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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).

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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.

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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).

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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).

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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.

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

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

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

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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**.

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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.

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Preview of results

1. We find **large positive impacts** of the performance-contingent contracts, particularly on business profits.

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2. We also find evidence of positive **spillovers**.

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

   This is the **opposite** 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).

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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 evidence for **high returns to capital** among microenterprises (De Mel et al, 2008), the first wave of microcredit evaluations found very limited impacts of the standard rigid microfinance contract (Banerjee, Karlan and Zinman, 2015; Meager, 2018).

- Subequent work highlights important **heterogeneous** (Meager, 2019; Banerjee et al, 2015; Bryan et al, 2021) and general **equilibrium** effects (Breza and Kinnan, 2020).

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- Subequent work highlights important **heterogeneous** (Meager, 2019; Banerjee et al, 2015; Bryan et al, 2021) and general **equilibrium** effects (Breza and Kinnan, 2020).

Contractual innovations can improve the effectiveness of microcredit contracts, for example by allowing repayment flexibility with grace periods (Field et al., 2013; Battaglia, Gulesci, & Madestam, 2021; Barboni & Agarwal, 2021), and through asset collateralisation (Jack, Kremer, de Laat and Suri, 2019; Carney, Kremer, Lin and Rao, 2022).

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).

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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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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**.

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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 perspective.

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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 perspective.

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.

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Four microfinance contracts

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

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1. **Debt**

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

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1. **Debt** : Fixed flat monthly repayments (annual interest rate = 15%).
2. **Equity** : Half the liability of the debt contract, plus 10% of gross profit.

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3. **Hybrid** : Same as the **equity** contract, until the **total payments** match those of the **debt contract**.

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4. **Index insurance**

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

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Four microfinance contracts

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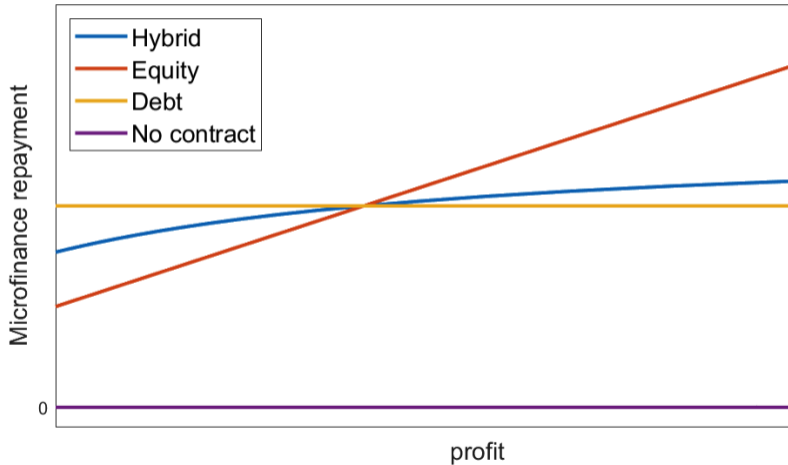
Data

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.

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Dataset

For the experimental sample, the average age was 31, with 15% female and 73% married. 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).

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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

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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.

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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).

Conceptual framework: **Profit through (risky) effort**

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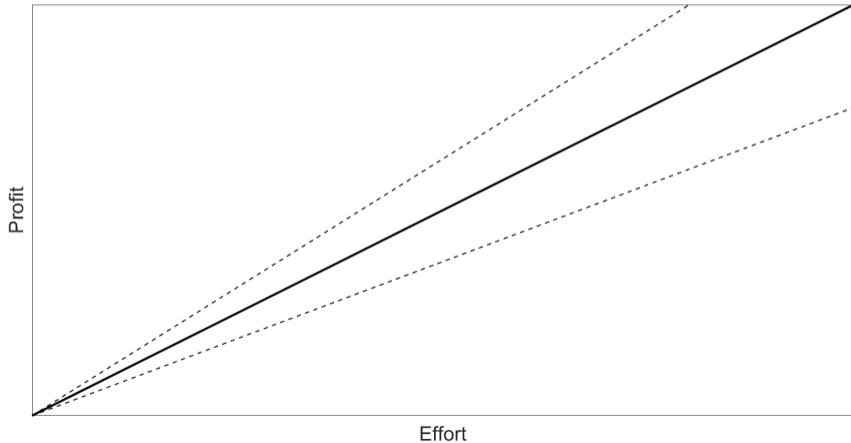
Conceptual framework: **Profit through (risky) effort**

Conceptual framework: **The client's problem**
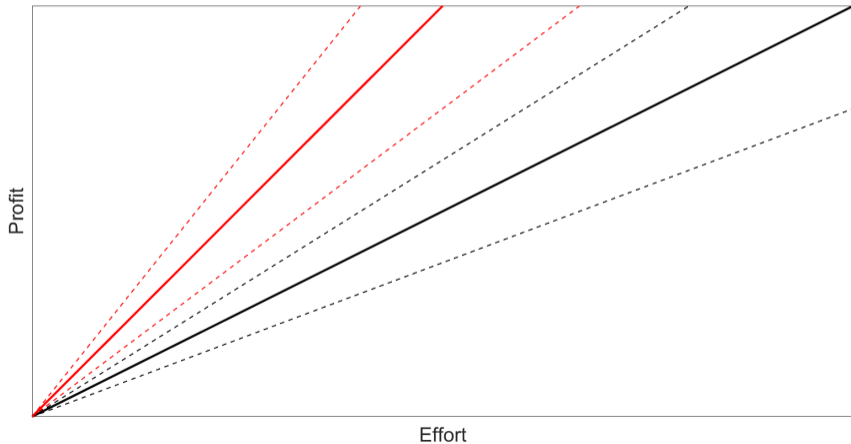
$$V(\omega, F; r, \kappa) = \max_{e_c \geq 0, \, e_n \geq 0} \int \int u \left[\underbrace{\omega \cdot \pi(e_c, \eta_c; \kappa) + \pi(e_n, \eta_n; \kappa)}_{\text{retained profit}} - \underbrace{C(e_c, e_n)}_{\text{cost}} - F; r \right] \, dF(\eta_c, \eta_n)$$

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Conceptual framework: **The client's problem**

$$V(\omega, F; r, \kappa) = \max_{e_c \geq 0, \, e_n \geq 0} \int \int u \left[\underbrace{\omega \cdot \pi(e_c, \eta_c; \kappa) + \pi(e_n, \eta_n; \kappa)}_{\text{retained profit}} - \underbrace{C(e_c, e_n)}_{\text{cost}} - F; r \right] \, dF(\eta_c, \eta_n)$$

$$\pi(e, \eta; \kappa) \equiv \kappa \cdot (1 + \eta) \cdot e;$$

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$$C(e_c, e_n) \equiv \frac{(e_c + e_n)^{1+\gamma}}{1 + \gamma}$$

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

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Conceptual framework: **The client's problem**

$$V(\omega, F; r, \kappa) = \max_{e_c \geq 0, \, e_n \geq 0} \int \int u \left[\underbrace{\omega \cdot \pi(e_c, \eta_c; \kappa) + \pi(e_n, \eta_n; \kappa)}_{\text{retained profit}} - \underbrace{C(e_c, e_n)}_{\text{cost}} - F; r \right] \, dF(\eta_c, \eta_n)$$

$$\pi(e, \eta; \kappa) \equiv \kappa \cdot (1 + \eta) \cdot e;$$

$$C(e_c, e_n) \equiv \frac{(e_c + e_n)^{1+\gamma}}{1 + \gamma}$$

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

$$\eta_c, \eta_n \sim_{iid} \mathcal{N}\left(0, \sigma^2\right)$$

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Conceptual framework: **Introducing financing contracts**

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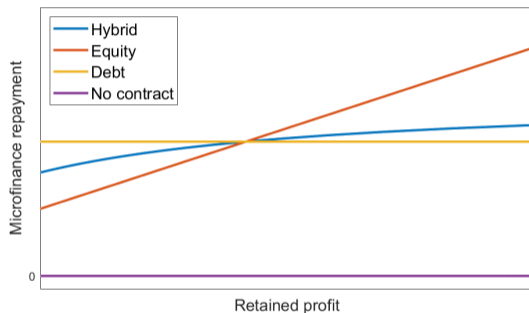
For **debt** and **equity**, the certainty equivalent has an analytical solution.

For **hybrid**, we take the **net present equivalent** (**ignoring advantages of intertemporal smoothing**), and we integrate using a Tauchen (1986) approximation.

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Conceptual framework: **Equity can crowd-in on-contract effort**

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Conceptual framework: **Preferred contract**

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Conceptual framework: **Preferred contract**

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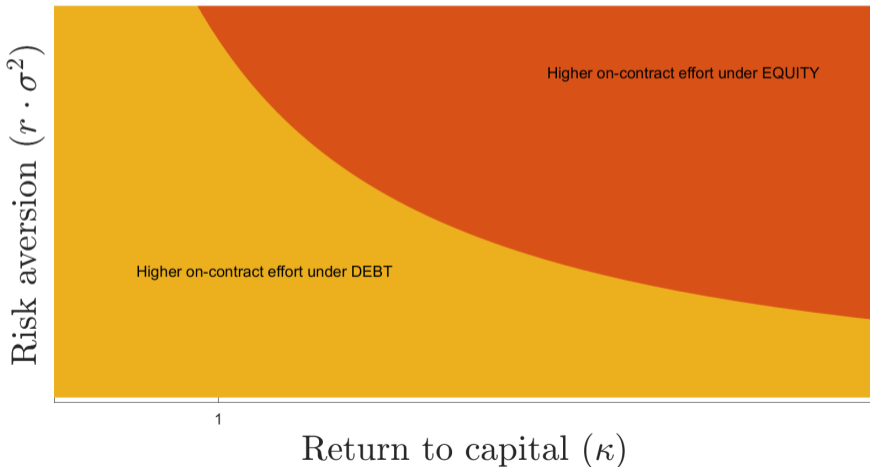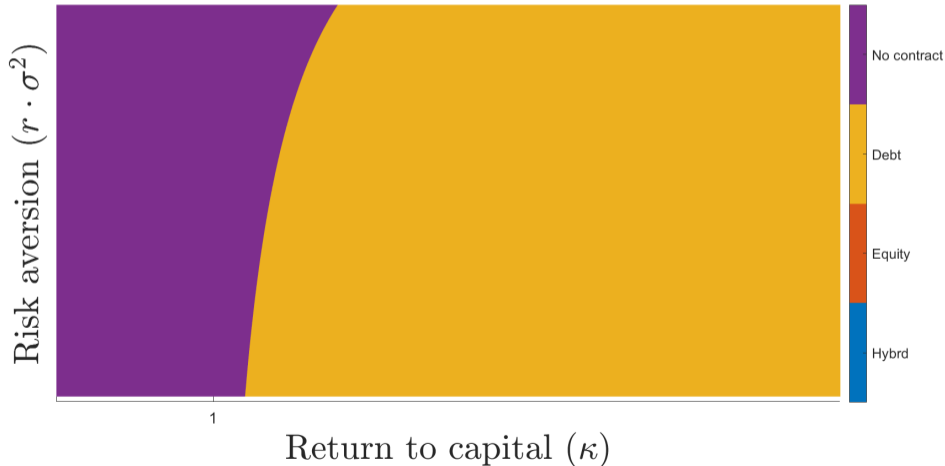
Conceptual framework: **Preferred contract**

Conceptual framework: **Take-away messages**
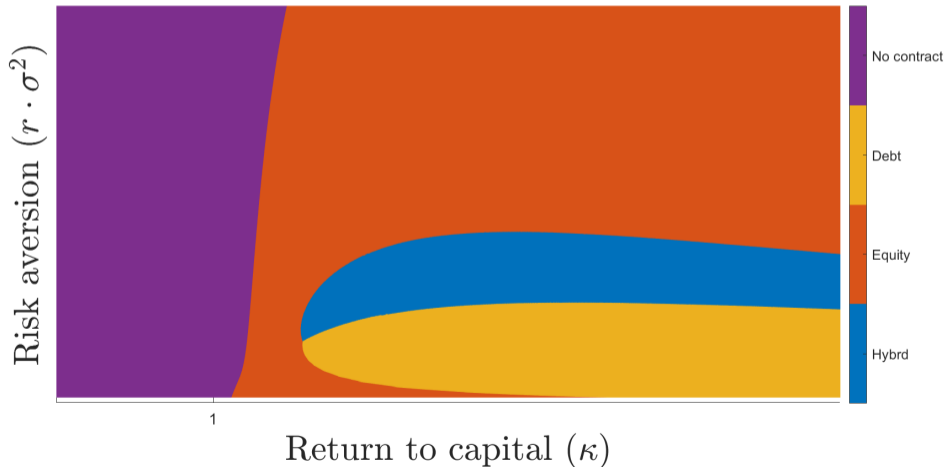
Three implications follow from this conceptual framework:

Conceptual framework: **Take-away messages**

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1. Performance-contingent contracts can **crowd *in* on-contract effort** relative to the debt contract, because bundled insurance can directly increase the marginal product of effort (potentially counteracting any moral hazard problem from '**taxing entrepreneurial success**').

Conceptual framework: **Take-away messages**

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1. Performance-contingent contracts can **crowd *in* on-contract effort** relative to the debt contract, because bundled insurance can directly increase the marginal product of effort (potentially counteracting any moral hazard problem from '**taxing entrepreneurial success**').

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).

Conceptual framework: **Take-away messages**

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3. 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).)

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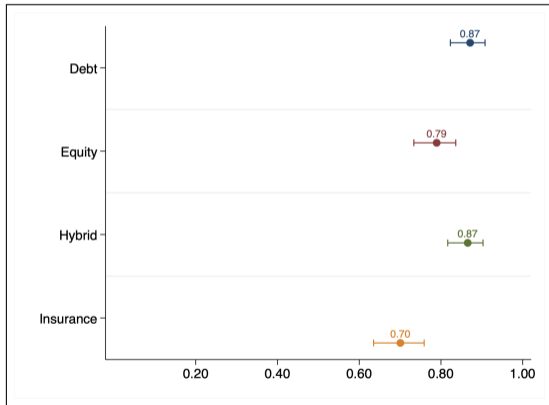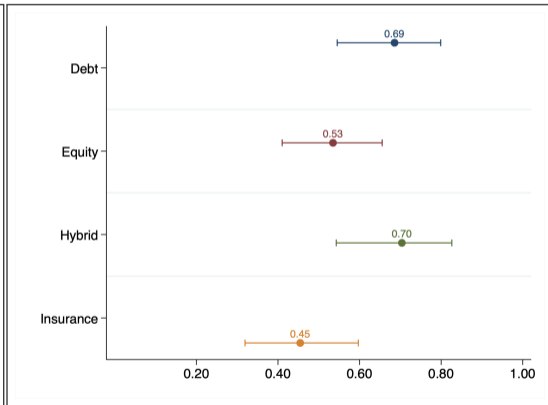
Take-up heterogeneity: baseline profits (FoodCo admin data)

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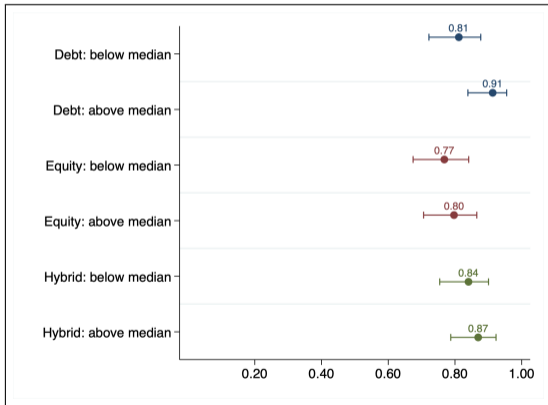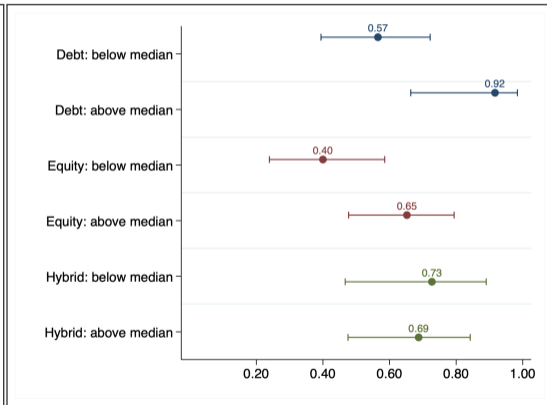
Take-up heterogeneity: risk preferences
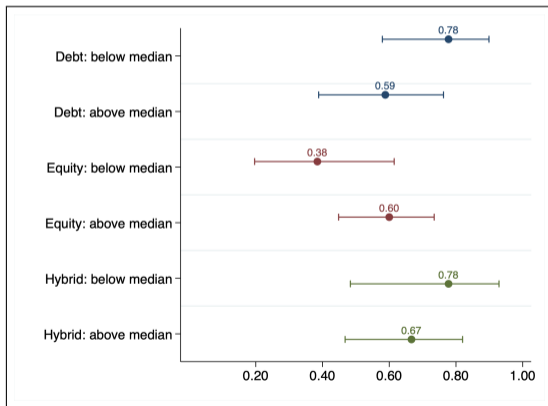
RISK-AVERSION   LOSS-AVERSION
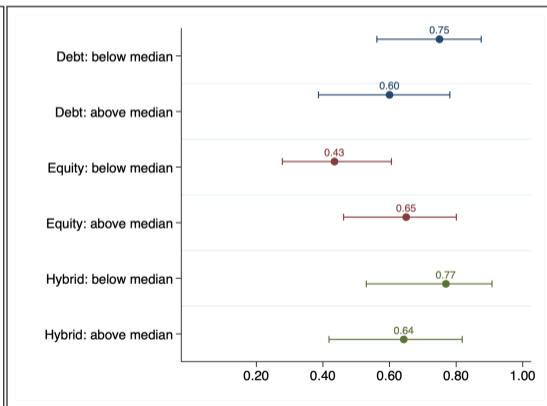
Treatment effects

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:

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

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).

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Main outcomes

	(1) FoodCo profits	(2) FoodCo profits	(3) Activity: seller	(4) FoodCo proportion	(5) Other earnings
Debt	10.39	10.39	-0.05	-0.11**	5.95
	(11.535)	(11.520)	(0.054)	(0.046)	(15.253)
Performance-contingent	25.96**				
	(10.786)				
Hybrid		34.43**	0.03	0.03	-7.73
		(15.227)	(0.044)	(0.060)	(13.347)
Equity		19.61*	-0.03	-0.01	-1.68
		(11.742)	(0.053)	(0.046)	(12.270)
Insurance	11.85	11.87	0.02	-0.06	3.07
	(10.312)	(10.269)	(0.040)	(0.045)	(15.415)
Observations	2598	2598	468	468	468
Individuals	161	161	160	160	160
Control mean	11.32	11.32	0.93	0.48	70.67
Test: Hybrid = Debt		0.133	0.181	0.018	0.319
Test: Hybrid = Insurance		0.357	0.326	0.469	0.557
Test: Hybrid = Equity		0.472	0.741	0.023	0.541

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Spillovers

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

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).

Level of analysis:	(1)	(2)	(3)	(4)
	Non-participating clients		Stockpoints	
Number treated at the stockpoint	3.96***	4.11***	4.07*	4.03**
	(1.343)	(1.388)	(2.075)	(2.039)
Constant	11.04***	10.97***	11.64***	11.64***
	(1.298)	(1.229)	(1.002)	(0.993)
Controls: Total participating at the stockpoint	yes	yes	yes	yes
Controls: Time	no	yes	no	yes
Observations	52948	52948	9737	9737

Notes: In this table, we use administrative data on micro-distributors who were not involved in our experiment, and test the consequence of random variation in the number of treated respondents at the stockpoint. * p < 0.10, ** p < 0.05, *** p < 0.01..

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Bicycle GPS data

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Mechanisms

	(1) Stockpoint visits	(2) Profit concentration	(3) Product varieties	(4) Sales expansion	(5) Credit extension	(6) Management practices	(7) Record keeping	(8) Bike use: business	(9) Bike use: hours
Debt	1.28	-0.05	-0.02	0.10	0.01	0.00	-0.02	0.73***	22.32***
	(1.154)	(0.048)	(0.441)	(0.082)	(0.023)	(0.061)	(0.072)	(0.055)	(2.142)
Hybrid	2.96*	-0.10*	0.71	0.19**	0.05**	0.10*	0.14**	0.90***	34.82***
	(1.539)	(0.054)	(0.532)	(0.090)	(0.026)	(0.055)	(0.068)	(0.037)	(5.553)
Equity	1.29	-0.03	0.10	0.13	0.01	0.03	0.01	0.71***	24.90***
	(1.032)	(0.044)	(0.468)	(0.087)	(0.020)	(0.055)	(0.067)	(0.058)	(2.067)
Insurance	0.27	0.01	0.07	0.22***	-0.00	0.11**	0.11*	0.79***	31.23***
	(1.124)	(0.042)	(0.391)	(0.076)	(0.019)	(0.052)	(0.069)	(0.068)	(5.981)
Observations	2598	2598	2598	468	468	468	468	468	468
Individuals	161	161	161	160	160	160	160	160	160
Control mean	2.42	0.55	1.33	0.58	0.08	0.68	0.65	0.00	0.00
Test: Hybrid = Debt	0.307	0.311	0.140	0.228	0.157	0.089	0.014	0.008	0.036
Test: Hybrid = Insurance	0.241	0.137	0.231	0.486	0.104	0.161	0.036	0.006	0.094
Test: Hybrid = Equity	0.994	0.719	0.777	0.626	0.948	0.676	0.651	0.847	0.386

Mechanisms

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Individuals	161	161	161	160	160	160	160	160	160
Control mean	2.42	0.55	1.33	0.58	0.08	0.68	0.65	0.00	0.00
Test: Hybrid = Debt	0.307	0.311	0.140	0.228	0.157	0.089	0.014	0.008	0.036
Test: Hybrid = Insurance	0.241	0.137	0.231	0.486	0.104	0.161	0.036	0.006	0.094
Test: Hybrid = Equity	0.994	0.719	0.777	0.626	0.948	0.676	0.651	0.847	0.386

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	(1) Stockpoint visits	(2) Profit concentration	(3) Product varieties	(4) Sales expansion	(5) Credit extension	(6) Management practices	(7) Record keeping	(8) Bike use: business	(9) Bike use: hours
Debt	1.28	-0.05	-0.02	0.10	0.01	0.00	-0.02	0.73***	22.32***
	(1.154)	(0.048)	(0.441)	(0.082)	(0.023)	(0.061)	(0.072)	(0.055)	(2.142)
Hybrid	2.96*	-0.10*	0.71	0.19**	0.05**	0.10*	0.14**	0.90***	34.82***
	(1.539)	(0.054)	(0.532)	(0.090)	(0.026)	(0.055)	(0.068)	(0.037)	(5.553)
Equity	1.29	-0.03	0.10	0.13	0.01	0.03	0.01	0.71***	24.90***
	(1.032)	(0.044)	(0.468)	(0.087)	(0.020)	(0.055)	(0.067)	(0.058)	(2.067)
Insurance	0.27	0.01	0.07	0.22***	-0.00	0.11**	0.11*	0.79***	31.23***
	(1.124)	(0.042)	(0.391)	(0.076)	(0.019)	(0.052)	(0.069)	(0.068)	(5.981)
Observations	2598	2598	2598	468	468	468	468	468	468
Individuals	161	161	161	160	160	160	160	160	160
Control mean	2.42	0.55	1.33	0.58	0.08	0.68	0.65	0.00	0.00
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Household consumption and health

	(1) Expenditure: food	(2) Expenditure: clothing	(3) Expenditure: schooling	(4) Health impedes work	(5) Work caused pain
Debt	8.99*	0.25	-4.91	-0.09	-0.10
	(5.075)	(1.965)	(3.420)	(0.070)	(0.062)
Hybrid	8.47*	4.92**	3.10	-0.06	-0.03
	(5.117)	(2.372)	(4.360)	(0.078)	(0.073)
Equity	1.54	-0.16	-0.81	-0.07	-0.02
	(4.152)	(2.146)	(3.649)	(0.072)	(0.067)
Insurance	8.18*	-2.34	-0.44	-0.03	0.02
	(4.247)	(1.974)	(3.355)	(0.079)	(0.078)
Observations	468	468	468	468	468
Individuals	160	160	160	160	160
Control mean	45.72	9.26	11.34	0.26	0.19
Test: Hybrid = Debt	0.927	0.032	0.029	0.644	0.204
Test: Hybrid = Insurance	0.155	0.030	0.312	0.792	0.883
Test: Hybrid = Equity	0.111	0.831	0.150	0.827	0.084

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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**.

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Conclusion

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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.

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

FRANCESCO CORDARO (EOM)
MARCEL FAFCHAMPS (STANFORD)
COLIN MAYER (OXFORD)
MUHAMMAD MEKI (OXFORD)
SIMON QUINN (OXFORD)
KATE ROLL (UCL)

Summary statistics

	Control	Debt	Hybrid	Equity	Insurance	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)	131.54	123.51	138.44	101.44	151.36	0.101
Profits from selling FoodCo products	33.35	40.14	69.34	49.68	58.76	0.330
Has wage job	0.29	0.18	0.35	0.22	0.28	0.473
Wage earnings	17.54	14.47	14.62	13.29	25.78	0.675
Total household income	204.07	181.75	162.65	166.01	224.77	0.369
Consumption expenditure	173.07	207.14	221.72	179.50	200.76	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	

Notes: The first five columns present baseline summary statistics for individuals who were randomly assigned to the control, debt, hybrid, equity, or insurance arms, respectively. The sixth column presents a test of equality across the five groups. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. We also conducted an omnibus balance test of equality, which comfortably passes ($p=0.497$).

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