

# Credit, Capital, and Firm Growth<sup>1</sup>

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<sup>1</sup>Material from this lecture is drawn from [Jeremy Magruder's UC Berkeley Microeconomics of Development course](#), from [Emily Breza and Supreet Kaur's AEA Continuing Education Development Economics course](#), and from the [Microfinance VoxDevLit](#).

# Outline

Firm growth

Access to credit

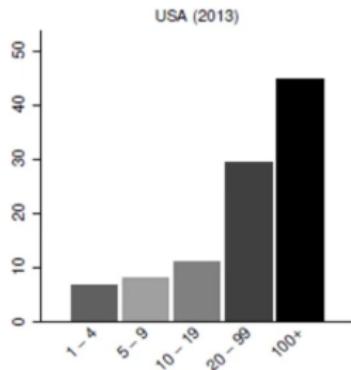
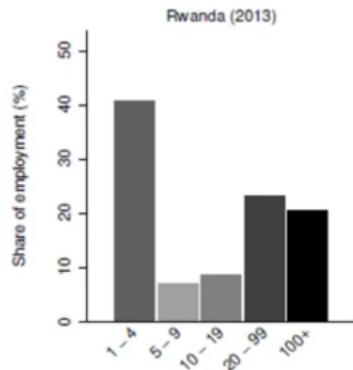
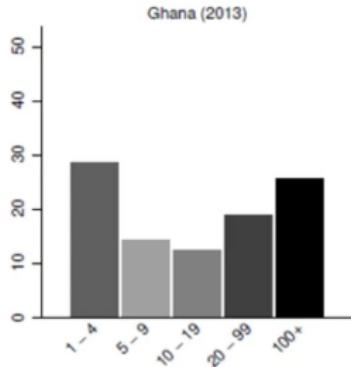
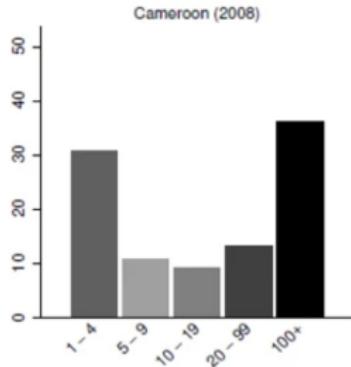
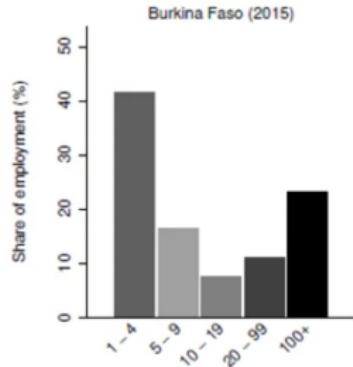
Student presentations

Setup: De Mel, McKenzie, & Woodruff (2008) and McKenzie (2017)

Results: De Mel, McKenzie, & Woodruff (2008) and McKenzie (2017)

Explaining high returns

# Stylized fact: missing "middle" of firms



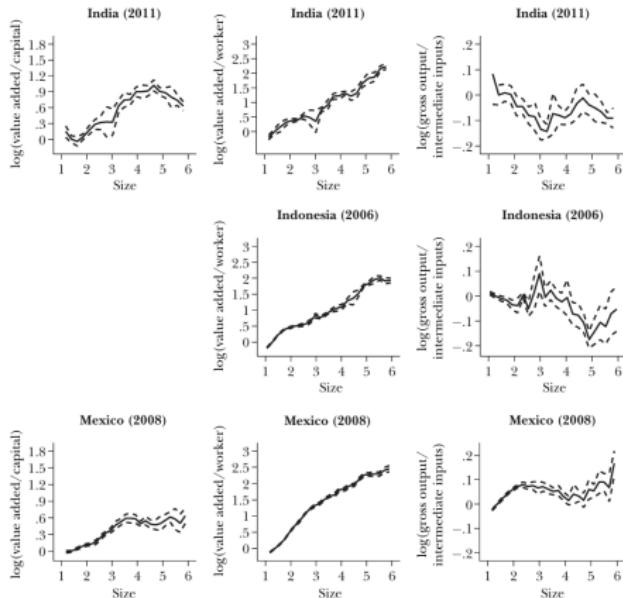
## Stylized fact: few large firms

<i>Firm Size (Employment)</i>	<i>India 2011</i>	<i>Indonesia 2006</i>	<i>Mexico 2008</i>
<i>Panel A: Distribution of Firm Size</i>			
1–9	97.88	96.78	91.74
10–49	1.85	2.83	5.85
50+	0.28	0.39	2.41
<i>Panel B: Distribution of Employment Share by Firm Size</i>			
1–9	64.77	53.95	22.45
10–49	12.10	12.04	10.55
50+	23.13	34.01	66.99

Source: Hsieh & Olken 2014

# Problem? Firm size and productivity

Figure 3  
Average Product and Firm Size  
(size measured as  $\log(\text{employment})$ )



Source: Hsieh & Olken 2014

Note: Some disagreements in empirical literature

# Thinking about firm growth

What does it mean for a firm to grow?

# Thinking about firm growth

What does it mean for a firm to grow?

- ▶ Produce more ⇒ increase inputs/improve technology
- ▶ Distinguish between **costs of acquiring vs using inputs**
  - ▶ *Capital*: acquisition costs would be things like building a factory or buying a machine, use costs would be operating the factory or machine (e.g., electricity, water, maintenance)
  - ▶ *Labor*: acquisition costs would be hiring, recruitment, and training, and use costs would be wages
  - ▶ *Technology*: acquisition costs would be R&D, patent costs, implementation, and use costs could be licensing fees, maintenance
- ▶ Acquiring inputs requires **investment**

# A simple model of firm investment

*Production* (usage)

$$\pi_t^{Op} = PF(L_t, K_t, A_t) - \underbrace{(wL_t + rK_t)}_{\text{Variable Costs}}$$

*Growth* (investment/acquisition)

$$I_t = P_L(L_t - L_{t-1}) + P_K(K_t - K_{t-1}) + P_A(A_t - A_{t-1})$$

*Financing/liquidity constraint*

$$I_t \leq \Pi_{t-1}^{Net} + B_t$$

What are **total net profits** at  $t$ ?

# A simple model of firm investment

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$$I_t \leq \Pi_{t-1}^{Net} + B_t$$

What are **total net profits** at  $t$ ?

$$\Pi_t^{Net} = \pi_t^{Op} - I_t - (1 + R)B_{t-1}$$

# Financing investment

$$I_t \leq \Pi_{t-1}^{Net} + B_t$$

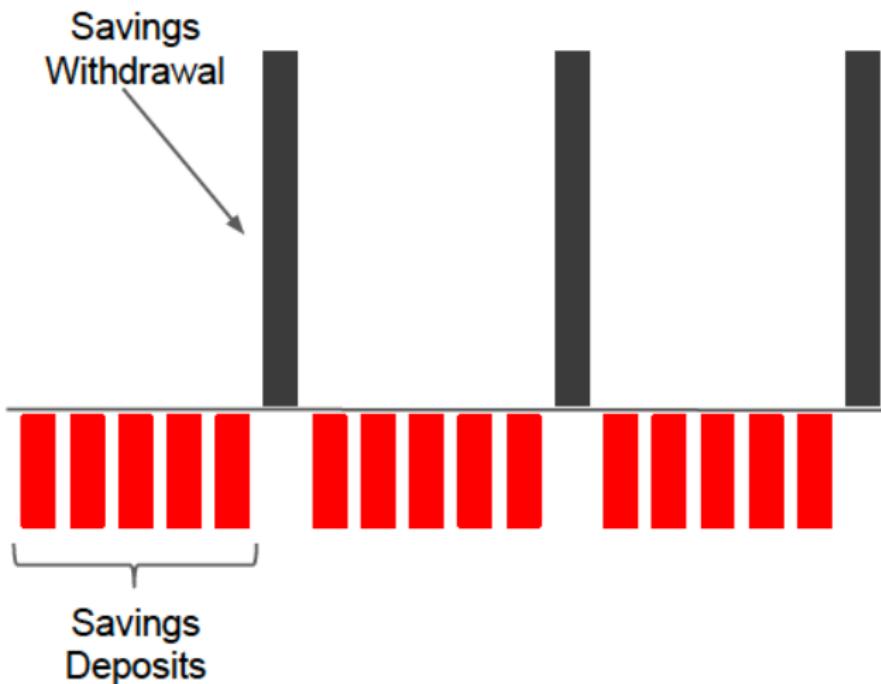
- ▶ How to finance investment  $I$ ?
- ▶ Either *save and reinvest* or *borrow*
- ▶ What are the tradeoffs?

# Financing investment

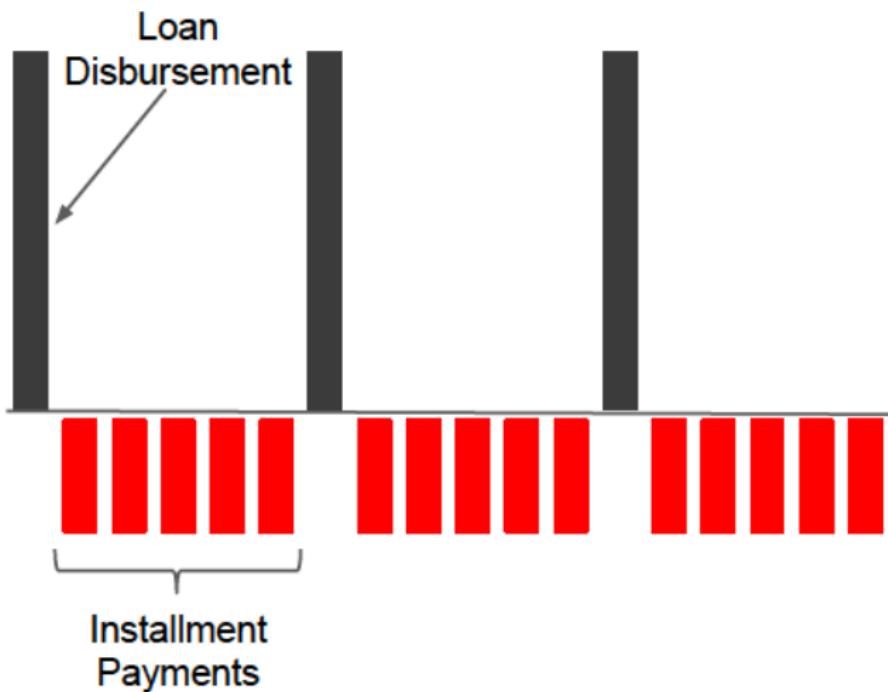
$$I_t \leq \Pi_{t-1}^{Net} + B_t$$

- ▶ How to finance investment  $I$ ?
- ▶ Either *save and reinvest* or *borrow*
- ▶ What are the tradeoffs?
- ▶ *Self-financing*: If  $B_t = 0$ , growth is capped by past performance
  - ▶ Even very productive firms must grow slowly
- ▶ *Credit access*: Borrowing allows faster growth but adds interest costs to  $\Pi_{t+1}$ 
  - ▶ Firm grows to its optimal scale immediately: it can finance any  $I_t$  where the marginal return exceeds the interest rate  $(1 + R)$
  - ▶ Potential repayment concerns if future profit uncertain
  - ▶ What if credit is constrained (generally or to new/small firms)?

Possible to accumulate resources through savings cycles



## Credit changes timing of payouts



Also: possibility to accumulate loans, subject to credit availability

# Saving vs. borrowing for household producers

In models with complete markets and no frictions, typically think of households as being either savers or borrowers, not both

- ▶ Consumption smoothing
  - ▶ Borrow when  $u'(c)$  high, save when  $u'(c)$  low
  - ▶ Never want to both save and borrow in a given period
- ▶ Profitable investments for household-producers
  - ▶ Have great investment opportunity: borrow to invest
  - ▶ Don't have an opportunity: save rather than invest
- ▶ Note that the two goals could be in conflict (as we have seen)
- ▶ What does credit/borrowing allow?
  - ▶ Consumption: overcome need for savings buffer, especially if there are savings constraints or shocks
  - ▶ Production: allow optimal investment right away rather than waiting to accumulate savings

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Explaining high returns

# Information barriers and market failures

- ▶ Classic **information asymmetries** plague credit markets
  - ▶ Adverse selection (hidden type)
  - ▶ Moral hazard (hidden action): e.g., effort under-provision, strategic default
- ▶ Typical solutions
  - ▶ Screening: due diligence, review financial statements, look up credit history
  - ▶ Monitoring: pay to monitor effort
  - ▶ Enforcement: claim collateral, garnish income
- ▶ **Problem:** all solutions are traditionally harder for formal banking sector in developing country contexts
  - ▶ Especially for small, informal firms
- ▶ Result: many poor populations don't live in places with perfect financial markets
  - ▶ Limited access, social taxation, social norms

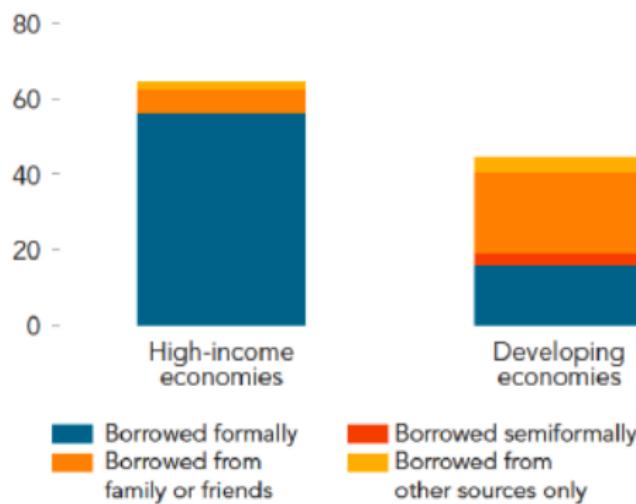
## Selected studies on these constraints

- ▶ Karlan & Ziman (2008 AER): strong evidence of moral hazard in borrowing
- ▶ Blouin & Macchiavello (2019 QJE): 50% of coffee mill defaults are strategic (break contract when world price  $>$  contract price)
- ▶ Rao (2022 WP): court inefficiencies in India suppress lending
- ▶ Ponticelli & Alancar (2016 QJE): bankruptcy reforms in Brazil increase supply of collateralized loans

# Implications for credit supply

The most common source of credit in high-income economies is formal borrowing—in developing economies, family or friends

Adults borrowing any money in the past year (%), 2017



Source: Global Findex database.

# Loan sources in developing countries

- ▶ Family and friends
- ▶ Banks: wealthier clients, larger loans, lower interest
  - ▶ Costs of monitoring and enforcement too high/uncertain with small/poor clients
- ▶ Saving and lending groups
  - ▶ Clearly prescribed rules and limitations on when can access loan, often limited amounts
- ▶ Moneylenders
  - ▶ Typically no collateral, very high interest, high monitoring
- ▶ Microfinance: a formal product reaching the unbanked
  - ▶ Typically small loans, collateral-free, basic screening, historically in a group structure, dynamic incentives
- ▶ Digital credit: for mobile money (MM) users
  - ▶ Adverse selection: operators observe call data and MM transactions
  - ▶ Moral hazard: can block account after default
  - ▶ Mainly small, short loans

# Selected studies on impacts of credit access

- ▶ Formal banking
  - ▶ Branch expansion ↓ poverty (Burgess & Pande 2005), improved health (Cramer 2023)
- ▶ Microcredit
  - ▶ No significant average effects of early microcredit interventions on business or household outcomes (Meager 2019), but heterogeneity
  - ▶ Helps smooth consumption and finance large lumpy purchases (Fink et al 2020, Burke et al 2019)
  - ▶ Aggregate welfare gains from access to microcredit are large (Loeser 2022, Kaboski & Townsend 2012)
  - ▶ Welfare losses from credit disruption (Breza & Kinnan 2021)
- ▶ Digital credit
  - ▶ Supports consumption smoothing (Bharadwaj et al 2019), but can accumulate high fees (Brailovskaya et al 2021)
  - ▶ Increases investment but limited downstream effects for farmers (Karlan et al 2024)

## Credit/capital and firm growth

- ▶ Broad policy interest in potential for credit to promote business growth
  - ▶ Particular interest in helping firms hire more workers
  - ▶ Major motivation of microfinance movement
- ▶ Evidence that some firms have high returns to credit/capital: existence of moneylenders, effects of credit among those that apply and receive
- ▶ Question: are returns high among broader populations of firms?
- ▶ Associated question: whose returns should we measure?
  - ▶ All small firms at time  $t$ ?
  - ▶ All small firms who demand credit at time  $t$ ?
  - ▶ All new (potential) small firms at time  $t$ ?
  - ▶ All long-tenured small firms at time  $t$ ?
- ▶ Different likely returns for each population  $\Rightarrow$  affects interpretation of studies on different groups

## Question: Would small firms benefit from receiving more credit or investment?

- ▶ Possibility for large returns if firms are small because of constraints to growth
- ▶ But possibility they are small because not productive
- ▶ Motivates research: what are the returns to capital/investment for small enterprises?
  - ▶ Goes beyond just credit 'access'
- ▶ Today: two papers studying this in Indonesia and Nigeria
  - ▶ Look at grants rather than loans, so "best-case" scenario for returns
- ▶ Look at two different populations of businesses:
  1. All existing (very) small firms
  2. A selection of young and 'potential' firms with potentially high returns

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## De Mel, McKenzie, & Woodruff (2008 QJE) sample

- ▶ Sample selection:
  1. Self-employed workers in Sri Lanka
  2. No paid employees ⇒ micro-enterprises; more or less hiring/growth potential?
  3. Did not work in agriculture, fishing, or professional services
  4. Under \$1000 in assets other than land or buildings; more or less hiring/growth potential?
- ▶ Baseline survey in April 2005; 8 additional quarterly waves through April 2007

TABLE I  
DESCRIPTIVE STATISTICS AND VERIFICATION OF RANDOMIZA

Baseline characteristic	Total number of observations in R1	Full sample	
		Mean	SD
Profits March 2005	391	3,851	3,289
Revenues March 2005	408	12,193	14,933
Total invested capital March 2005	408	146,441	224,512
Total invested capital excluding land and buildings March 2005	408	26,530	25,259
Own hours worked March 2005	408	52.6	22.3
Hours worked, unpaid family, March 2005	405	18.1	28.8
Age of entrepreneur	408	41.8	11.4
Age of firm in years	403	10.3	10.5
Proportion female	387	0.491	0.5
Years of schooling of entrepreneur	408	9.0	3.1
Proportion whose father was an entrepreneur	408	0.385	0.49
Proportion of firms that are registered	408	0.235	0.45
Number of household members working in wage jobs	408	0.7	0.83
Household asset index	408	0.276	1.610
Number of digits recalled in Digit Span Recall Test	370	5.9	1.23
Implied coefficient of relative risk aversion from lottery game	403	0.143	1.57

## DMW experiment

- ▶ 408 firms: 205 manufacturing, 203 retail
- ▶ Experiment: random allocation of firms to receive \$100 or \$200 in cash or in kind (business equipment/inventory)
  - ▶ \$100  $\approx$  10,000 LKSH  $\approx$  3 months profit
  - ▶ 124 firms treated after wave 1
  - ▶ Additional 104 firms after wave 2
  - ▶ Business chooses how in-kind grant used as long as a business purpose
  - ▶ No restrictions on how cash used (including non-business purpose)
- ▶ Outcomes: firm profits, assets, and investments

## McKenzie (2017 AER) sample

- ▶ Nigerian “firms”
  1. Young (< 40) citizens with internet access
  2. Filed a plan to create or expand a business that would employ Nigerians (YouWIN! competition)
  3. Primarily potential firms which do not yet exist
- ▶ Top 6000 (out of 24000) applicants invited to business training course
  - ▶ Refined business proposal, final ranking
- ▶ Data collection at baseline and 1, 2, and 3 years after application

# M2017 sample: dynamic potential firm founders

TABLE 1—BASELINE CHARACTERISTICS AND BALANCE OF EXPERIMENTAL SAMPLE

	Existing firms			New firms		
	Non-experimental winners	Treatment group	Control group	Non-experimental winners	Treatment group	Control group
<i>Applicant characteristics</i>						
Female	0.17	0.18	0.17	0.19	0.17	0.18
Age	32.5	32.0	31.8	30.1	29.3	29.6
Married	0.60	0.50	0.56	0.42	0.34	0.36
High school or lower	0.10	0.13	0.12	0.06	0.11	0.10
University education	0.71	0.63	0.67	0.79	0.69	0.71
Postgraduate education	0.12	0.08	0.12	0.13	0.05	0.06
Lived abroad	0.14	0.10	0.11	0.18	0.06	0.09
Choose risky option	0.59	0.56	0.52	0.63	0.57	0.55
Have internet access at home	0.68	0.57	0.61	0.60	0.47	0.48
Own a computer	0.94	0.87	0.88	0.92	0.84	0.86
Satellite dish at home	0.74	0.67	0.71	0.64	0.68	0.64
Freezer at home	0.64	0.57	0.61	0.63	0.51	0.55

## M2017 experiment

- ▶ Business plans sorted into top echelon (received grant); (small) bottom echelon (ineligible); (large) middle echelon (randomized into grant receipt)
  - ▶ Ranking focused on market, management skills, business experience, risks and financing needs, and job creation and cash flow prospects
- ▶ Stratification on gender, region, existing business ownership
- ▶ Around 2/3 new firms, 1/3 existing
- ▶ Grants up to **\$64000** paid out in 4 tranche payments
  - ▶ Compare to average incomes around \$1700
  - ▶ Conditionalities on employment and sales for tranche 3 and 4
  - ▶ Average total payment around \$50,000 (conditions designed to be achievable)
- ▶ Outcomes: survival, hours, profits, employment

# Profit measurement

- ▶ Big issue in firm studies: profits are hard to measure
- ▶ DeMel, McKenzie, Woodruff (JDE, 2009): ask directly
  - ▶ "What was the total income the business earned during XXX after paying all expenses including the wages of employees, but not including any income you paid yourself. That is, what were the profits of your business in XXX?"
- ▶ Find that self-reported profits track externally-measured profits more closely than profits based on estimates of revenues and expenses
- ▶ Profit data are very noisy: how to treat outliers?
  - ▶ DMW: omit top, bottom 0.5% of outliers
  - ▶ M: omit top, bottom 1%
- ▶ Difficult to reconcile measurement error with important and large fluctuations
  - ▶ 0 (or negative) profits may be a mistake
  - ▶ But if real, that impacts estimates of returns to capital

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## Empirical specifications

DMW (2008):  $g$  in-kind vs cash and wave 1 vs wave 2

$$Y_{it} = \alpha + \sum_{g=1}^4 \beta_g Treatment_{git} + \delta_t + \lambda_i + \epsilon_{it}$$

$$Y_{it} = \alpha + \beta LKR_{it} + \delta_t + \lambda_i + \epsilon_{it}$$

M (2017): separate regressions for each period

$$Y_i = \alpha + \beta Treatment_i + \gamma Region_i \times Gender_i + \epsilon_i$$

# DMW impacts

TABLE II  
EFFECT OF TREATMENTS ON OUTCOMES

Impact of treatment amount on:	Capital stock (1)	Log capital stock (2)	Real profits (3)	Log real profits (4)	Owner hours worked (5)
10,000 LKR in-kind	4,793* (2,714)	0.40*** (0.077)	186 (387)	0.10 (0.089)	6.06** (2.86)
20,000 LKR in-kind	13,167*** (3,773)	0.71*** (0.169)	1,022* (592)	0.21* (0.115)	-0.57 (3.41)
10,000 LKR cash	10,781** (5,139)	0.23** (0.103)	1,421*** (493)	0.15* (0.080)	4.52* (2.54)
20,000 LKR cash	23,431*** (6,686)	0.53*** (0.111)	775* (643)	0.21* (0.109)	2.37 (3.26)
Number of enterprises	385	385	385	385	385
Number of observations	3,155	3,155	3,248	3,248	3,378

# DMW impacts: Profits

Summary stats

TABLE III  
POOLING OF TREATMENT EFFECTS (DEPENDENT VARIABLE: REAL PROFITS)

	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE
Treatment amount	5.68*** (2.18)	5.41*** (2.09)				
Treatment amount × being 1–4 quarters posttreatment			5.47** (2.08)			
Treatment amount × being 5–8 quarters posttreatment				4.88* (2.85)		
In-kind treatment amount					4.17 (2.58)	
Cash treatment amount						6.70** (2.81)
Treated amount 10,000 LKR						7.65** (3.31)
Treated amount 20,000 LKR						8.95* (4.53)
Treatment amount × coastal zone (tsunami affected)						9.08** (4.36)
Treatment amount × near-coastal zone						5.10** (2.38)
Treatment amount × inland zone						5.34 (3.88)

# DMW returns to capital: 4-6% monthly

Instrument capital stock with grant amount: estimates average returns to capital weighed by business investment

TABLE IV  
INSTRUMENTAL VARIABLE REGRESSIONS MEASURING RETURN TO CAPITAL FROM EXPERIMENT

	Real profits IV-FE (1)	Log real profits IV-FE (2)	Real profits 4 instruments (3)	Real profits adjusted (1) IV-FE (4)	Real profits adjusted (2) IV-FE (5)
Capital stock/log capital stock (excluding land & buildings)	5.85** (2.34)	0.379*** (0.121)	5.16** (2.26)	5.29** (2.28)	4.59** (2.29)
First-stage					
Coefficient on treatment amount	0.91***	0.33***		0.91***	0.91***
F statistic	27.81	49.26	6.79	27.81	27.81
Observations	3,101	3,101	3,101	3,101	3,101
Number of enterprises	384	384	384	384	384

# McKenzie 2017 impacts: survival

TABLE 2—IMPACT ON START-UP AND SURVIVAL

	Operates a firm at time of survey			Weekly hours worked in self-employment		
	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
<i>Panel A. New firms</i>						
Experimental treatment effect	0.215 (0.029)	0.359 (0.023)	0.373 (0.024)	13.538 (1.961)	21.699 (1.704)	19.526 (1.748)
Sample size	1,021	1,181	1,085	993	1,071	927
Control mean	0.550	0.569	0.540	24.9	23.9	19.4
<i>Panel B. Existing firms</i>						
Experimental treatment effect	0.083 (0.027)	0.130 (0.025)	0.195 (0.031)	9.058 (2.653)	8.643 (2.552)	11.687 (2.492)
Sample size	432	505	477	423	458	409
Control mean	0.871	0.844	0.759	43.3	40.9	31.6

*Notes:* Robust standard errors in parentheses. Existing and new refers to firm status at time of application. Rounds 1, 2, and 3 are 1, 2, and 3 years after application. Regressions control for randomization strata.

# McKenzie 2017 impacts: profits

TABLE 4—IMPACTS ON BUSINESS SALES AND PROFITS

	New firms				Existing firms			
	Truncated sales	Truncated profits	Inverse hyperbolic sine profits	Aggregate index of sales and profits	Truncated sales	Truncated profits	Inverse hyperbolic sine profits	Aggregate index of sales and profits
<i>Experimental impacts</i>								
First follow-up	36.160 (49.884)	-24.512 (26.330)	2.156 (0.369)	0.016 (0.047)	50.805 (85.662)	0.074 (49.416)	0.972 (0.373)	0.080 (0.070)
Second follow-up	297.783 (56.494)	69.061 (15.150)	4.154 (0.326)	0.298 (0.036)	346.304 (134.728)	69.234 (35.420)	2.183 (0.401)	0.237 (0.060)
Third follow-up	64.541 (92.338)	20.137 (21.635)	3.962 (0.346)	0.167 (0.042)	349.228 (143.729)	32.035 (40.956)	2.580 (0.464)	0.211 (0.070)
Control mean: first follow-up	271.467	167.705	6.583	-0.005	509.699	257.025	10.772	-0.045
Control mean: second follow-up	278.177	91.061	6.161	-0.096	660.535	206.305	9.646	-0.117
Control mean: third follow-up	438.490	114.099	5.775	-0.050	509.975	192.151	8.565	-0.108
Sample size: first follow-up	995	995	995	995	423	423	423	423
Sample size: second follow-up	1,151	1,150	1,150	1,152	497	497	497	497
Sample size: third follow-up	1,063	1,063	1,063	1,063	468	469	469	470

- ▶ Concern for non-survival: is counterfactual ‘profit’ a wage salary?
- ▶ Effects relative to grant size?

# McKenzie 2017 impacts: employment

TABLE 3—IMPACT ON EMPLOYMENT AND INNOVATION

	Own employment	Total employment	Firm of 10+ workers	Firm of 25+ workers	Innovation index
<i>Panel A. New firms</i>					
First follow-up	0.074 (0.025)	1.426 (0.732)	0.024 (0.020)	0.007 (0.008)	0.099 (0.019)
Second follow-up	0.128 (0.017)	6.012 (0.412)	0.288 (0.026)	0.022 (0.009)	0.270 (0.018)
Third follow-up	0.119 (0.018)	5.227 (0.469)	0.229 (0.028)	0.025 (0.011)	0.219 (0.019)
Control mean: first follow-up	0.787	3.618	0.083	0.010	0.225
Control mean: second follow-up	0.841	3.305	0.088	0.009	0.214
Control mean: third follow-up	0.831	3.773	0.114	0.014	0.181
Sample size: first follow-up	1,021	987	987	987	995
Sample size: second follow-up	1,181	1,159	1,159	1,159	1,071
Sample size: third follow-up	1,085	1,044	1,044	1,044	927
<i>Panel B. Existing firms</i>					
First follow-up	0.047 (0.019)	1.512 (0.795)	0.057 (0.041)	0.007 (0.019)	0.105 (0.029)
Second follow-up	0.066 (0.018)	2.556 (1.388)	0.215 (0.041)	0.009 (0.018)	0.126 (0.028)
Third follow-up	0.070 (0.022)	4.425 (0.673)	0.208 (0.040)	0.028 (0.015)	0.141 (0.029)
Control mean: first follow-up	0.938	6.852	0.212	0.032	0.390
Control mean: second follow-up	0.922	8.134	0.231	0.038	0.407
Control mean: third follow-up	0.906	5.571	0.170	0.014	0.341
Sample size: first follow-up	432	422	422	422	423
Sample size: second follow-up	505	500	500	500	458
Sample size: third follow-up	477	461	461	461	409

~50% of employment effects driven by firm survival

# McKenzie 2017 returns to capital: 1-3% monthly

## Instrument capital stock with treatment assignment: assumptions?

TABLE 6—ESTIMATED MONTHLY REAL RETURN ON CAPITAL

	New firms		Existing firms	
	Round 2	Round 3	Round 2	Round 3
<i>Panel A. Levels specification: real monthly profits (truncated at 99th percentile)</i>				
Capital stock (truncated at 99th percentile)	0.017 (0.003)	0.013 (0.005)	0.023 (0.010)	0.004 (0.010)
<i>Panel B. logs specification: log (real monthly profits + 1)</i>				
log (capital stock + 1)	0.410 (0.026)	0.423 (0.030)	0.446 (0.057)	0.411 (0.052)
Implied monthly real return (percent)	3.03	3.38	3.34	2.45
Sample size	956	806	381	331

*Notes:* Robust standard errors in parentheses. Capital stock is instrumented by assignment to treatment. Implied monthly return for log specification estimated at median profit to capital ratio.

# Outline

Firm growth

Access to credit

Student presentations

Setup: De Mel, McKenzie, & Woodruff (2008) and McKenzie (2017)

Results: De Mel, McKenzie, & Woodruff (2008) and McKenzie (2017)

Explaining high returns

## Why is the return to capital so high?

- ▶ Returns of 4-6% per month in Indonesia and 1-3% per month in Nigeria
- ▶ Must there be a constraint? Why?

# Why is the return to capital so high?

- ▶ Returns of 4-6% per month in Indonesia and 1-3% per month in Nigeria
- ▶ Must there be a constraint? Why?
  - ▶ If the returns are so high, investments should already have been made by optimizing firms
  - ▶ McKenzie: “The impacts are not consistent with a model of no market failures in which the grants would be predicted to increase the incomes of the business owners without changing their production decisions.”
- ▶ We have seen that many different constraints can lead to reduced business investment
- ▶ How can we understand what constraints are important here?
- ▶ DMW propose a model to motivate heterogeneity tests that would suggest different explanations
  - ▶ Run tests by interacting treatment amount and time FE with given characteristics

# A simple model

$$\max_c \quad E[U(c)] \text{ s.t.}$$

$$c = \varepsilon f(K; \theta) - rK + r(A - A_k) + nw - I_k$$

$$K \leq A_k + I_k + B \quad (\lambda)$$

$$B \leq \bar{B} \quad (\mu_B)$$

$$A_k \leq A \quad (\mu_A)$$

$$I_k \leq nw \quad (\mu_I)$$

## FOC w.r.t. $K$

$$E[U'(c)(\epsilon f'(K; \theta) - r)] = \lambda$$

$$f'(K; \theta)E[U'(c)\epsilon] = \lambda + rE[U'(c)]$$

$$f'(K; \theta) = \frac{[r + \frac{\lambda}{E[U'(c)]}]E[U'(c)]}{cov(U'(c), \epsilon) + E[U'(c)]E[\epsilon]}$$

$$f'(K; \theta) = \left[ r + \frac{\lambda}{E[U'(c)]} \right] \frac{1}{1 + \frac{cov(U'(c), \epsilon)}{E[U'(c)]}}$$

With perfect credit and insurance markets, collapses to  $f'(K; \theta) = r$

- ▶ In this case: same returns to capital for all firms (controlling for  $\theta$  and industry)  $\Rightarrow$  no heterogeneity

## Perfect insurance but credit constraints

- ▶ With perfect insurance, can smooth consumption across states
- ▶ ⇒ don't have to worry about  $\varepsilon$ , base decisions just on  $E[\varepsilon] = 1$
- ▶ FOCs:

$$U'(c)[f'(K, \theta) - r] = \lambda$$

$$\lambda = \mu_B = \mu_A + r = \mu_I + 1$$

- ▶ Who is more likely to be constrained by the various multipliers?  
Look for heterogeneity on these dimensions
  - ▶  $B \leq \bar{B}$  ( $\mu_B$ ),  $A_k \leq A$  ( $\mu_A$ ): poorer households
  - ▶  $I_k \leq nw$  ( $\mu_I$ ): smaller households
  - ▶ If  $\theta$  and  $K$  are complements: more able households

# What if there are only risk constraints?

How does the original FOC change?

# What if there are only risk constraints?

How does the original FOC change?

$$f'(K; \theta) = \left[ r + \frac{\lambda}{E[U'(c)]} \right] \frac{1}{1 + \frac{\text{cov}(U'(c), \epsilon)}{E[U'(c)]}}$$
$$f'(K; \theta) = \frac{r}{1 + \frac{\text{cov}(U'(c), \epsilon)}{E[U'(c)]}}$$

- ▶  $\text{cov}(U'(c), \epsilon) < 0 \Rightarrow f'(K; \theta) > r$
- ▶ Implication: underinvest when income is riskier ( $\epsilon$ )
- ▶ Suggests tests of heterogeneity in returns to capital by entrepreneur risk aversion, (perceived) riskiness of income

# Heterogeneity tests

TABLE V  
TREATMENT EFFECT HETEROGENEITY (DEPENDENT VARIABLE: REAL PROFITS)

	(1)	(2)	(3)	(4)	Females	Males
	FE	FE	FE	FE	FE	FE
Treatment amount	5.41*** (2.09)	7.35** (2.86)	5.29*** (2.15)	4.96** (2.19)	2.83 (2.39)	6.74** (3.09)
<i>Interaction of treatment amount with:</i>						
Female owner		-7.51* (4.02)				
Number of wage workers			-3.69 (2.38)			
Household asset index				-2.43** (1.14)	-2.88** (1.35)	-3.05 (2.06)
Years of education				1.56*** (0.59)	0.24 (0.78)	2.03** (0.82)
Digit Span Recall				3.80** (1.88)	7.34*** (2.32)	1.84 (2.80)
Risk aversion					0.54 (1.25)	
Uncertainty					-7.82 (7.31)	
Constant	3,824*** (174)	3,777*** (179)	3,823*** (175)	3,840*** (174)	2,860*** (211)	4,700 (283)
Firm-period observations	3,248	3,084	3,149	3,218	1,484	1,510
Number of enterprises	385	365	369	381	174	176

## Interpreting heterogeneity tests

- ▶ Do we believe these tests?
- ▶ Different business types likely correlated with these characteristics
- ▶ Characteristics may also be correlated with different constraints
  - ▶ E.g., bigger households have more insurance constraints
  - ▶ E.g., more able entrepreneurs have lower insurance constraints
- ▶ Concerns about measurement of ability, risk aversion, uncertainty
- ▶ But suggestive of importance of credit constraints in this context
- ▶ Heterogeneity may also explain lack of formal lending: high variance in returns and many with negative returns
  - ▶ Results suggests screening for ability may be helpful

# Conclusions

- ▶ Returns to capital are quite large
  - ▶ For poor, long-run micro-entrepreneurs in Sri Lanka receiving small(er) grants
  - ▶ For well-off, prospective entrepreneurs in Nigeria receiving very large grants
- ▶ Additional questions:
  - ▶ Why no compounding of effects? Similar effects over time in both samples
    - ▶ Entrepreneurs could save profits to reinvest
  - ▶ What drives the gender differences?
  - ▶ Spillovers? Evidence of negative spillovers in DMW