Microequity and Mutuality: Experimental Evidence on Credit with Performance-Contingent Repayment

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Productive assets and performance-contingent financing

Fixed asset investments often come with **high expected returns** but also **increased risk** (Field, Pande, Papp and Rigol, 2013).

Equity-like contracts may provide a more appropriate level of **risk-sharing** than more rigid debt contracts, but are challenging to implement due to costly state verification (Townsend, 1979). Most small firms in low-income countries only have access to rigid microcredit contracts.

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'FinTech' firms in high-income countries are increasingly using high-quality administrative to provide such performance-contingent financing to small firms.

We explore whether large firms can leverage high-quality administrative data to provide novel performance-contingent microfinance for productive assets.

Multinationals and performance-contingent financing

Many large multinational firms operate **'route-to-market'** programmes in developing countries, utilising a network of small firms and informal workers, who often rely on this large supplier for a significant share of their income.

In many such cases, suppliers have:

1. (Increasingly) detailed **data** on sales; and
2. A direct interest in increasing the distribution of their product, which can be facilitated with a **productive business asset** for the worker (e.g. a transportation asset).

Setting: **Micro-distributors** and food supply chains

We implement a **field experiment** within one of the world's largest manufacturers of food products (and owners of a large chewing gum producer in Kenya).

Like UberEats, Deliveroo, GoJek and many other companies around the world, 'FoodCo' relies in Kenya on a **network of micro-distributors**: individuals who provide route-to-market services, moving product from a stock-point to customers.

Microdistributors within FoodCo's programme need to transport large amounts of stock, and often do so **on foot**.

Setting: **Asset financing in the supply chain**

Our setting has several key characteristics that are ideal for testing the viability of performance-contingent financing:

1. High expected return to a **lumpy fixed investment**;
2. **Excellent administrative data on purchases**, on which to base a performance-contingent contract;
3. Sales of an **homogeneous good with predictable mark-up**.

Setting: **Asset financing in the supply chain**

We partner with a local microfinance institution (MFI) to finance **bicycles**.

We test the effectiveness of several **alternative microfinance contracts** designed to allow micro-distributors to purchase the lumpy fixed asset. Our collaboration allows us to design novel financial contracts that utilise FoodCo's **administrative data** to link payments to performance.

Preview of results

- We find **large positive impacts** of the performance-contingent contracts, particularly on business profits. The largest impacts come from a **hybrid** contract that combines debt- and equity-like features.

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- We find **large positive impacts** of the performance-contingent contracts, particularly on business profits. The largest impacts come from a **hybrid** contract that combines debt- and equity-like features.

- We use a simple conceptual framework to understand mechanisms. In the model, greater **effort** leads to greater **risk**, and performance-contingent contracts can **mitigate this effect** in selling the product that is being 'taxed'.

  (This adds a caveat to the **usual narrative** about sharecropping (Holmström, 1979; Burchardi et al, 2019).)

Related literature: **Supply chain finance in developing countries**

Large multinationals increasingly have programmes in developing countries that use low-income **sellers** to distribute both consumer goods and durables (Roll, 2020).

There is relatively little academic literature on supply chain financing in developing countries, despite the significant potential **mutual benefits** for host firms and workers. Other literature emphasises strong theoretical justifications for suppliers acting as financial intermediaries – due to their comparative advantage in assessing the client performance and creditworthiness, and their ability to use informal means for getting repayment (e.g. threat to cut future supplies) (Beck et al., 2015; Breitbach, 2017; Breza & Liberman, 2017; Casaburi & Reed, 2020; Jack, Kremer, de Laat and Suri, 2021; Klapper et. al, 2012; Macchiavello & Morjaria, 2015, 2021; Maksimovic & Demirguc-Kunt, 2001; Mian & Smith Jr, 1992; Petersen & Rajan, 1997; Prahalad & Hammond, 2002).

Related literature: **Designing better microfinance contracts**

Despite aggregate evidence for the importance of finance for small firm growth (Beck et al, 2005) and evidence of **high returns to capital** among microenterprises (De Mel et al, 2008), the first wave of microcredit evaluations found limited impacts of the standard rigid contract (Banerjee, Karlan and Zinman, 2015).

Contractual innovations have been shown to improve the effectiveness of microcredit contracts, for example by allowing repayment flexibility with grace periods for graduated borrowers (Field et al., 2013; Battaglia, Gulesci, & Madestam, 2021; Barboni & Agarwal, 2021).

Developments in financial technology potentially improve the contracting space (Higgins, 2019; Suri, 2017; Beck et al, 2018).

Related literature: **Equity-like financing for productive assets**

Equity-like contracts have the potential to incentivise **greater risk-taking** than standard debt contracts through their implicit insurance (Fischer, 2013).

However, they potentially introduce a number of problems due to **costly state verification**, **adverse selection and moral hazard**, and **legal enforcement of ownership claims** for small businesses in environments of limited enforcement and court systems (Townsend, 1979; de Mel, McKenzie, and Woodruff, 2019).

In our experiment, we make no attempt to own shares in the **microenterprises** – we focus instead on sharing claims to **the income stream**, designing performance-contingent contracts based on a credible observable measure of **gross** profit (sales minus the main cost of goods sold).

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1. Introduction
2. Setting and design
3. Take-up
4. Impacts
5. Conceptual framework

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Route-to-market programme incentive structure

Micro-distributors initially purchase the gum at a **discount** to the market price, with the margin varying for six different products. For every bag of gum that they sell, they receive an end-of-month **bonus** via M-Pesa.

There is no obligation for them to sell gum exclusively, but selling FoodCo's product is easy to transport and **profitable**.

Our intervention

On the basis of feedback from FoodCo and interviews with micro-distributors, it was clear that bicycle access could substantially improve incomes.

Many micro-distributors, particularly women, had complained of **back problems** from carrying large bags for their distribution work, so bicycles could also be beneficial from a health and welfare perspective (Muralidharan and Prakash, 2017; Fiala et al, 2022).

However, good-quality work-appropriate bicycles are often too **expensive** for this population.

Our sample consists of micro-distributors who had been involved in the programme for some time and expressed interest in a bicycle.

Choice of bicycles

Four microfinance contracts

We randomly offered four different contracts, with each providing 90% financing and requiring a 10% deposit.

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For the **control group**, it was '**business as usual**' and no contract offer.

Data

Between 2016 and 2020, an average of 478 micro-distributors per month were active sellers in FoodCo's micro-distribution programme.

We have **daily administrative data on purchases** (from which we can calculate a non-self-reported measure of gross profits) for 1,727 unique micro-distributors over the period, which we use for our spillover regressions.

The actual experiment involved 161 micro-distributors who expressed an interest in expanding their business with the purchase of a bicycle.

Data

For the experimental sample, the average age was 31, 15% female, 20% had a post-secondary education. In the three months prior to the baseline survey, their mean **profits** were $133 (median $107). Focusing just on profits from FoodCo products (**administrative data**), the average was $53 (median $34).

Very few had any business employees (mean 0.16, median 0). 26% of microdistributors also had a separate form of **income** (casual labour / wage job). Total household income was $198 on average (median $142), and total household expenditure was $196 on average (median $174).

Baseline balance

Baseline workshops and contract assignment

Micro-distributors from across Kenya – all of whom had had expressed an interest in a bicycle – attended a baseline **workshop**, where they completed a household survey and behavioural games.

There, they were introduced to the different microfinance contracts that were available to finance the bike purchase.

We offered one of the contracts using a **public randomisation** (drawing a ball from a bag). Individuals offered a contract that they accepted chose a bicycle from a **menu** (the average bike price was just under $100) and signed a contract with the **MFI** (which provided the financing and bore the contract risk / responsibility for collecting payment via MPesa).

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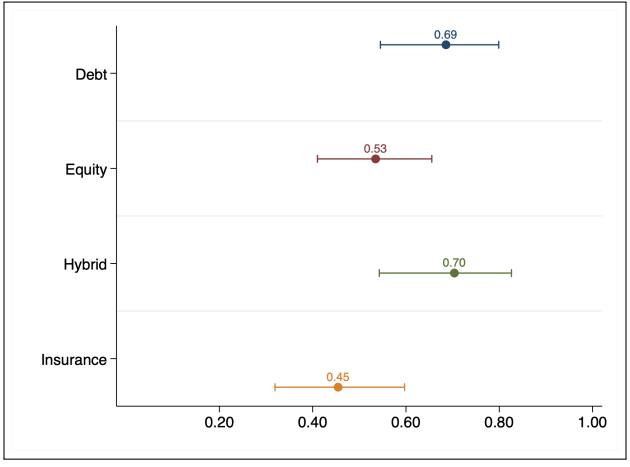
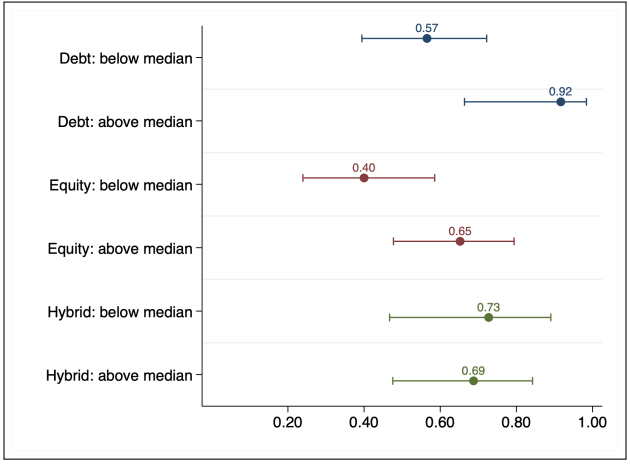
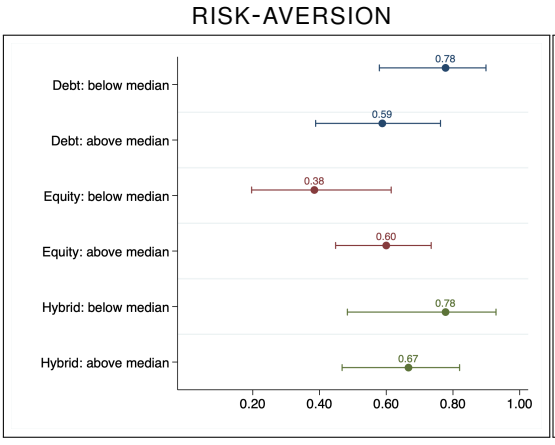
Contract take-up

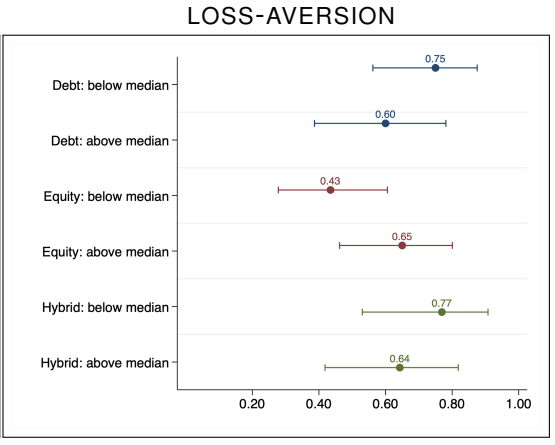


Take-up heterogeneity: baseline profits (FoodCo admin data)



Take-up heterogeneity: risk preferences





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Treatment effects

For the primary outcome (administrative data on stock purchases, from which we calculate gross profits), we construct a **monthly panel** (from daily data), and for all other variables we use **quarterly** follow-up surveys. We estimate an intent-to-treat ANCOVA specification:

$$y_{it} = \beta_0 + \sum_{k \in \{1,\ldots,4\}} \beta_k \cdot \texttt{Offered}_{ik} + \gamma \cdot y_{i0} + \varepsilon_{it}.$$

$\texttt{Offered}_{ik}$ is a dummy for whether individual i had contract k randomly drawn, y_{i0} is the baseline value for outcome y. We cluster at the individual level throughout (and results are robust to using randomisation inference).

Positive impacts on effort and profits, especially for hybrid contract

	(1) Stockpoint visits	(2) Stockpoint visits	(3) Sales expansion	(4) Sales expansion	(5) Profits: Foodco	(6) Poisson regression	(7) Profits: Foodco	(8) Other earnings	(9) Other earnings
Any contract (ITT)	1.49*		0.16**		813**	0.67**		446	
	(0.882)		(0.071)		(380)	(0.310)		(1,029)	
Any contract (LATE)		2.28*		0.27**			1,221**		755
		(1.345)		(0.121)			(560)		(1,731)
Debt (ITT)	1.41		0.10		583	0.28		1,127	
	(1.113)		(0.082)		(432)	(0.423)		(1,362)	
Hybrid (ITT)	2.88*		0.19**		1,496**	1.10***		-339	
	(1.499)		(0.090)		(6,090)	(0.354)		(1,192)	
RevShare (ITT)	1.32		0.13		787*	0.69*		321	
	(0.998)		(0.087)		(441)	(0.366)		(1,113)	
Index (ITT)	0.29		0.22***		279	0.43		499	
	(1.137)		(0.076)		(440)	(0.357)		(1,349)	
Debt (LATE)		1.85		0.14			771		1,599
		(1.466)		(0.117)			(566)		(1,952)
Hybrid (LATE)		3.72*		0.26**			1,920**		-454
		(1.955)		(0.126)			(819)		(1,584)
RevShare (LATE)		2.21		0.26			1,314*		600
		(1.677)		(0.170)			(691)		(2,117)
Index (LATE)		0.58		0.46***			532		1,036
		(2.167)		(0.179)			(816)		(2,815)
Observations	2888	2888	468	468	2,888	2,888	2,888	468	468
Individuals	161	161	160	160	161	161	161	160	160
Timeframe	1m-36m	1m-36m	1m-12m	1m-12m	1m-36m	1m-36m	1m-36m	1m-12m	1m-12m
Control mean	2.57	2.57	0.58	0.58	897	897	897	6,088	6,088

Treatment effects are stable over time, and Hybrid outperforms

	(1) Profits: Foodco	(2) Profits: Foodco	(3) Profits: Foodco	(4) Profits: Foodco	(5) Poisson regression	(6) Poisson regression	(7) Poisson regression	(8) Poisson regression
Debt	718**	341	74	5,830	0.09	0.50	0.16	0.28
	(345)	(393)	(577)	(432)	(0.305)	(0.483)	(0.813)	(0.423)
Hybrid	1,601***	1,764***	1,330*	1,496**	0.89***	1.30***	1.10*	1.10***
	(500)	(620)	(680)	(6,090)	(0.261)	(0.436)	(0.567)	(0.354)
RevShare	495	675	718	787*	0.28	0.78*	0.77	0.69*
	(363)	(426)	(558)	(441)	(0.291)	(0.443)	(0.587)	(0.366)
Index	58	336	-15	279	0.17	0.57	0.12	0.43
	(396)	(519)	(526)	(440)	(0.297)	(0.484)	(0.654)	(0.357)
Observations	785	817	910	2,888	785	817	910	2,888
Individuals	160	145	119	161	160	145	119	161
Timeframe	1m-6m	7m-12m	13m-24m	1m-36m	1m-6m	7m-12m	13m-24m	1m-36m
Control mean	1,389	940	806	897	1,389	940	806	897
Test: Hybrid = Debt	0.049	0.012	0.080	0.121	0.001	0.008	0.142	0.026
Test: Hybrid = RevShare	0.456	0.368	0.281	0.633	0.510	0.364	0.346	0.292
Test: RevShare = Debt	0.019	0.056	0.375	0.227	0.006	0.033	0.381	0.156

Positive impacts on business management practices

	(1) Management practices	(2) Record keeping	(3) Credit extension	(4) Uses for business	(5) Usage: hours
Debt	0.00	-0.02	0.02	0.73***	22.3***
	(0.062)	(0.073)	(0.023)	(0.055)	(2.1)
Hybrid	0.10*	0.15**	0.05**	0.90***	34.8***
	(0.055)	(0.069)	(0.026)	(0.037)	(5.6)
RevShare	0.03	0.01	0.01	0.71***	24.9***
	(0.055)	(0.068)	(0.020)	(0.058)	(2.1)
Index	0.11**	0.12*	0.00	0.79***	31.2***
	(0.052)	(0.070)	(0.018)	(0.068)	(6.0)
Observations	468	468	468	468	468
Individuals	160	160	160	160	160
Timeframe	1m-12m	1m-12m	1m-12m	1m-12m	1m-12m
Control mean	0.68	0.65	0.08	0.00	0.0
Test: Hybrid = Debt	0.091	0.014	0.182	0.008	0.036
Test: Hybrid = RevShare	0.165	0.035	0.117	0.006	0.094
Test: RevShare = Debt	0.674	0.651	0.913	0.847	0.386

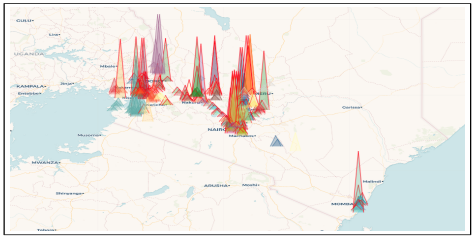
Spillover analysis: we rule out 'business stealing'

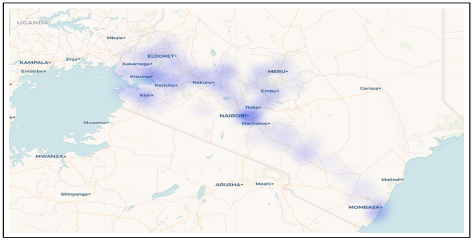
$$y_{ist} = \beta_0 + \beta_1 \cdot A_{st} + f(P_{st}) + \varepsilon_{ist},$$

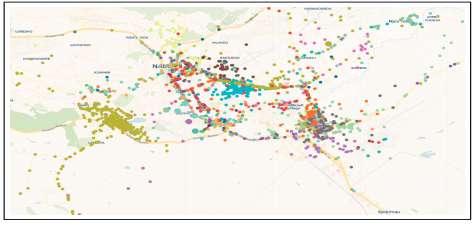
where P_{st} is the number of participants assigned at stockpoint s by period t, f is a flexible function, and we cluster by stockpoint (Miguel and Kremer, 2004).

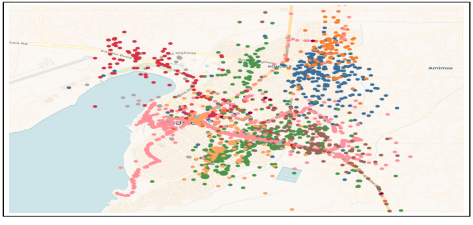
	(1)	(2)	(3)	(4)
Number treated at the stockpoint	-12.92	13.16	-13.27	12.09
	(26.312)	(20.927)	(26.695)	(21.513)
Number at the stockpoint in the experiment	-0.87		2.65	
	(19.188)		(19.550)	
Average pre-experiment sales at the stockpoint (de-meaned)	0.53***	0.55***	0.52***	0.54***
	(0.077)	(0.078)	(0.077)	(0.077)
Constant	71.11***	62.92***	69.91***	63.24***
	(6.654)	(8.615)	(6.631)	(8.704)
Dummy variables: Month	no	no	yes	yes
Dummy variables: Number at the stockpoint in the experiment	no	yes	no	yes
Observations	5202	5202	5202	5202

Bicycle GPS data shows geographical sales expansion









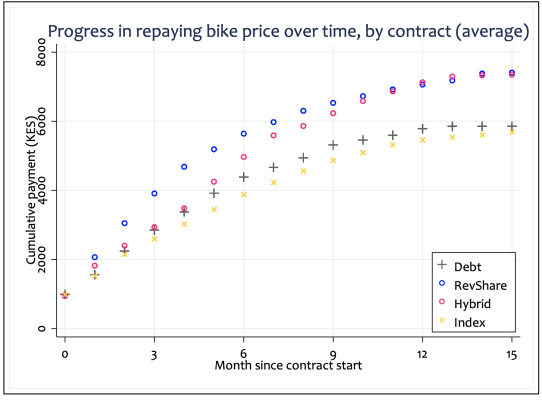
Positive impacts on downstream household outcomes

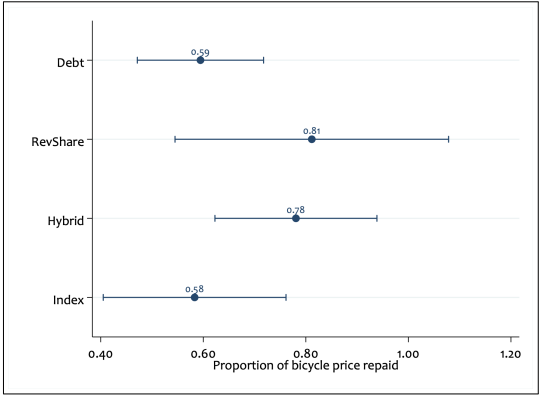
	(1) Expenditure: Food	(2) Expenditure: Clothing	(3) Expenditure: Schooling	(4) Health impedes work	(5) Work caused pain
Debt	866*	98	-333	-0.09	-0.10
	(491)	(161)	(252)	(0.070)	(0.062)
Hybrid	936*	397**	315	-0.06	-0.03
	(506)	(180)	(3360)	(0.078)	(0.073)
RevShare	116	34	-23	-0.07	-0.02
	(412)	(170)	(278)	(0.072)	(0.067)
Index	739*	-155	34	-0.03	0.02
	(415)	(1590)	(255)	(0.079)	(0.078)
Observations	468	468	468	468	468
Individuals	160	160	160	160	160
Timeframe	1m-12m	1m-12m	1m-12m	1m-12m	1m-12m
Control mean	4546	808	886	0.26	0.19
Test: Hybrid = Debt	0.898	0.079	0.024	0.644	0.204
Test: Hybrid = RevShare	0.085	0.043	0.267	0.792	0.883
Test: RevShare = Debt	0.092	0.680	0.151	0.827	0.084

Aggregate returns to the intervention are very large

	(1) Distributors	(2) Distributors	(3) FoodCo	(4) FoodCo	(5) Stockpoints	(6) Stockpoints	(7) MFI	(8) MFI	(9) Total Return	(10) Total Return
Debt (ITT)	583		1649		300		-159***		2457	
	(432)		(2407)		(372)		(36)		(3169)	
Hybrid (ITT)	1496**		4929		859		-57*		7214	
	(609)		(4091)		(645)		(30)		(5327)	
RevShare (ITT)	787*		2475		463		-39		3779	
	(441)		(2731)		(445)		(41)		(3602)	
Index (ITT)	279		1362		226		-125***		1653	
	(440)		(1923)		(306)		(41)		(2606)	
Debt (LATE)		771		2176		395		-211***		3232
		(566)		(3179)		(491)		(45)		(4183)
Hybrid (LATE)		1920**		6660		1166		-73*		9677
		(819)		(5420)		(855)		(39)		(7060)
RevShare (LATE)		1314*		4294		803		-65		6497
		(691)		(4463)		(722)		(68)		(5825)
Index (LATE)		532		2566		431		-238***		3135
		(816)		(3610)		(575)		(69)		(4882)
Observations	2888	2888	2888	2888	2888	2888	2888	2888	2888	2888
Individuals	161	161	161	161	161	161	161	161	161	161
Timeframe	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m	1m-36m
Control mean	897	897	5283	5283	798	798	-7	-7	6972	6972

Contract repayment is highest under Hybrid and RevShare





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Conceptual framework: setup

Consider a credit-constrained micro-distributor whose productivity increases with a bicycle. She must answer two questions:

1. **Incentive compatibility**: “under each available contract, how much effort shall I invest in sales for FoodCo (‘on contract’), and how much effort shall I invest in other activities (‘off contract’)?”
2. **Individual rationality**: “given a take-it-or-leave-it decision, which contracts should I accept?”

Conceptual framework: the role of **risk**

Risk plays two important roles in our conceptual framework:

1. Micro-distributors are **risk averse**; *ceteris paribus*, they value a contract that bundles some degree of risk-sharing.
2. They operate in a **risky environment** – with the risk increasing along with use of the new asset (e.g. asset damage / theft, uncertain new markets).

Conceptual framework: Preliminaries

$$\pi(e, \kappa, \eta) = \exp(\eta_t) \cdot \kappa \cdot e^{\alpha};$$
$$\eta_t \sim_{iid} \mathcal{N}(\mu, \sigma^2)$$

$$u(x) = -\exp(-rx)$$

Conceptual framework: A **repeated static** problem

$$V(\kappa, F, \omega; \sigma^2) = \frac{1}{1-\beta} \cdot \max_{e \geq 0} \ \mathbb{E}_\eta \left\{ u \left[\underbrace{\omega \cdot \pi(e, \kappa, \eta)}_{\text{retained earnings}} - \underbrace{e}_{\text{effort}} - \underbrace{F}_{\text{fixed payment}} \right] \right\}$$

Four important cases:

1. The value of not taking the contract: $V^n \equiv V(1, 0, 1; \sigma^2)$;
2. The value of having the bicycle, post-contract: $V^p \equiv V(\kappa, 0, 1; \sigma^2)$;
3. The initial value of taking the debt contract:

$$V_0^d = \left(1 - \beta^{12}\right) \cdot V(\kappa, F_d, 1; \sigma^2) + \beta^{12} \cdot V^p;$$

4. The initial value of taking the revenue-sharing contract:

$$V_0^s = \left(1 - \beta^{12}\right) \cdot V(\kappa, F_s, \omega; \sigma^2) + \beta^{12} \cdot V^p.$$

The hybrid contract: A **dynamic** problem

The hybrid contract presents a **dynamic problem** with **state** D_t (outstanding debt).

The value function is:

$$V^h(D_t) = \max_{e \geq 0} \mathbb{E}_\eta \left(u \left\{ \max \left[\underbrace{\omega \cdot \pi(e, \eta; \kappa) - F_s}_{\text{contract ongoing}}, \underbrace{\pi(e, \eta; \kappa) - D_t}_{\text{contract ending/ended}} \right] - e \right\} + \beta \cdot V^h(D_{t+1}) \right),$$

where the law of motion for D_t is:

$$D_{t+1} = \max \left[\underbrace{D_t - F_s - (1 - \omega) \cdot \pi(e, \eta; \kappa)}_{\text{contract ongoing}}, \underbrace{0}_{\text{contract ended}} \right].$$

This can be solved by **backward induction** in D_t, given $V^h(0) = V^p$.

Conceptual framework: **Take-away messages**

Several implications follow from this conceptual framework:

1. Performance-contingent contacts may be **profitable for the client**, by facilitating capital investments *and* additional effort. (This is consistent with the literature on '**risk rationing**': when capital investment brings additional risks, an absence of bundled insurance implies that profitable investments often do not go ahead (Boucher, Carter, and Guirkinger, 2008).)
2. The **implicit insurance** of performance-contingent contracts should be particularly attractive to clients who are more risk averse (Burchardi et al., 2019; Stiglitz, 1975, 1989; Stiglitz & Weiss, 1981) – and has implications for **effort invested**.
3. The **hybrid contract** adds flexibility to the **debt** contract and may provide **additional incentives for early repayment**.

Conclusion

We conduct a field experiment within a large multinational food company to help micro-distributors in their supply chain finance a **productive asset**.

We find particularly large benefits to contracts structured with **performance-contingent repayments**.

This suggests exciting potential for designing contracts that leverage developments in monitoring and **financial technology** to facilitate the financing of productive assets for low-income workers in a way that provides greater risk-sharing than a conventional fixed-repayment debt contract.

Microequity and Mutuality: Experimental Evidence on Credit with Performance-Contingent Repayment

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Summary statistics

	Control	Debt	Hybrid	RevShare	Index	Equality test (p-val)
Age	30.29	31.32	31.62	29.41	32.31	0.219
Married	0.71	0.76	0.85	0.63	0.78	0.241
Female	0.14	0.12	0.08	0.20	0.19	0.431
Household size	3.21	3.38	3.27	3.17	3.81	0.486
Number of earners	1.43	1.44	1.35	1.34	1.56	0.256
Education (post-secondary)	0.18	0.15	0.27	0.27	0.09	0.145
Number of employees	0.46	0.12	0.15	0.02	0.16	0.109
Business profit (all sources)	13,154.05	12,351.37	13,843.97	10,143.72	15,136.25	0.101
Profits from selling FoodCo products	2,747.89	3,145.39	3,227.11	2,419.66	2,992.38	0.477
Has wage job	0.29	0.18	0.35	0.22	0.28	0.473
Wage earnings	1,753.57	1,447.06	1,461.54	1,329.27	2,578.12	0.675
Total household income	20,407.14	18,175.00	16,265.38	16,600.85	22,477.38	0.369
Consumption expenditure	17,306.79	20,714.12	22,172.31	17,950.49	20,075.62	0.584
Management practices	0.73	0.72	0.83	0.77	0.78	0.198
Maths score	0.61	0.66	0.65	0.63	0.66	0.798
Time preferences index	7.32	6.44	6.23	6.98	6.84	0.942
Risk aversion index	4.04	3.71	4.08	4.08	3.84	0.472
Loss aversion index	5.64	5.32	6.35	5.56	6.72	0.308
Number of individuals	28	34	26	41	32	

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