$$x(I_{nt}) \sim \mathcal{N}\left(\theta_0, \quad \underbrace{I_{nt}^{-1}\Sigma_x}_{\text{Precision } \nearrow I_{nt}} \quad + \quad \underbrace{\Sigma_n}_{\searrow \text{ volatility}}\right)$$

Learning setup Posteriors Back

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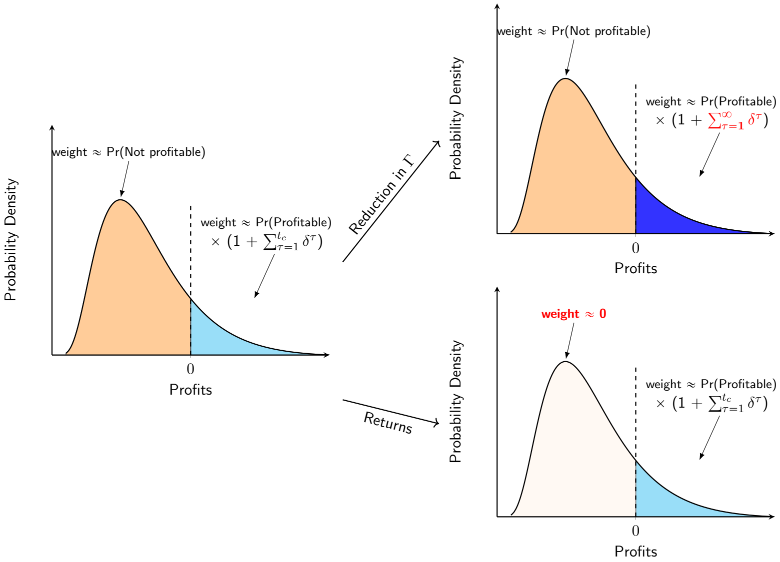
- Learning enters utility as lower future **regret**

$$R(y_t, \mathcal{I}_t, \Gamma, \theta) = V(\text{optimal incomplete info strategy}|\theta) - V^*(\text{optimal full info strategy}|\theta)$$

Model illustration Back



A mean-preserving contraction Back

Definition 1 (Mean-preserving contraction of the profit function)

A mean-preserving contraction of the profit function at the minimum order size, χ, is a one-period perturbation, $\pi_n^p(\cdot)$, such that

1. $\mathbb{E}_t\left[\pi_n^p(\chi, \nu_{nt+1}, \theta)\right] = \mathbb{E}_t\left[\pi_n(\chi, \nu_{nt+1}, \theta)\right]$
2. $\int_{-\infty}^{x} F_p(\chi, y)dy \leq \int_{-\infty}^{x} F(\chi, y)dy \quad \forall x$, strictly for some x. $F(I_{nt}, y)$ denotes $Pr(\pi_n(I_{nt}, \nu_{nt+1}, \theta) \leq y)$, and F_p is the same for the perturbed profit function.
3. $\pi_n^p(I_{nt}, \nu_{nt+1}, \theta) = \pi_n(I_{nt}, \nu_{nt+1}, \theta) \quad \forall I_{nt} \neq \chi$

Learning about demand: formal proposition Back

Proposition 4 (Learning about demand)

If firms face **demand uncertainty** *(var$(\theta) > 0$), then*
i.) New product stocking increases when the firm is offered returns.
ii.) Reducing future supply chain uncertainty, Γ, increases stocking.
iii.) If $\delta \approx 1$, non-stock costs of helmet sales are low, and capital constraints are not binding, then a reduction in supply chain uncertainty has no effect if a firm has access to returns.
iv.) A one-time return offer will have persistent effects on new product stocking.

Learning mechanism: formal proposition Back

Proposition 5 (Learning mechanism)

Suppose that a one-time returns policy has a persistent positive effect on new product adoption.

a.) If returns correct the pessimistic priors of risk neutral firms, each of the following should hold:

i.) Prior uncertainty about demand and uptake are positively correlated absent returns.

ii.) Returns cause firms with pessimistic priors to stock.

iii.) Experience selling the new product causes firms to positively update beliefs.

b.) If returns cause risk averse firms to stock and overcome demand uncertainty:

i.) Prior uncertainty about demand and uptake are negatively correlated absent returns.

ii.) Returns cause firms with uncertain priors to stock.

iii.) Experience reduces uncertainty about demand.

Information externalities: formal proposition Back

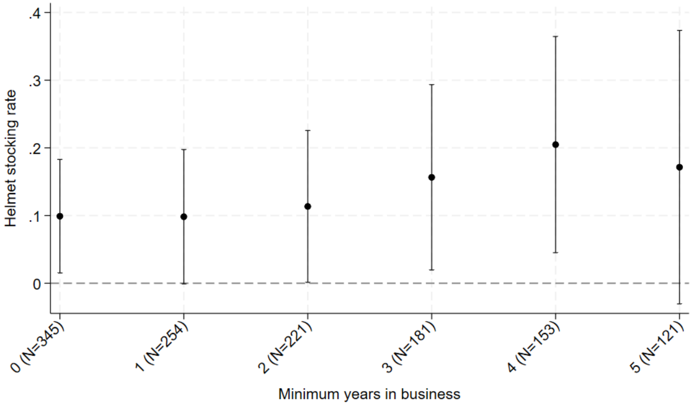
Proposition 6 (Information externalities)

If firms can learn about demand from competitors
a.) The effects of a returns offer or change in Γ are decreasing in φ.
b.) Exposure to a seller increases I^*_{nt} if agents are risk averse or have pessimistic priors.
c.) Receipt of a signal x_{ot} below an agent's expectation increases I^*_{nt} only if agents are risk averse.

Premium values Back

$$P_i = \begin{cases} 1000 \cdot (1 - so_i) + 25, & so_i < 0.8 \\ 225, & so_i \geq 0.8 \end{cases}$$

Are results driven by new firms? Back



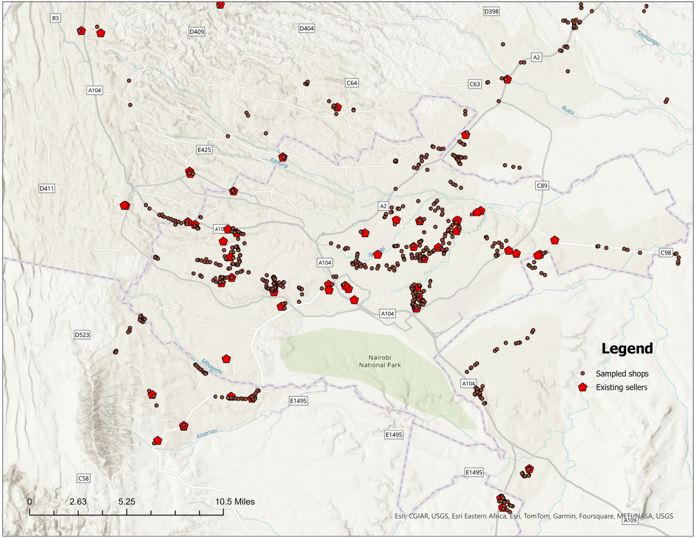
Insurance experiment: heterogeneous treatment effects Back

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: Stocked within 24 hours			Dependent variable: Stocked		
	Employees	Firm profits	Firm age	Employees	Firm profits	Firm age
Treatment effect of insurance: smaller/younger firms						
Below median × Offered insurance	0.025	0.020	0.036	0.046	0.039	0.043
	(0.032)	(0.045)	(0.034)	(0.047)	(0.060)	(0.060)
Treatment effect of insurance: larger/older firms						
Above median × Offered insurance	0.197***	0.118**	0.120**	0.249**	0.173***	0.170**
	(0.071)	(0.047)	(0.054)	(0.100)	(0.066)	(0.066)
Pr(below = above)	0.039	0.160	0.219	0.070	0.130	0.169
Control mean ($\leq$ median)	0.044	0.072	0.033	0.193	0.193	0.228
Control mean ($>$ median)	0.054	0.027	0.062	0.243	0.216	0.175
Observations	344	316	345	344	316	345

$* \ p < 0.1, \ \ ** \ p < .05 \ \ *** \ p < .01$. Robust standard errors in parenthesis.

This table reports heterogeneous treatment effects of *insurance* with respect to firm size and age. Panel A presents treatment effects of receiving an insurance offer on helmet stocking. In columns (1) - (3) the dependent variable equals 1 if the shop stocked helmets within 24 hours of the survey, while in columns (4) - (6) the dependent variable captures stocking within the 2 week window provided after the baseline. The below median group of firms by employee size contains no paid employees, while the above median group includes all firms with at least 1. Median firm profits in the last month were PPP USD 325. The median enterprise age is 3 years. Pr(below=above) reports the p-value of the test that the treatment effects are equal. Control means capture the untreated average of the dependent variable within the respective groups. All estimates include market fixed effects and controls for industry, baseline revenue, days open per week, knowledge of a nearby helmet seller, and indicators for having space to store helmets, selling multiple products, and stocking a new product in the past year.

Map of sampled shops and existing sellers Back



Summary statistics and balance Learning experiment Insurance experiment I

	Insurance experiment		Learning experiment Returns		Learning experiment Supplier commitment	
Variable	(1) Control mean [SD]	(2) T - C	(3) Control mean [SD]	(4) T - C	(5) Control mean [SD]	(6) T - C
Respondent age	34.18	0.77	28.92	-0.77	28.68	-1.32
	[10.86]	(1.12)	[6.75]	(1.85)	[6.97]	(2.08)
Female	0.30	0.03	0.28	-0.03	0.27	0.00
	[0.46]	(0.05)	[0.45]	(0.03)	[0.44]	(0.03)
Years of education	12.78	0.19	13.23	0.16	13.34	-0.02
	[2.79]	(0.27)	[2.48]	(0.16)	[2.54]	(0.17)
Business age	4.53	-0.22	5.29	0.18	5.68	-0.57
	[5.46]	(0.52)	[5.45]	(0.36)	[5.77]	(0.36)
Motorcycle spares shop	0.59	-0.01	0.37	-0.02	0.37	-0.00
	[0.49]	(0.05)	[0.48]	(0.03)	[0.48]	(0.03)
Revenue last month	1,235.46	-132.01	1,459.28	153.17	1,590.50	-125.91
	[1,482.82]	(152.00)	[2,107.67]	(159.08)	[2,458.95]	(168.67)
Costs last month	972.27	15.70	655.92	138.05*	747.21	-49.55

Summary statistics and balance Learning experiment Insurance experiment II

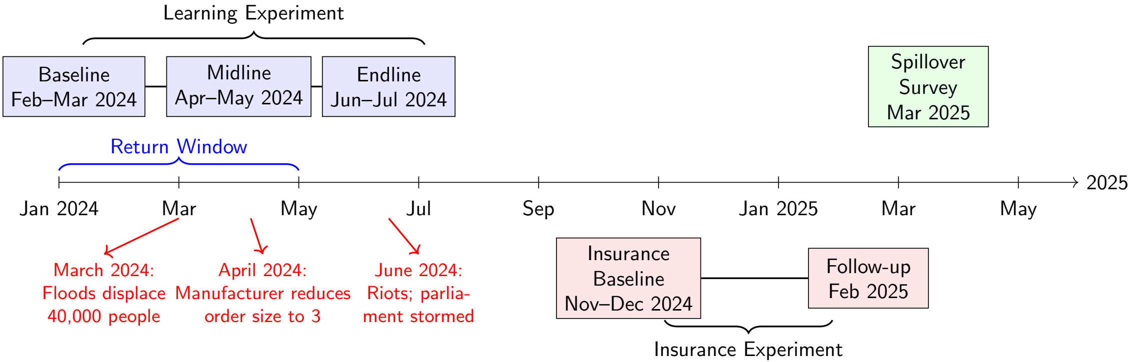
	[1,280.78]	(185.11)	[835.61]	(79.85)	[1,045.04]	(83.74)
Profits last month	508.77	-46.39	622.90	61.17	674.88	-32.39
	[593.92]	(57.29)	[977.04]	(66.44)	[937.10]	(66.60)
1(paid employees)	0.22	0.05	0.25	-0.01	0.25	-0.01
	[0.41]	(0.04)	[0.43]	(0.03)	[0.43]	(0.03)
Wage bill last week	58.26	10.85	34.69	-5.05	21.60	18.33**
	[348.89]	(29.99)	[164.33]	(10.47)	[47.16]	(9.01)
Hours open/week	77.41	0.24	85.35	-0.16	86.06	-1.74*
	[19.50]	(1.57)	[15.37]	(0.95)	[15.07]	(0.95)
KM to helmet seller	NA	NA	2.24	0.06	2.28	-0.06
	–	–	[3.17]	(0.15)	[3.27]	(0.15)
Know helmet seller	0.56	-0.10**	0.25	0.03	0.27	0.00
	[0.50]	(0.05)	[0.44]	(0.03)	[0.44]	(0.03)
Min. to motorcycle taxi stand	NA	NA	3.16	-0.07	3.00	0.24
	–	–	[6.01]	(0.36)	[5.77]	(0.36)
New product in last year	0.28	0.03	0.34	-0.01	0.36	-0.05
	[0.45]	(0.04)	[0.48]	(0.03)	[0.48]	(0.03)

Summary statistics and balance Learning experiment Insurance experiment III

E[sales]	3.43	-0.04	3.75	0.06	3.89	-0.21
	[1.73]	(0.13)	[2.01]	(0.13)	[2.06]	(0.14)
V(sales)	2.96	-0.13	1.26	0.08	1.33	-0.06
	[2.88]	(0.25)	[1.84]	(0.12)	[1.80]	(0.12)
Observations	172	173	461	468	463	466
Joint p-value		0.87		0.91		0.47

$* \ p < 0.1, \quad ** \ p < .05 \quad *** \, p < .01.$ Standard deviations in brackets. Standard errors in parenthesis.

Timeline


Learning Experiment
Baseline
Feb–Mar 2024
Midline
Apr–May 2024
Endline
Jun–Jul 2024
Spillover
Survey
Mar 2025
Return Window
2025
Jan 2024
Mar
May
Jul
Sep
Nov
Jan 2025
Mar
May
March 2024:
Floods displace
40,000 people
April 2024:
Manufacturer reduces
order size to 3
June 2024:
Riots; parlia-
ment stormed
Insurance
Baseline
Nov–Dec 2024
Follow-up
Feb 2025
Insurance Experiment

Insurance experiment: Contract take-up and foregone returns Back

	Insurance uptake		Insurance expected payout − guaranteed		Insurance realized payout − guaranteed	
	(1)	(2)	(3)	(4)	(5)	(6)
	Stocked ($\leq 24H$)	Stocked	Dollars	Share	Dollars	Share
$\mathbb{E}$[Sales]	-0.017	-0.033				
	(0.113)	(0.036)				
SD[Sales]	0.239	0.153**				
	(0.221)	(0.078)				
Accepted insurance			-0.024	-0.003	0.932	-0.044
			(0.274)	(0.063)	(2.748)	(0.266)
Constant	0.224	0.290*	-0.822***	-0.117***	-6.046***	-0.472**
	(0.254)	(0.152)	(0.158)	(0.038)	(1.983)	(0.213)
Observations	22	51	51	51	47	47
Mean	0.500	0.392	-0.812	-0.113	-6.048	-0.493

$* \ p < 0.1, \quad ** \ p < .05 \quad *** \ p < .01.$ Bootstrapped standard errors in parenthesis (500 draws).

Profit dynamics and selling costs Back

	(1) Helmet profits per month EL	(2) Total costs selling helmets	(3) Helmet costs net est. stock	(4) Any fixed costs	(5) Fixed costs	(6) Δ capacity utilization
Stocked in phase 1	-9.419					0.046*
	(5.956)					(0.024)
Estimated cost of helmet stock (PPP)		0.451***				
		(0.167)				
Returns			-8.747	0.050	-0.632	
			(8.575)	(0.060)	(2.009)	
Observations	127	132	132	128	128	712
Dep. var. mean	21.552	73.735	-10.925	0.133	2.381	0.064

$* \, p < 0.1, \quad ** \, p < .05 \quad *** \, p < .01$

Robust standard errors in parenthesis. The sample consists of shops that reported selling helmets, supplied by the study or a different source. Column (1) regresses helmet profits accumulated between midline and endline on an indicator equal to 1 if the shop stocked helmets in the month after baseline to test for learning by doing. Column (2) regresses total reported costs of stocking helmets on the cost of the helmet stock, measured via administrative data or estimated. The dependent variable in column (3) equals reported helmet costs net of stock price. Column (4) examines whether shops reported any fixed costs of helmet sales, and column (5) reports total fixed costs. Column (6) reports the change in capacity utilization of the firm from baseline to endline, measured as worst week over best week profits in the last month.

Installment take-up

	Mean	SD	25th percentile	50th percentile	75th percentile	Obs
Accepted installments	0.65	0.48	0.00	1.00	1.00	107
Balance owed	30.79	25.37	0.02	40.56	57.38	110
Initial payment/minimum	5.03	2.33	4.16	5.16	5.24	109
Balance cleared on time	0.91	0.29	1.00	1.00	1.00	110
Balance cleared pre-ML	0.97	0.16	1.00	1.00	1.00	110
Defaulted	0.02	0.13	0.00	0.00	0.00	110

Back

Learning experiment: treatment effect on stocking and entry

Back

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Stocked in Phase 1		Ever Stocked		Stocked in Phase 2		Entrant	
Returns	0.096***	0.089***	0.085**	0.078**	0.070**	0.065**	0.069**	0.066**
	(0.029)	(0.028)	(0.034)	(0.032)	(0.031)	(0.030)	(0.028)	(0.027)
Supplier commitment	0.053*	0.060**	0.038	0.045	0.041	0.044	0.022	0.027
	(0.027)	(0.027)	(0.033)	(0.031)	(0.030)	(0.028)	(0.025)	(0.024)
Returns $\times$ Supplier commitment	-0.056	-0.042	-0.061	-0.043	-0.063	-0.047	-0.032	-0.021
	(0.043)	(0.042)	(0.049)	(0.046)	(0.044)	(0.042)	(0.039)	(0.038)
Observations	929	929	929	929	929	929	929	929
Control mean	0.068	0.068	0.131	0.131	0.102	0.102	0.068	0.068
Controls	Strata FE	Yes	Strata FE	Yes	Strata FE	Yes	Strata FE	Yes

$* \ p < 0.1, \quad ** \ p < .05, \quad ***p < .01$

This table plots treatment effects on helmet stocking and helmet market entry from the Learning Experiment. Column (1)-(2) report effects on phase 1 stocking, supplied by the study or any other source. Columns (3)-(4) examine effects on stocking at any point prior to the endline survey. Columns (5)-(6) examine effects on phase 2 stocking. Column (7)-(8) examine effects on entry into the helmet market, defined by two or more stock purchases and reported intent to permanently stock helmets. The dependent variable in columns (5)-(8) is coded to 0 if a shop withdrew from the study because they did not wish to sell helmets or if the outcome was confirmed without the survey. All estimates include strata fixed effects. Columns where controls indicates "Yes" also include industry fixed effects, controls for distance to the manufacturer, log revenue, days open per week, and indicators for stocking a new product in the year before the baseline survey, selling multiple products at baseline, and having space to store helmets without stocking less of another item.

Heterogeneous treatment effects on phase one stocking Back

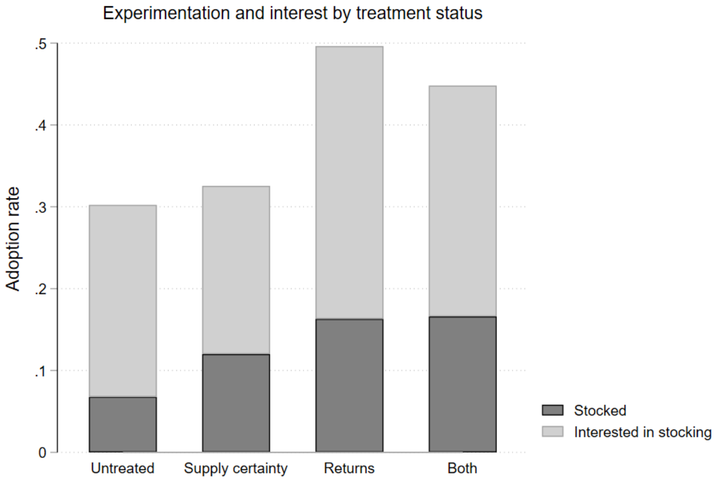
	(1) Risk averse	(2) Multi-product firm	(3) Female	(4) log(Revenue)	(5) 1(Employees)	(6) Motorcycle part shop
Returns	0.028	-0.027	0.095***	0.185	0.093***	0.040
	(0.050)	(0.048)	(0.034)	(0.274)	(0.035)	(0.025)
Supplier commitment	0.007	-0.032	0.064**	0.259	0.045	0.036
	(0.050)	(0.045)	(0.033)	(0.263)	(0.031)	(0.022)
Returns × Supplier commitment	0.066	0.102	-0.072	-0.583	-0.045	0.019
	(0.071)	(0.068)	(0.050)	(0.374)	(0.050)	(0.039)
Variable	-0.103***	-0.028	-0.008	0.067**	-0.046	0.099**
	(0.038)	(0.044)	(0.041)	(0.030)	(0.036)	(0.043)
Returns × Variable	0.105*	0.148**	-0.015	-0.013	-0.016	0.140**
	(0.063)	(0.060)	(0.067)	(0.041)	(0.063)	(0.070)
Supplier commitment × Variable	0.093	0.121**	-0.003	-0.030	0.069	0.060
	(0.059)	(0.056)	(0.060)	(0.039)	(0.065)	(0.064)
Returns × Supplier commitment × Variable	-0.217**	-0.202**	0.062	0.077	-0.035	-0.190*
	(0.089)	(0.086)	(0.098)	(0.056)	(0.097)	(0.100)
Observations	929	929	928	809	928	929
Control mean	0.068	0.068	0.068	0.068	0.068	0.068
Controls	Yes	Yes	Yes	Yes	Yes	Yes

$* \; p < 0.1, \quad ** \; p < .05 \quad *** \; p < .01$

Robust standard errors in parenthesis. All estimates include strata fixed effects.

Interest in stocking by treatment arm

Back



Effects of returns on phase 2 stocking and entry Back

	Stocked in phase 2				Entrant (restocked and intent)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Returns	0.070**	0.078**	0.065**	0.077**	0.069**	0.076***	0.066**	0.077***
	(0.031)	(0.034)	(0.030)	(0.033)	(0.028)	(0.029)	(0.027)	(0.029)
Supplier commitment	0.041	0.069**	0.044	0.055*	0.022	0.054**	0.027	0.046*
	(0.030)	(0.032)	(0.028)	(0.030)	(0.025)	(0.027)	(0.024)	(0.026)
Returns × Commitment	-0.063	-0.080	-0.047	-0.051	-0.032	-0.051	-0.021	-0.030
	(0.044)	(0.049)	(0.042)	(0.047)	(0.039)	(0.044)	(0.038)	(0.042)
BL Seller		0.092*		0.029		0.091*		0.040
		(0.053)		(0.048)		(0.049)		(0.045)
Returns × BL Seller		-0.038		-0.047		-0.036		-0.041
		(0.080)		(0.074)		(0.073)		(0.069)
Commitment × BL Seller		-0.112		-0.043		-0.126*		-0.074
		(0.077)		(0.071)		(0.066)		(0.063)
Returns × Commitment		0.074		0.019		0.082		0.037
× BL seller		(0.111)		(0.106)		(0.099)		(0.095)
Observations	929	929	929	929	929	929	929	929
Control mean	0.102	0.073	0.102	0.073	0.068	0.040	0.068	0.040
Controls	Strata	Strata	Yes	Yes	Strata	Strata	Yes	Yes

$* \ p < 0.1, \ \ ** \ p < .05, \ \ ***p < .01$

Robust standard errors in parenthesis. Dependent variable in columns (1) - (4): shop purchased helmet stock in phase 2. Dependent variable in columns (5) - (8): shop purchased helmets two or more times during the study (restocked) and reported intent to permanently keep selling them. All estimates include strata fixed effects. Firms that did not complete the endline survey had the outcome coded to 0 if they withdrew from the study because they did not wish to sell helmets or if the outcome was confirmed without the survey. Estimates where controls are included ("Yes") include industry fixed effects, controls for distance to the manufacturer, log revenue, days open per week, and indicators for stocking a new product in the year before the baseline survey, selling multiple products at baseline, and having space to store helmets without stocking less of another item.

Effects of returns on restocking, alternative definitions Back

	(1) Restocked (Primary)	(2) Restocked, 5+	(3) 3+ orders	(4) Selling at EL	(5) Orders, exc. BL offer
Returns	0.066**	0.052**	0.066***	0.087***	0.156***
	(0.027)	(0.024)	(0.018)	(0.033)	(0.055)
Commitment	0.027	0.020	0.053***	0.052*	0.092*
	(0.024)	(0.022)	(0.017)	(0.032)	(0.048)
Returns × Commitment	-0.021	-0.028	-0.076***	-0.050	-0.143*
	(0.038)	(0.034)	(0.027)	(0.047)	(0.075)
Observations	929	929	929	891	929
Control mean	0.078	0.059	0.033	0.151	0.184
Controls	Yes	Yes	Yes	Yes	Yes

$* \ p < 0.1, \quad ** \ p < .05 \quad *** \, p < .01$

Robust standard errors in parenthesis. All estimates include strata fixed effects.

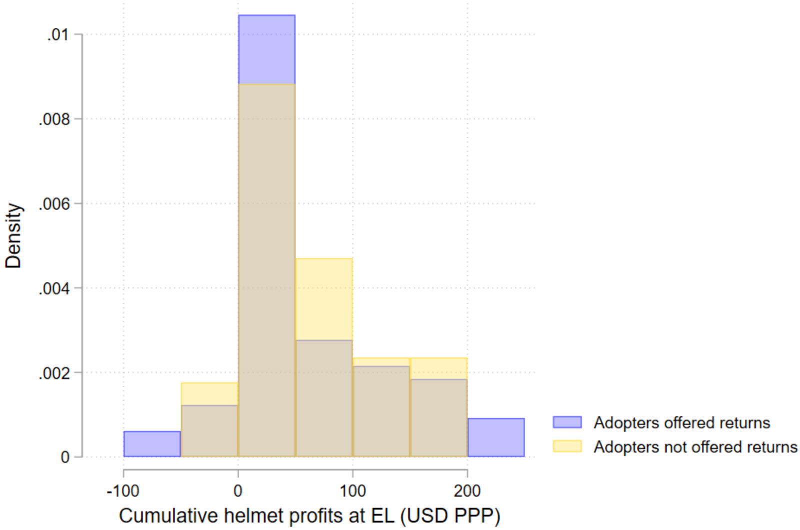
Effects of returns on restocking, heterogeneous TEs Back

	(1) High BL Revenue	(2) Agent cautious	(3) Agent risk loving	(4) Motorcycle shop	(5) High slack capacity
Returns	0.083*	0.105***	0.017	0.126*	0.084**
	(0.049)	(0.036)	(0.048)	(0.065)	(0.040)
Commitment	0.009	0.071**	-0.056	0.052	0.029
	(0.045)	(0.032)	(0.045)	(0.063)	(0.033)
Returns $\times$ Commitment	0.001	-0.116**	0.078	-0.098	-0.065
	(0.070)	(0.050)	(0.064)	(0.093)	(0.058)
Observations	392	529	400	338	404
Control mean	0.067	0.042	0.106	0.163	0.048
Controls	No	No	No	No	No
Supplier commitment $= 0$	Yes	Yes	Yes	Yes	Yes

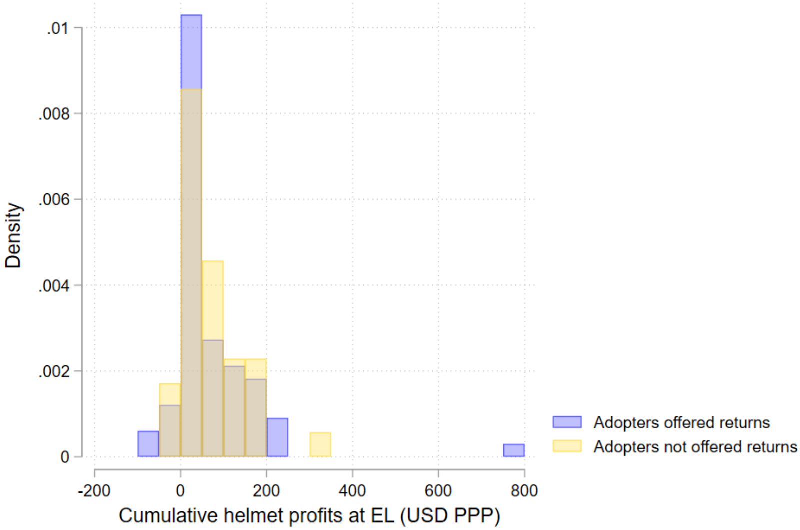
$* \ p < 0.1, \quad ** \ p < .05 \quad *** \ p < .01$

Robust standard errors in parenthesis. All estimates include strata fixed effects.

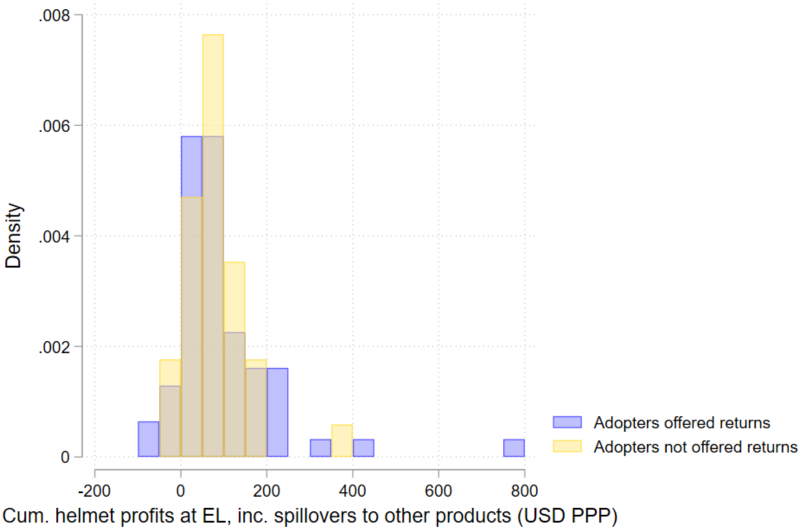
EL reported helmet profits Back



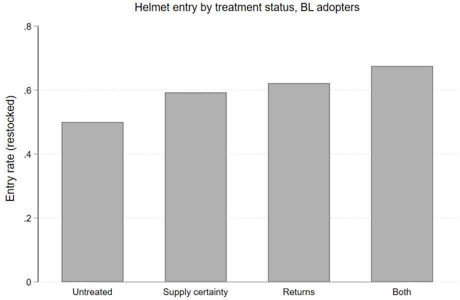
EL reported helmet profits Back



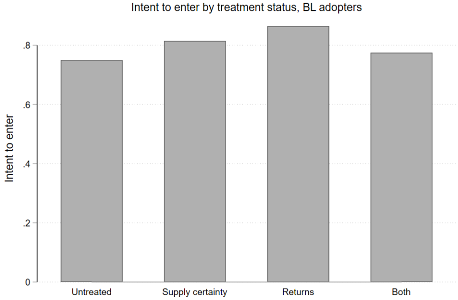
EL reported helmet profits (plus spillovers) Back



Restocking rates Back



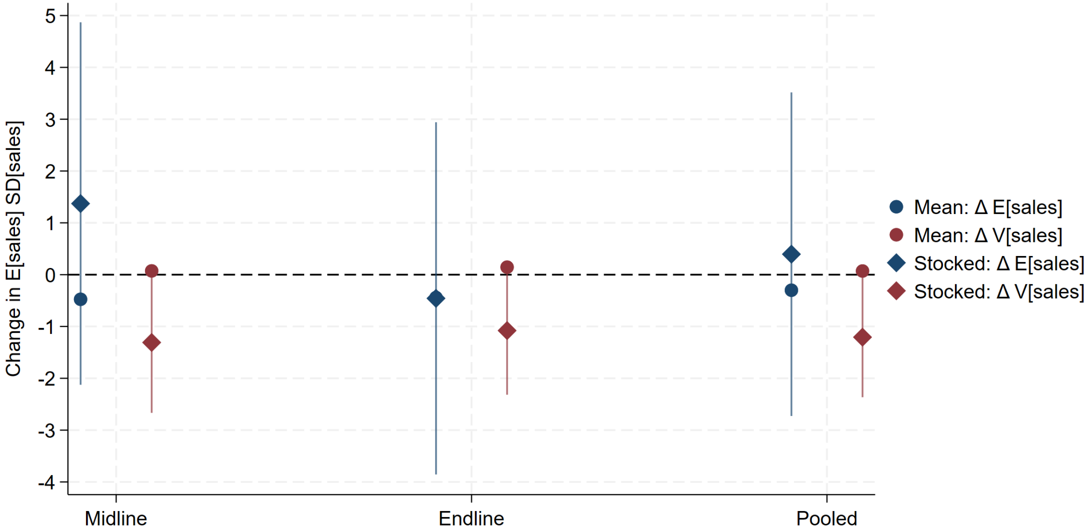
Restocked



Intent to restock

Effect of experimentation on beliefs, levels

Back



Effect of experimentation on beliefs, revenue Back

	Instrumental Variables Estimates						Reduced form	
	(1) $\Delta\,\mathbb{E}[Rev]$	(2) $\Delta SD[Rev]$	(3) $\Delta\,\mathbb{E}[Rev]$	(4) $\Delta SD[Rev]$	(5) $\Delta\,\mathbb{E}[Rev]$	(6) $\Delta SD[Rev]$	(7) $\Delta\,\mathbb{E}[Rev]$	(8) $\Delta SD[Rev]$
Panel a: Change in $\mathbb{E}[Revenue]$ or $SD[Revenue]$ since BL								
Stocked (phase 1)	34.916	-26.360*	-15.067	-24.916*	8.425	-25.942**		
	(38.015)	(14.376)	(36.264)	(13.295)	(33.431)	(12.357)		
Returns							1.143	-2.235
							(4.554)	(1.606)
Supplier commitment							5.195	-1.022
							(4.163)	(1.482)
Returns × Supplier commitment							1.262	1.701
							(6.269)	(2.240)
Observations	820	820	832	832	1,652	1,652	1,652	1,652
Dep. var. mean	-8.213	1.842	-6.968	3.488	-4.963	1.748	-7.548	2.392
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weak IV robust p-val	0.419	0.081	0.596	0.082		0.049		
Survey	ML	ML	EL	EL	Pooled	Pooled	Pooled	Pooled

Robust standard errors in parenthesis in columns (1) - (4) and standard errors clustered by firm in columns (5) - (8). $* \, p < 0.1$, $** \; p < .05$ $*** \, p < .01$

Dependent variables are the change in beliefs of the firm since baseline. Columns (1) - (6) instrument for BL stocking using treatment assignment and treatment interacted with an indicator for a seller at baseline, controlling for the presence of a seller. All estimates include controls for shop and respondent characteristics.

Effect of experimentation on beliefs, log revenue Back

	Instrumental Variables Estimates						Reduced form	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta\,\mathbb{E}[Rev]$	$\Delta SD[Rev]$	$\Delta\,\mathbb{E}[Rev]$	$\Delta SD[Rev]$	$\Delta\,\mathbb{E}[Rev]$	$\Delta SD[Rev]$	$\Delta\,\mathbb{E}[Rev]$	$\Delta SD[Rev]$
Panel b: Change in $log(\mathbb{E}[Revenue])$ or $log(V[Revenue])$ since BL								
Stocked (phase 1)	0.467	-2.257	0.057	-1.846	0.265	-2.163*		
	(0.565)	(1.431)	(0.550)	(1.285)	(0.493)	(1.233)		
Returns							-0.005	-0.143
							(0.067)	(0.128)
Supplier commitment							0.059	-0.046
							(0.060)	(0.120)
Returns $\times$ Supplier commitment							0.088	0.132
							(0.092)	(0.184)
Observations	814	660	827	651	1,641	1,311	1,641	1,311
Dep. var. mean	-0.141	0.115	-0.104	0.360	-0.080	0.149	-0.112	0.183
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weak IV robust p-val	0.475	0.136	0.970	0.140	0.683	0.077		
Survey	ML	ML	EL	EL	Pooled	Pooled	Pooled	Pooled

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Effect of experimentation on beliefs Back

	Instrumental Variables Estimates						Reduced form	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta\,\mathbb{E}[Sales]$	$\Delta SD[Sales]$	$\Delta\,\mathbb{E}[Sales]$	$\Delta SD[Sales]$	$\Delta\,\mathbb{E}[Sales]$	$\Delta SD[Sales]$	$\Delta\,\mathbb{E}[Sales]$	$\Delta SD[Sales]$
Panel b: Change in $\mathbb{E}[Sales]$ or $SD[Sales]$ since BL								
Stocked (phase 1)	1.373	-1.308*	-0.457	-1.079*	0.395	-1.206**		
	(1.784)	(0.693)	(1.734)	(0.631)	(1.593)	(0.591)		
Returns							0.015	-0.116
							(0.218)	(0.077)
Supplier commitment							0.188	-0.052
							(0.197)	(0.070)
Returns × Supplier commitment							0.187	0.098
							(0.300)	(0.108)
Observations	820	820	832	832	1,652	1,652	1,652	1,652
Dep. var. mean	-0.475	0.073	-0.442	0.145	-0.300	0.071	-0.411	0.103
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weak IV robust p-val	0.499	0.070	0.711	0.113		0.054		
Survey	ML	ML	EL	EL	Pooled	Pooled	Pooled	Pooled

Robust standard errors in parenthesis in columns (1) - (4) and standard errors clustered by firm in columns (5) - (8). $*\,p < 0.1$, $**\;p < .05$ $***\,p < .01$

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Uncertainty-stocking relationship: Robustness Back

Dependent variable: Stocked helmets

	Sample: Pr(Loss|Stock 5) $>$ 0			All	Non-degenerate	All
	(1) Revenue	(2) Sales	(3) Sales	(4) Sales	(5) Sales	(6) Sales
Returns	-0.193	-0.006	0.024	0.015	0.022	-0.022
	(0.213)	(0.073)	(0.072)	(0.067)	(0.086)	(0.076)
$\mathbb{E}$[sales/revenue]	0.052*	0.021	0.021	0.008	0.023*	0.023
	(0.028)	(0.015)	(0.015)	(0.008)	(0.013)	(0.015)
σ(sales/revenue)	-0.041**	-0.042**	-0.031*	-0.022	-0.054**	-0.054**
	(0.020)	(0.020)	(0.018)	(0.017)	(0.024)	(0.022)
Returns $\times$ $\mathbb{E}$[sales/revenue]	-0.001	0.014	0.008	0.013	-0.018	0.013
	(0.065)	(0.033)	(0.033)	(0.015)	(0.021)	(0.033)
Returns $\times$ σ(sales/revenue)	0.045	0.039	0.032	0.023	0.092*	0.051
	(0.038)	(0.053)	(0.053)	(0.039)	(0.053)	(0.054)
σ(sales/revenue) $\times$ Pr(Loss|Stock 5) $=0$						0.101
						(0.086)
Observations	283	304	304	427	286	427
Control mean	0.068	0.068	0.068	0.068	0.068	0.068
Controls	Full	DPLASSO	None	Full	Full	Full

$*\ p<0.1,\ \ **\ p<.05\ \ ***\,p<.01$

Robust standard errors in parenthesis.

Returns adopters have more uncertain, no more pessimistic beliefs Back

Learning experiment: Beliefs of adopters with versus without returns
Dependent variable: *returns*

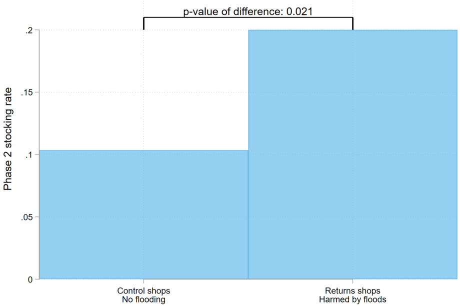
	(1) Belief levels	(2) Belief logs
E[sales]	-0.001	
	(0.034)	
$\sigma(sales)$	0.202**	
	(0.089)	
log(1 + E[sales])		-0.012
		(0.178)
log(1 + V(sales))		0.246**
		(0.103)
Know helmet seller	-0.309**	-0.313**
	(0.143)	(0.142)
Observations	46	46

$* \, p < 0.1, \quad ** \, p < .05 \quad *** \, p < .01$

This table reports beliefs about demand for helmets of adopters with and without *returns*. The dependent variable in each column is an indicator equal to 1 if the agent received *returns*, and the sample is restricted to those that stocked helmets in phase one and did not receive the supplier commitment offer. Robust standard errors in parenthesis.

Can relaxed capital constraints explain TE persistence? Back

- Manufacturer lowered order size to 3, but treated shops restock at 5
- No significant differences in midline profits across treatment arms
- Randomized info drop → 4.5 times stocking rate ($p < .05$)
- Massive flooding at ML → **exposed firms' profits down 20% (96$, $\mathbf{p < .05}$)**



Is exhibited risk aversion extreme? Back

- Paper argues consumption preferences affect business decisions, argument valid if those preferences are neoclassical risk aversion or non-standard preferences
  - Non-standard preferences (e.g. loss aversion) would actually make the problem worse
  - Will rule out max-min in learning experiment

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  - Non-standard preferences (e.g. loss aversion) would actually make the problem worse
  - Will rule out max-min in learning experiment
- But the levels of risk aversion are not necessarily high
- Area PPP GDP/capita $\approx$ \$3,200 vs US \$85,800
  - Same treatment as share of income in US $\rightarrow$ about \$700 insurance payout
- Sample very liquidity constrained $\rightarrow$ buffer stock savings
  - Only 26% of shops have ever taken a loan, 12.5% median monthly rate among those that have borrowed
- Structural estimates of average CRRA implied by response to insurance below 1

Structural CRRA estimates Back

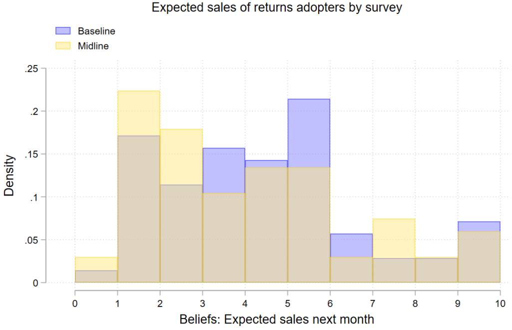
- From frequentist beliefs, estimate expected utility from stocking with vs without insurance, given a CRRA value
- If treated, helmet utility max of the two, otherwise no insurance utility
- Discrete choice to adopt vs not, EV1 shocks, additional intercept to stocking to capture capital constraints
- Estimate with nonlinear GMM using treatment assignment to instrument for helmet utility
- Global optimizer searching from $\rho = 0$ to 8, also estimate for below vs above game measured utility

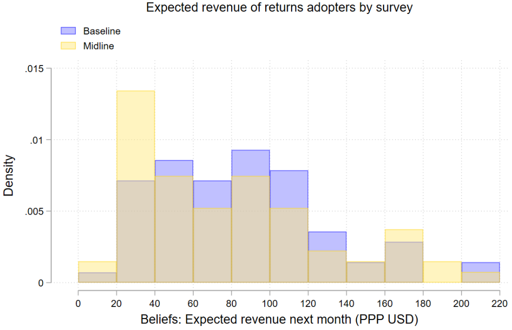
	Estimate	90% CI Low	90% CI High
Average	0.61	0.006	7.96
Less risk averse	0.53	0	7.02
More risk averse	2.21	0	7.75

Why doesn't the manufacturer offer returns? Back

- Can't resell returned stock (safety concerns)
- Mistrust when offered by private company vs researchers with permits
- Costly to deliver to, track many small retailers making small orders
    - Pre-study: order size 10+
    - Unexpectedly dropped to 3+ near learning midline
    - Facilitated by sending vehicle to neighborhoods, rapidly selling to many small shops at once
- Reputation risk if promise to offer returns, fail to return to even 1 shop
- Only 14% of shops in West Kenya ever offered returns

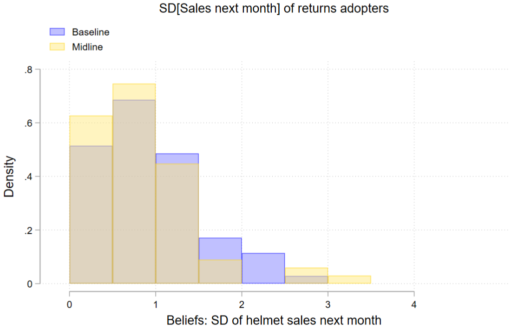
Phase one adopters do not become more optimistic Back

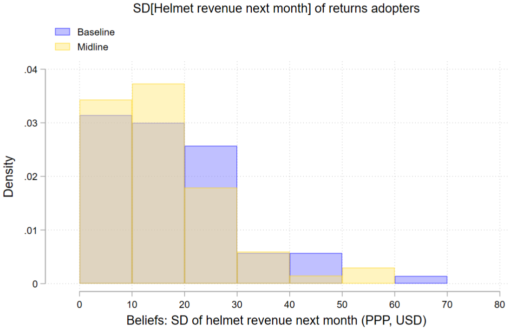




Phase one adopters beliefs are more precise Back

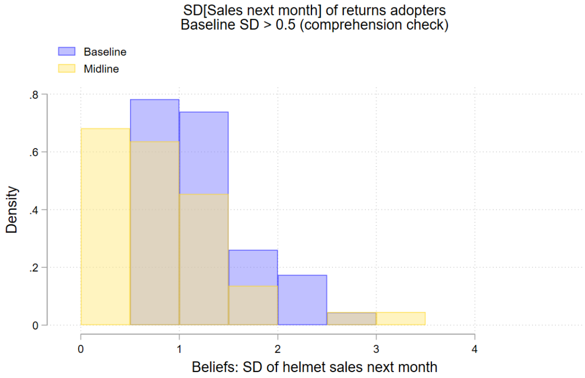
- Non-adopters: variance of beliefs increases by over 10% from baseline to midline
    - Higher volatility due to flooding
    - $\approx 1/3$ of respondents struggle to express variance through mechanism at baseline (creates jumps from ≈ 0 variance upwards as comprehension improves)





Phase one adopters beliefs are more precise Back

- Effects starker when screen for understanding
    - Drop observations where extremely low BL variance (e.g. all beans on 4 sales, or 19 on 4 and 1 on 5 since instrument prompted that they could place on multiple boxes)
    - Not the focus of analysis to avoid restricting on high prior variance, but illustrates collapsing uncertainty more clearly

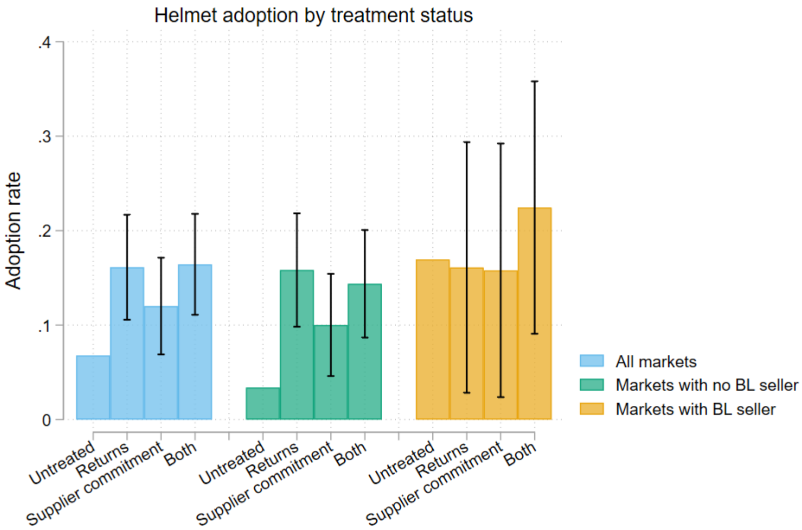


Example helmet

Back

Learning experiment: effects by pre-existing seller

Spillovers Stocking



Receiving info (even just below priors) $\uparrow$ stocking Back

	(1) Received any information	(2) Revenue Signal	(3) Revenue signal	(4) Sales signal	(5) Sales signal
1(Information treatment)	0.022**	0.030**	0.028**	0.029*	0.039**
	(0.009)	(0.015)	(0.014)	(0.017)	(0.017)
Signal > Expectation		-0.014		-0.011	
		(0.021)		(0.023)	
Signal > Median			-0.011		-0.030
			(0.017)		(0.018)
Expectation		-0.000		0.001	
		(0.000)		(0.003)	
Observations	727	722	727	722	727
Control mean	0.006	0.006	0.006	0.006	0.006
Controls	Yes	Yes	Yes	Yes	Yes

$* \; p < 0.1, \quad ** \; p < .05 \quad *** \; p < .01$

Robust standard errors in parenthesis. All estimates include controls for knowing of a helmet seller at midline, exposure to flooding at midline, and revenue in the month before treatment was delivered. Column 1 reports a regression estimating the effect of receiving sales information from 5 shops on stocking decisions. Columns 2-3 and 4-5 indicate whether shops that received information received positive or negative signals about revenues and profits. Columns 2 and 4 examine whether the signal exceeded the agent's priors, and columns 3 and 5 examine whether the signal was above the average. The mean signal value is an average of 3.8 sales, and the SD across signals is 1.2.

Do firms learn from each other? Conclusion

- Learning from one's own experience has a large effect on stocking
- Can firms also learn from other information sources, namely by observing neighbors?
  - Validates role of information
  - Candidate explanation for how risk averse firms survive competition

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- Three pieces of evidence indicate information externalities are important
  1. *Returns* have no effect when shops are located near an existing helmet seller at baseline Details
  2. Experimentally inducing a seller to enter a market → other shops more likely to stock Details
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- However, information only spreads about 3 city blocks
  - Rationalizes why helmets had not diffused after 2 years

How reliable are elicited beliefs? Back

If the belief measures and learning results are accurate, we would expect:

1. Beliefs about $\mathbb{E}[\text{sales}]$ from BL should modestly predict ML sales (uncertainty of beliefs is high)

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2. The elasticity of ML $\rightarrow$ EL sales wrt midline expectations should increase among phase 1 adopters
   - Uncertainty is lower, so outcomes should be closer to expectations
   - Empirically: η el sales-midline expectation $= 0.69, (p < .001, R^2 = 0.24)$ among phase one adopters
   - Pr(BL elasticity $=$ ML elasticity) $< .05$
3. Implies about an 80% reduction in Var(sales)
   - Details: estimate $sales_{it} = \alpha_t + \beta_t E[sales]_{it-1} + \epsilon_{it}$ at both times
   - $\beta_t = 1$ if no uncertainty
   - Estimated coefficient $.169 \rightarrow .544 \Rightarrow 83\%$ variance reduction (applying formula for attenuation bias)

Adopters get better at predicting sales (logs) Back

	log(Sales)		log(Revenue)	
	(1)	(2)	(3)	(4)
	BL $\rightarrow$ ML	ML $\rightarrow$ EL	BL $\rightarrow$ ML	ML $\rightarrow$ EL
log(Expectation at BL)	0.279**		0.239*	
	(0.122)		(0.131)	
log(Expectation at ML)		0.690***		0.364***
		(0.139)		(0.114)
Constant	0.921***	0.425***	3.298***	2.703***
	(0.184)	(0.139)	(0.587)	(0.463)
Observations	98	91	97	85
Adjusted R^2	0.045	0.239	0.028	0.099
Pr(η BL= η ML)		0.047		0.473

$* \; p < 0.1, \quad * * \; p < .05 \quad * * * \, p < .01$

Adopters get better at predicting sales (levels) Back

	Sales		Revenue	
	(1)	(2)	(3)	(4)
	BL → ML	ML → EL	BL → ML	ML → EL
Expectation at BL	0.169		0.199	
	(0.123)		(0.159)	
Expectation at ML		0.544***		0.463**
		(0.119)		(0.217)
Constant	3.229***	1.199***	67.270***	29.601**
	(0.603)	(0.431)	(16.052)	(14.219)
Observations	107	111	109	116
Adjusted R^2	0.011	0.179	0.007	0.073
Pr(η BL= η ML)		0.032		0.300

$* \ p < 0.1, \quad ** \ p < .05 \quad *** \ p < .01$

Observing a neighbor sell helmets ↑ stocking Back

	Motorcycle shops				All shops			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Know seller in market		Ordered helmets		Know seller in market		Ordered helmets	
Treated market	0.115*	0.133**	0.098***	0.104***	0.122**	0.143***	0.048**	0.059***
	(0.069)	(0.061)	(0.035)	(0.036)	(0.052)	(0.049)	(0.022)	(0.022)
Observations	376	376	376	376	665	665	665	665
Control mean	0.361	0.361	0.091	0.091	0.300	0.300	0.070	0.070
Controls	No	Yes	No	Yes	No	Yes	No	Yes

$* \ p < 0.1, \quad ** \ p < .05, \quad ***p < .01$

Standard errors in parenthesis clustered by market.

Firms free-ride off neighbors' experimentation Back

- Information spillovers → firms can avoid risk by waiting to observe a neighbor stock new products
- Do firms strategically under-experiment with new products to free-ride off neighbors?
  - Don't experiment → can still discover profitable products but don't bear risks
  - Do experiment → competitors observe successful discovery, enter and undercut profits

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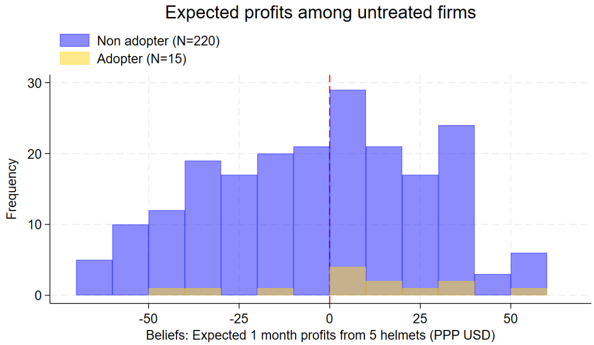
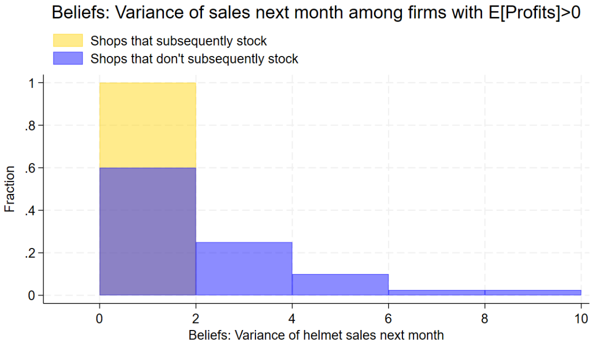
  - Don't experiment → can still discover profitable products but don't bear risks
  - Do experiment → competitors observe successful discovery, enter and undercut profits
- Patents are issues to protect intellectual property to protect new products
  - Don't protect discovering if a product is a fit
- Randomize across 283 markets in Burundi if a new product is offered **exclusively** to one retailer
  - Exclusive contract → **19 percentage point** (70%, $p < .001$) increase in the share of markets that stock
  - Ongoing work → welfare effects, trade-off between adoption and markups

Motivation: beliefs about expected helmet profits Back

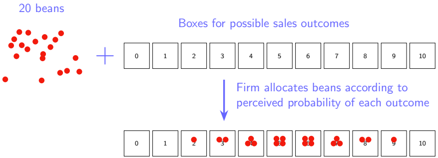


Motivation: variance of beliefs about sales Back



Eliciting firms' beliefs Back

1. Ask intended sales price if stock, give 20 beans + a sheet with boxes 0 to 10
2. Respondent allocates beans → boxes according to the likelihood of selling each #



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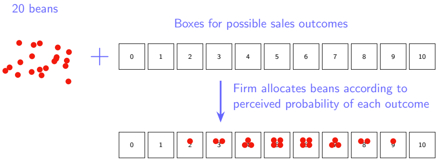

4. $\mathbb{E}[\text{sales}] = \sum_{x=0}^{10} \frac{1}{20} (\text{\# beans in box } x) \cdot x.$
   - Highly correlated with asking "how many sales do you expect to make" $(t > 18, R^2 = .49)$.

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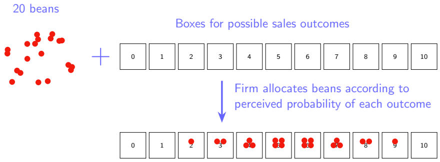

4. $\mathbb{E}[\text{sales}] = \sum_{x=0}^{10} \frac{1}{20} (\#\text{ beans in box } x) \cdot x.$
   - Highly correlated with asking "how many sales do you expect to make" $(t > 18, R^2 = .49)$.
5. $\text{Var}(\text{sales}) = \sum_{x=0}^{10} \frac{1}{20} (\#\text{ beans in box } x) \cdot (x - \mathbb{E}[\text{sales}])^2.$

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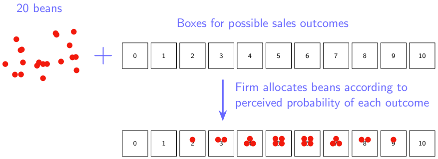

4. $\mathbb{E}[\text{sales}] = \sum_{x=0}^{10} \frac{1}{20} (\#\text{ beans in box } x) \cdot x.$
   - Highly correlated with asking "how many sales do you expect to make" $(t > 18, R^2 = .49)$.
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Eliciting firms' beliefs Back

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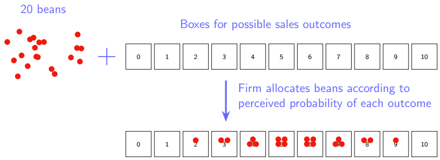

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     - → Keep all observations

Do firms learn from each other? Proposition

- Learning from one's own experience has a large effect on stocking
- Can firms acquire the same information from neighbors?
  - Distinct test of the mechanism
  - Helps rationalize why competition doesn't weed out risk averse firms
    - No spillovers: more risk averse firms less productive, driven out of business
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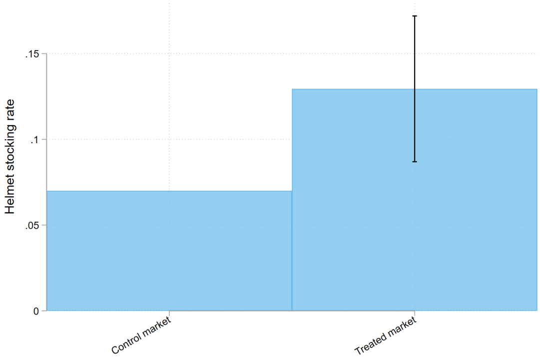
Observing a neighbor sell helmets ↑ stocking



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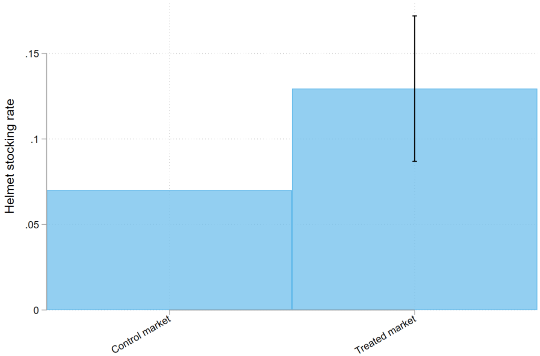
Conclusion Learning heterogeneity

Information treatment



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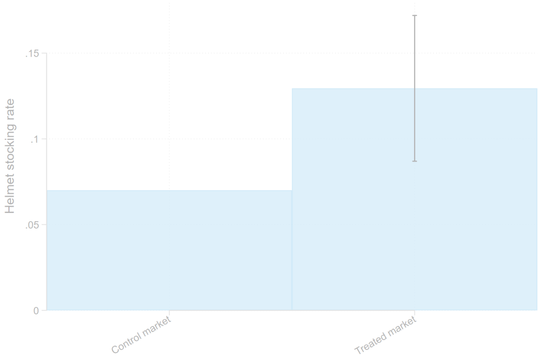

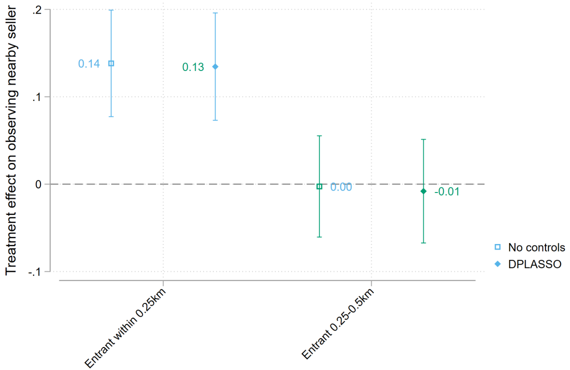

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  - **Nairobi: shops don't notice a seller outside of 0.25km (3 city blocks)**
- Spillovers may harm incentives for competitors to experiment (project in the field) Details

Learning setup Posteriors Back

- Agents begin with priors

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- Learning enters utility as lower future **regret**

$$R(y_t, \mathcal{I}_t, \Gamma, \theta) = V(\text{optimal incomplete info strategy}|\theta) - V^*(\text{optimal full info strategy}|\theta)$$

Control firms uncertain about demand stock less DPLASSO Back

Dependent variable: Stocked helmets

	(1) LPM	(2) Logit	(3) LPM
Returns	-0.032	0.290	0.232
	(0.077)	(1.339)	(0.185)
E[sales]	0.021	0.479	
	(0.015)	(0.311)	
$\sigma(sales)$	-0.052**	-0.933**	-0.053**
	(0.023)	(0.406)	(0.024)
Returns $\times$ E[sales]	0.013	-0.145	
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Returns $\times$ $\sigma(sales)$	0.058	0.984*	0.096**
	(0.055)	(0.586)	(0.048)
Observations	304	271	304
Control mean	0.068	0.068	0.068
Controls	Full	Full	Full
Expected Sale x Returns FEs	No	No	Yes

$* \, p < 0.1, \quad ** \, p < .05 \quad *** \, p < .01$

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Returns cause firms with uncertain priors to stock DPLASSO Back

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- *Returns* primarily affect shops with optimistic but uncertain beliefs
- Results similar without sample restriction to avoid censoring Details