The demand for digital identification amongst small enterprise owners in Uganda

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Abstract

There are many barriers to firm profitability and growth in developing countries, including issues of trust and fraud that limit firms to suppliers in their social networks. Digital IDs may ease these frictions; identity verification and signature authentication may allow businesses to expand their networks and overcome contracting constraints to growth. We present the first evidence on the effects of verified authentication services for businesses based on a new government initiative in Uganda. By combining a willingness to pay exercise and a randomized control trial, we study the demand for verified authentication services among small and medium business owners, and the effect of such services on business networks and growth.

Keywords: Digital identification, Uganda, Small enterprises, Willingness-to-pay, Contracting

JEL codes: O17, O33, C9

Study pre-registration: We will lodge a pre-registration before we start the baseline survey in March 2024.

Proposed timeline

Round	Start date	End date
Baseline, Treatment and WTP exercise	15 March 2024	15 April 2024
Endline survey	15 October 2024	15 November 2024

Reporting checklist for Stage 1 submissions *(optional)*

Section	Item	Description and details to report	Reported?	Page(s)
Cover page *(required)*	*Title*	Informative title specifying the study design, population, and interventions	yes	1
	Date of latest draft	Date of when the prospective review article was last edited.	yes	1
	Study pre-registration status	Link, registration identifier and registry name (or intended registry if not yet registered)	yes	1
	Keywords	Up to six keywords, to be used for indexing purposes.	yes	1
	JEL codes	Up to six codes.	yes	1
Abstract *(required)*	*Abstract*	Summarize research question, outcome variables, methodological framework and contribution in less than 150 words.	yes	1
Timeline *(required)*	*Expected completion date*	Expected date for completion of the pre-specified research design.	yes	2
Introduction	*Background and relevance of the study*	Brief overview of previous research, and relevance of the research question(s) for the field of economic development	yes	4
	Research question(s)		yes	4
Research design	*Basic methodological framework*	Outline of the identification strategy in your study (experimental/non-experimental)	yes	12
	Hypotheses	Pre-specified hypotheses to be tested in the study and reported as primary findings in the Stage 2 full manuscript	yes	10
	Outcome variable(s)	Definition of the main outcome variable(s) and (if applicable) secondary outcome variable(s)	yes	6
		Specification of how outcome(s) will be constructed from the dataset	no	
	Intervention(s)	Details of the intervention (when, where, how, by whom)	yes	5
		Number of treatment arms and whether they are exclusive or overlapping	yes	5
		Randomization strategy	yes	5
		Blinding strategy (if applicable)	no	5
		Instructions and supporting materials for administering the intervention	no	
		Source(s) of exogenous variation	no	
	Theory of change	How and why the intervention is predicted to lead to certain effects	yes	10

	Sample	Specification of unit of analysis (individuals, organizations, countries, etc.)	yes	15
		Data source(s)	yes	14
		Projected sample size and statistical power calculations	yes	12
	Variations from the intended sample	Specification of the degree of attrition that may threaten the robustness of the study	yes	14
		Strategies to deal with attrition, non-compliance with the assigned treatment, etc.	yes	14
	Data collection and processing	Type of data, collection method/data source(s), and timeline for collection	yes	14
		Rule for terminating data collection / stopping rule	no	
		Data management plan	no	
		Pilot data and experiments run in preparation of the Stage 1 submission	yes	14
Empirical analysis	*Statistical method(s)*	Main evaluation method(s) and underlying assumptions	yes	1512
		Rules for handling missing values	yes	15
		Definition and rules for handling outliers	yes	15
	Multiple hypothesis testing	Strategies to prevent false positives	yes	16
	Heterogeneous effects	Anticipated heterogeneous effects and theoretical justification	yes	16
	Statistical model	A functional (mathematical) form of the causal mechanism explored in the study	yes	15
		Specification if regression model is linear, generalized linear, or other	yes	15
		How will standard errors be calculated	yes	15
Limitations and challenges	*Challenges in the study implementation*	Potential objective circumstances that might jeopardize the implementation of the proposed study design	yes	19
Administrative information *(required)*	*Ethics approval*	Statement confirming that all necessary ethics approvals are in place.	Yes	23
	Funding	Funding sources in the suggested format	Yes	23
	Acknowledgments	List of (non-author) individuals who provided help to the research project.	Yes	23
Bibliography	*Bibliography*	References can be in any style or format as long as the style is consistent.	Yes	21
Other items	*Appendices*	Tables and figures	No	

1. Introduction

Research question: background, importance and relevance

Most micro and small businesses in developing countries are limited in their access to formal finance, participation in government contracts and programs, and ability to contract with other businesses and customers. These limits can themselves hinder the growth of these businesses, leading to a self-perpetuating cycle. One area that the literature highlights as particularly important to such firms is relational contracting (Greif, 1993; Banerjee and Duflo, 2000; Baker, Gibbons and Murphy, 2002; Brown, Falk and Fehr, 2004; Macchiavello and Morjaria, 2015; Chandrasekhar et al., 2018; Startz, 2021; Macciavello, 2021). In a weak institutional environment, relational contracting allows businesses to rely on their networks and repeated interactions to support business transactions. However, relational contracting severely restricts the ability of firms to find lower priced suppliers or take advantage of contracts with new buyers. Those with smaller networks, such as women and minorities, may be disproportionately limited by relying on relationships instead of formalized contracting (Chandrasekhar, 2018; Jayachandran, 2021).

Digital ID systems offer a way to increase the formalization of contracting in developing countries by allowing the verification of identities and signing of digital contracts under a government sponsored system. While these systems do not completely solve contracting problems when enforcement options are limited, they can offer a way to reduce identity-related fraud and provide verifiable contracts that commit firms to stick to them. As such, digital ID systems may improve the ability of small enterprises to write contracts, expanding their set of suppliers and buyers and hence facilitating business growth.

To date, there is no empirical evidence on the impact of digital ID systems on business contracting. Further, there is no evidence about demand from businesses for a digital ID and whether they would use the digital ID to alter their business networks. We would plug this evidence gap through studying the new digital ID in Uganda, UGPass. Our findings will be relevant across developing countries, where issues like contracting remain a major impediment to business growth and productivity (Macciavello, 2021) and where digital IDs are increasingly being developed and rolled out.

This project asks: Firstly, what is the willingness-to-pay (WTP) of micro, small and medium enterprises (MSMEs) owners for a digital ID, UGPass, and does this WTP depend on whether contracting is highlighted as a benefit of UGPass? Secondly, what is the impact of UGPass on firm-related outcomes for MSMEs, including their ability to establish contracts with suppliers and the profit of the business? The first question will establish evidence on the appropriate funding model for UGPass and inform as to the value MSMEs perceive this technology to have, particularly as it relates to contracting. The second question will provide new insights into the ability of digital IDs to help alleviate the expansion-related difficulties that firms face in developing countries.

Our project contributes to two key areas of the literature. Firstly, our project will strengthen the literature on the benefits of digital ID systems. Digital IDs have been shown to improve public services by enabling citizens to prove their identity and service eligibility (Muralidharan et al., 2016, 2021). However, there is less evidence on the benefits of digital IDs in other domains. We take this literature in a new direction by examining the impact of digital IDs on a large and important group for economic growth, MSMEs, with particular focus on a new area: identity verification in business settings.

Even if a digital ID has potential benefits, these benefits will not materialize without users recognizing the service's value. Through a simple information intervention embedded in our survey, we seek to test whether nudges about a potential use of UGPass for MSMEs – contracting – increases the respondent's valuation.

Secondly, our project contributes to the literature on the importance of contracting for firms in developing countries. When institutions are weak and enforcement limited, firms rely on repeated contracts with a network of trusted suppliers and buyers (Macchiavello, 2021). While many studies have documented this reliance on relationships, fewer have tested ways to improve contracting. Aker et al. (2020) are an exception; they randomize the introduction of a phonebook in Tanzania and find that access to contact details expands the set of suppliers and buyers used by firms. Digital platforms that allow firms to signal their reputation have also been shown to matter for contracting, though they can have unintended side effects (Chen and Wu, 2021; Bai et al., 2020). Our project would provide new evidence on an intervention designed to improve the ability of firms to write contracts. We expect this intervention to be particularly beneficial to female business owners, who often have smaller networks or are more to the periphery of networks, than male business-owners (Chandrasekhar, 2018; Jayachandran, 2020).

2. Research Design

Intervention

The intervention we will test in this study is based around UGPass, the Ugandan government's new digital identity verification initiative. UGPass, a product from Uganda's National Information Technology Authority (NITA) provides a way to authenticate signatures on documents; specifically, a signature via UGPass indicates that the signatory's identity has been verified by the government of Uganda. In the future, the app is also planned to help streamline access to private and public services. This technology is novel, not only for Uganda, but for Sub-Saharan Africa as a whole. As such, there is little preliminary or pilot evidence available. In this study, we will document the overall demand for UGPass among MSMEs owners, evaluate the effects of the provision of UGPass on a range of business outcomes, and assess how knowledge of a specific use case – contracting – affects not only WTP but also downstream outcomes. UGPass is being rolled out by the Ugandan government in the first quarter of 2024. We match the timing of our study to be shortly after launch, such that UGPass will be available publicly but not widely used.

The intervention will be implemented by Innovation for Poverty Action (IPA) Uganda enumerators at a location of the respondent's choosing. During the intervention, we will introduce all respondents to UGPass and assess WTP for UGPass via the Becker-DeGroot-Marschak (BDM) mechanism. All respondents will be provided with basic information about UGPass and told that if they purchase UGPass in the WTP experiment, they will receive assistance installing UGPass. In addition, we will randomize a **Contracting (C)** treatment. Respondents in this treatment group will receive a short information prime about the potential to use UGPass to verify customer and supplier identities and sign contracts with them.

After taking the survey, respondents will complete a WTP experiment. We will utilize the BDM mechanism to elicit truthful WTP. First, respondents provide their WTP for an item. Second, a random price is drawn. If the subject's WTP is greater than the randomly drawn price they will receive the item at the price drawn. If their WTP is less than the randomly drawn price they will not receive the item. Before requesting their WTP for UGPass, we will play a practice round illustrating the BDM mechanism with an example good. We will

ask respondents for their WTP after letting them know that the drawn price will vary from $0 to $5, where $5 is the public price that UGPass will cost. In all cases, a purchase of UGPass covers the cost of signing up for the service, allows the respondent to verify other documents signed using UGPass and gives them three signatures to use on documents of the respondent's choosing.[1]

We will set the price distribution in the WTP experiment such that 1,250 respondents are offered a price of $0 **(T)**, 1200 respondents are offered $5 (the true price of UGPass), and 50 respondents are offered a price of between $1 and $4. The manipulation of the underlying price distribution is intentional, so that we will have enough respondents who get offered UGPass for free to ensure a high first stage of adoption while still being able to estimate a demand curve and maintaining incentive compatibility (Berkouwer and Dean, 2022). We assign 50 respondents to receive an intermediate price of $1-$4 so that we can truthfully tell respondents that they will receive a random price of $0, $1, $2, $3, $4 or $5, by having some mass on the probability of drawing all prices.

An individual participant in the study will ultimately vary on contracting treatment status and the random price they are offered in the WTP experiment (see Table 1 below).

Table 1. Study Design

	Non-Zero Price	**Zero Price (T)**
No Contracting	625 respondents	625 respondents
Contracting (C)	625 respondents	625 respondents

For treatment to be considered successful, the enumerator must meet with the respondent to conduct the baseline survey and provide general information about UGPass, inform them about the treatments and conduct the WTP experiment. The baseline survey will involve a set of screening questions to determine eligibility; for example, the respondent will need to have a working smartphone capable of installing UGPass.

Any respondent who successfully purchases UGPass through the WTP exercise will be offered on-the-spot sign up assistance for UGPass. The randomly drawn price will be available only for immediate use. Note that respondents whose valuation is below their randomly selected price would be able to sign themselves up for UGPass at the market price at any time after the survey if their valuation changed (i.e., UGPass will be freely available to everyone at the market price throughout the study).

There will be no promoting or reminders of treatment status at the time of endline; we do not expect that the enumerators conducting the endline survey will be meaningfully aware of treatment status.

Primary Outcomes

We have two primary outcomes of interest:

1. Supplier network index (of the following components)
    a. Whether the business has explored finding alternate suppliers

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[1] After using up the initial three signatures, all respondents will be free to purchase additional signatures within the app at a cost of $1 per signature.

      b.   Number of suppliers

      c.   Number of new suppliers in last three months

      d.   Share of suppliers located non-locally (not within the respondent's neighbourhood)

      e.   Share of suppliers who are not friends or family

      f.   Whether purchases from suppliers are made on credit

      g.   Value of outstanding payments owed to suppliers

2. Business profit (self-reported value of business profits earned in the last 30 days)

We expect that UGPass will enable businesses to expand their supplier network through the ability to verify the respondent's and suppliers' identities and sign formal written contracts. We examine this in the form of an index to capture the multiple ways through which UGPass could affect supplier relationships, including the number of suppliers, whether a supplier is from the respondent's social network or not and the ability to obtain credit from suppliers. We will also utilize secondary outcomes to determine how UGPass allowed an expansion of the supplier network.

Business profits is the ultimate outcome we care about when thinking about small enterprises. Examining this outcome will allow us to determine whether UGPass led to real improvements in business performance, whether through contracting or alternative mechanisms. We would utilize secondary outcomes to determine how UGPass led to improvements in business profitability.

Secondary Outcomes

As secondary outcomes we consider the following six families of outcomes collected via our baseline and endline surveys. We think about secondary outcomes as explaining how UGPass led to any changes in supplier networks and business profitability.

1. UGPass uptake and usage:

      a.   Willingness to pay for UGPass (price of between $0 and $5), collected during the baseline survey experiment

      b.   UGPass intent index

            i.   Whether respondent downloaded the UGPass app

            ii.   Whether respondent attempted to sign-up for UGPass (either with the enumerator if selected by receive UGPass as part of the WTP experiment or by themselves)

           iii.   Whether respondent knows how to sign a document using UGPass

           iv.   Whether the respondent knows how to verify anyone's identity using UGPass.

            v.   Whether the respondent tried to identify themselves using UGPass or asked someone else to identify themselves using UGPass

           vi.   Whether the respondent tried to get another party to sign a document using UGPass

          vii.   Number of times the respondent has attempted to use UGPass in the last month

      c.   UGPass network index

            i.   Number of respondent's household members that have UGPass

            ii.   Number of people the respondent knows who have UGPass

           iii.   Number of business suppliers the respondent knows who have UGPass

           iv.   Number of business customers the respondent knows who have UGPass

            v.   Number of people the respondent has encouraged to sign up for UGPass

           vi.   Number of suppliers the respondent has encouraged to sign up for UGPass

       vii. Number of customers the respondent has encouraged to sign up for UGPass
- d. Sign up for UGPass (dummy variable indicating whether the respondent successfully downloaded the app and completed the sign-up process in UGPass), collected via endline survey and administrative data.
- e. Whether respondent has ever used UGPass for any purpose (we will collect this via the survey and verify it using administrative data).
    - i. Number of times the respondent has used UGPass
    - ii. Whether the respondent has ever used UGPass for identity verification
    - iii. Number of times the respondent has used UGPass for identity verification
    - iv. Whether the respondent has ever used UGPass for signing
    - v. Number of times the respondent has used UGPass for signing
    - vi. Whether the respondent has ever used UGPass for any other purpose
    - vii. Number of times the respondent has used UGPass for any other purpose
- f. UGPass perception index
    - i. Whether respondent expects to use UGPass in the future
    - ii. Whether respondent believes that UGPass is useful
    - iii. Whether the respondent believes that UGPass is useful for business contracting
    - iv. Whether respondent believes that UGPass works well
- g. UGPass problems index
    - i. Whether the respondent had technical issues using UGPass themselves
    - ii. Whether the respondent had issues getting others to use UGPass

2. Business contracting outcomes:
   - a. Whether the respondent used UGPass for contracting-related identity verification or signing
   - b. Number of contracts signed using UGPass
   - c. Business contract index
       - i. Whether the business has formal agreements with any suppliers
       - ii. Number of formal contracts with suppliers
       - iii. Whether the business has formal agreements with customers
       - iv. Number of formal agreements with customers
   - d. Interest in contracts for business purposes
   - e. Perception of usefulness of contracting for the business
   - f. Extent of perceived barriers to using contracts for business purposes

3. Business other network outcomes
   - a. Customer network index
       - i. Number of customers
       - ii. Number of new customers in last three months
       - iii. Share of customers located not-locally
       - iv. Whether customers are allowed to make purchases on credit
       - v. Value of outstanding payments owed by customers
   - b. Business contact index
       - i. Number of business-related calls and texts in the last week
       - ii. Number of contacts with whom business correspondence occurred in the last week

4. Business management outcomes

      a. Supplier management index
          i. Losses to the business from supplier delays
          ii. Whether the business has engaged in negotiation to lower prices from suppliers
          iii. Whether the business runs out of stock monthly or more often
          iv. How long it takes the business to re-stock out-of-stock goods
          v. Whether the enumerator rates the store as well-stocked
          vi. Closure of the business due to lack of stock or to purchase stock
      b. Use of internet for business purposes
      c. Inventory management practice index
          i. Whether respondent received a discount on inventory or raw materials in the last month
          ii. Whether the respondent regularly experiences delivery delays
          iii. Whether the respondent regularly suffers financial losses due to delivery delays
          iv. Value of losses due to delivery delays over the last three months
          v. Whether the respondent runs out of stock once a month or more
          vi. Whether the respondent has had to close their business due to lack of stock in the last three months
          vii. Number of times the respondent has had to close their business due to last of stock in the last three months

5. Business growth outcomes
      a. Hours per week of operation
      b. Days per month of operation
      c. Asset value
      d. Monthly expenses value
      e. Monthly sales value
      f. Monthly profit
      g. Inventory value and purchases in the last 30 days
      h. Access to financial services index
          i. Whether the business has a bank account
          ii. Whether the business has a formal bank loan
          iii. Amount of formal bank loans
      i. Number of full-time employees
      j. Number of part-time employees
6. Business formalization outcomes
      a. Whether business self-report being registered with the Uganda Revenue Authority (URA) for tax purposes
      b. Whether business owners have registered with Uganda Revenue Authority (URA) [2]
      c. Whether the business (or owner) paid taxes in the most recent fiscal year[2]
      d. The amount of taxes paid by the business (or owner) in the most recent fiscal year[2]

Nearly all of these outcomes will be collected through our baseline and endline surveys. We will also access administrative data held by our research partner NITA, the government organization responsible for UGPass, to construct non-self-reported versions of the second and third primary outcomes. As well, we

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[2] We will include these outcomes only if we are able to access data from the Uganda Revenue Authority (URA).

plan to seek permission to access data from the Uganda Revenue Authority (URA). As we expect most of these businesses to fall under Uganda's presumptive tax, which covers businesses with sales of up to 150 million UGX (nearly $40,000) per year and is paid as an individual tax by the business owner, we will seek to access registration and presumptive tax records. If successful, we will construct the second, third and fourth outcomes under the sixth family above.

Hypotheses and theory of change

We plan to conduct the study alongside NITA's formal rollout of UGPass to Uganda as a whole. The national campaign is expected to include advertisements, videos, and other types of promotion of UGPass. As our study will take place alongside the launch, we expect the number of users of UGPass to grow over the six months between baseline and endline. We expect that UGPass may affect business outcomes through different channels, which may be affected by network effects to varying degrees.

Even in the absence of others adopting, UGPass likely has benefits for a user. Firstly, UGPass allows the user to prove their identity. This is an important first step towards establishing a relationship in a context of low trust. While this would be possible with the physical national ID card, in practice people do not carry these around, and photocopies are easy to fake. Hence a user could prove their own identity to potential customers or suppliers, potentially overcoming trust barriers to establishing a relationship with them. Secondly, a user of UGPass could write and sign contracts themselves and provide these to a partner to physically sign. Again, this would likely reduce trust issues on the part of others.

As others also adopt the technology, users will be more able to use UGPass to create contracts with authenticated signatures from all parties. Uganda has an efficient small claims court system that is frequently used by small business owners (Nabafu and Musoke, 2020). Being able to provide documentation to that court in the form of a signed agreement with an identified party would increase the likelihood that a claim was successful.

The benefit of UGPass, however, is not necessarily limited to formal enforcement settings. We think the main mechanism through which UGPass would improve contracting would be more one of deterrence or perceptions of deterrence. First, the need to sign may itself be a deterrent to fraud; fraudsters may back off from targeting someone who requires a UGPass-verified contract. Second, and likely more importantly, we think that in a setting where business owners are concerned about fraud, the existence of UGPass can relax those concerns. Essentially, high levels of concern about fraud and the lack of enforcement mechanisms might lead business owners to be reluctant to move beyond relational contracting. The potential to use UGPass may make business owners more willing to expand their business networks by allaying concerns about fraud (as well as, hopefully, both deterring and making fraud easier to enforce legally). These channels are less dependent, at least in our short-run setting, on trust in the Ugandan court system.

Overcoming these contracting and identity verification frictions is expected to benefit business owners chiefly through enhanced ability to create new formal contracts with suppliers and to expand beyond relational contracting. Subsequently, business owners may be able to hire more workers, buy stock at lower prices, reduce stock-outs, and have more regular customers, among other potentially related outcomes, and so the profits of the business may increase. There may also be mechanisms through which UGPass could improve business profits that do not operate through contracting, including by expanding access to formal finance and increasing the formalization of the business. While we expect these later mechanisms

to be less likely upon launch as they are not included in UGPass' initial functionality, over time they are planned to be added, and so could become important channels for impact.

Fundamentally, we leverage two sources of variation: whether the respondent is primed on contracting uses for UGPass and whether the respondent is offered a zero price for UGPass. We will test the following hypotheses for our primary outcomes:

*H1. Being primed about contracting via UGPass (**C**) will:*

> *H1A. Increase the supplier network*

> *H1B. Increase business profits*

*H2. Being offered a price of zero for UGPass (**T**) will:*

> *H2A. Increase the supplier network*

> *H2B. Increase business profits.*

Our secondary outcomes are broader and focused on tracing through the causal pathways described above. We will test the following hypotheses for our secondary outcomes:

*H3. Being primed about contracting via UGPass (**C**) will:*

> *H3A. induce a higher willingness to pay for UGPass;*

> *H3B. lead to a greater likelihood of using UGPass for contracting-related authentication or signing.*

> *H3C. improve a broad suite of measures of uptake and usage of UGPass, including an index of the presence of UGPass in the respondent's network;*

> *H3D. Increase the likelihood of business contracting outcomes*

> *H3E. improve other business network outcomes, including customer networks and business contacts;*

> *H3F. improvement business management outcomes, including supplier management and inventory management;*

> *H3G. increase business growth, as measured by indicators like expenses, sales, profits, inventory value, and access to financial services.*

*H4. Being offered a price of zero for UGPass (**T**) will:*

> *H4A. improve a broad suite of measures of uptake and usage of UGPass, including an index of the presence of UGPass in the respondent's network;*

> *H4B. increase the likelihood of business contracting outcomes;*

> *H4C. improve other business network outcomes, including customer networks and business contacts;*

> *H4D. improvement business management outcomes, including supplier management and inventory management;*

> *H4E. increase business growth, as measured by indicators like expenses, sales, profits, inventory value, and access to financial services.*

H4F. increase business formalization[3]

Basic methodological framework / identification strategy

We use a randomized control trial (RCT) to examine the effects of offering a zero price for UGPass on supplier networks and business profitability, as well as a host of intermediate outcomes capturing use of UGPass, use of contracting, supplier management and other business outcomes. We manipulate the distribution of the randomly offered price within the BDM mechanisms in the WTP experiment to randomly assign respondents to receive a zero price for UGPass or not.

We will randomize the provision of information about the ability to use UGPass for contracting to examine the role of this factors in determining WTP and to assist in isolating contracting as the mechanism through which UGPass operates.

We will conduct a WTP exercise following the standard BDM approach, where we ask the respondent for the maximum price that they would be willing to pay for UGPass. If the price the individual is willing to pay is equal to or greater than a randomly offered price, they will be able to buy UGPass at that price. We will vary the offered price of UGPass from $0 to $5 (where $5 is the expected eventual market price for the bundle in question). We will manipulate this distribution to ensure that a sufficiently large sample is offered UGPass by assigning 1250 respondents to receive a price of 0, 1200 to receive a price of $5 and 50 to receive an intermediate price.

We will ultimately collapse the WTP experiment into a binary indicator for whether the respondent was randomized to receive UGPass at a price of $0. As some respondents may have a valuation sufficiently high to purchase UGPass with a higher price and as it remains possible to purchase UGPass on the open market regardless of one's draw in the WTP experiment, this is more analogous to an encouragement design. As discussed below, however, our scoping work to date leads us to believe there will be a strong first stage.

Sample and statistical power

We will implement our intervention with 2,500 Ugandan small enterprise owners in Kampala. We will select respondents using a sampling survey in several business districts in Kampala. We have the following inclusion criteria:

1. The business owner must have a national ID, which is a requirement for UGPass installation.
2. The business owner must own a smartphone, capable of installing the UGPass application and loading data.
3. The business must operate out of a permanent (concrete or similar) structure and employ at least 1 employee (other than the owner) or operate out of any type of establishment and have at least 2 employees (other than the owner).
4. The business must employ fewer than 20 employees.

In Table 2 below, we present power calculations for the planned study. We assume a comparison of equally sized groups for our contract priming treatments. While we allow for potential drop out between the start of the survey and the intervention, since this will occur before treatment assignment we will exclude these

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[3] We will test this hypothesis only if we are able to access data from URA.

individuals from the study sample. Hence, we assume near perfect compliance with our assigned treatments. We will conduct surveys until 2,500 respondents have completed the baseline survey.

We assume a standard significance level (alpha) of 0.05 and a standard power of 0.8 and calculate all results using two-sided tests. We look at two variables representative of our primary outcomes (number of suppliers and monthly sales). Given the uniqueness of UGPass, we present several alternative scenarios grounded in the scoping and piloting exercises described below. Across them, we are confident in our ability to detect reasonable minimum effects, presented below in units of the outcome.

For primary outcomes, we look at the number of suppliers and monthly sales. The data for the mean and standard deviation of those outcomes comes from the subsample of female entrepreneurs in one of Dr. Riley's other projects in Kampala that met our screening criteria and was collected in 2022. These were the closest outcomes to our primary outcomes that were available in this dataset.

The first row for each outcome focuses on our current approach and is what we would expect to detect under a standard intent-to-treat approach. We expect to be able to detect roughly .1 standard deviations, which corresponds to a change of 1.17 suppliers or $28 dollars per month in profit. In other words, in an intent-to-treat approach, we are well powered to detect even small changes in outcomes, suggesting we may in fact be able to detect a (relatively) precise null. Ex-post, in case of a null, we would also plan to use our survey data to rule out effects of larger or smaller than certain magnitudes.

We also explore what our ability to detect effects would look like under much more conservative scenarios for compliance. As a thought experiment, we calculate power calculations as if our intervention was the installation of UGPass (rather than the random assignment of a price). We then vary compliance - the install rate - for that version of the experiment, from 100% installation (the same as the first scenario) to 80% installation to 60% installation and calculate minimum detectable effects accordingly.

Under our most conservative scenario of 60% installation, we remain able to detect roughly .3 standard deviations, or a change of 3.24 suppliers or $42.5 dollars in monthly profit. While these magnitudes are not ideal, we think this is a highly conservative scenario, and hope it is reassuring that we are likely to be reasonably well-powered.

Table 2 – Power calculations for primary outcomes

Outcome	Install Rate	N	Mean	Std Dev	MDE
Number of Suppliers	100%	2500	6.90	10.40	1.17
Number of Suppliers	80%	2500	6.90	10.40	1.82
Number of Suppliers	60%	2500	6.90	10.40	3.24
Monthly Profit (USD)	100%	2500	$127.40	$136.49	$15.30
Monthly Profit (USD)	80%	2500	$127.40	$136.49	$23.91
Monthly Profit (USD)	60%	2500	$127.40	$136.49	$42.50

3. Data

Data collection and processing

We plan to conduct a baseline survey, and follow-up survey as follows:

- Baseline survey, treatment, and willingness to pay exercise: Following the baseline survey, respondents will receive the contracting treatment as assigned, complete the willingness to pay exercise, and be assigned either a zero or non-zero price. The exercise and survey will be conducted in person on a tablet device.

- Follow-up survey: UGPass usage tracking interviews, conducted by phone with data collection via a tablet device, six months post-intervention. This survey will focus on use of UGPass, use of contracts and business outcomes.

We will conduct sufficient baseline surveys to ensure 2,500 business owners complete the WTP exercise. To ensure high rates of follow up across the survey rounds, we will screen at baseline on willingness to participate in the study and collect multiple contact numbers for each respondent.

We will have access to administrative data on use of UGPass from our administrative partner, NITA, to construct outcomes in our first family of secondary outcomes. We also plan to seek access to data held by the Uganda Revenue Authority to supplement our sixth family of secondary outcomes.

Timeline:

Round	Start date	End date
Baseline survey, treatment and WTP exercise	15 March 2024	15 April 2024
Follow-up survey	15 October 2024	15 November 2024

Variations from the intended sample size

The randomized price offer of UGPass will be programmed into the tablet as part of the WTP exercise and allow the respondent to obtain UGPass at that price. Since we are randomizing almost all respondents to a price of either 0 or $5 (the market price of UGPass), we expect high adherence to the offer of a discounted price. Enumerators will ensure the respondent receives UGPass for free if assigned to this treatment. As such, we also expect high adherence to treatment assignment here.

We do not anticipate attrition to be a significant problem in this study as we will be working with a sample of smartphone users with established business premises. This gives us multiple ways to contact them. We are also conducting the endline survey after a relatively short time period of 6 months post intervention.

Pilot data

In advance of the intervention, we have conducted scoping work and a non-randomized pilot aimed at identifying an appropriate sample and preliminarily assessing interest in UGPass within that sample.

First, we conducted scoping work to help us determine the appropriate sample for the study and to provide some data on the potential willingness to pay variation. In addition, the scoping work has allowed us to refine instruments to explain UGPass and the installation set-up assistance procedures. We have also tested these procedures with a similar sample of respondents to ensure that we can install UGPass on respondent devices during the survey.

We conducted various scoping activities with roughly 30 business owners that met our criteria for the study. Overall interest among small and medium enterprise owners has been high, with nearly 80% of business owners describing UGPass as useful, and more than 70% of owners expressing an interest in using UGPass. In a scoping survey with business owners, we elicited un-incentivized valuations for a bundle similar to that which would be offered in the study (though with no priming or offers of set-up assistance), consisting of UGPass enrollment and three signatures. This bundle will ultimately be valued at roughly $5.00 in future years. The median owner was willing to pay $1.75 for the bundle. 84% of business owners had non-zero valuations, but only 15% had a valuation at or above $5.

From this exercise, we draw two main conclusions. First, there is promising variation even in the absence of additional treatments, suggesting that we are likely to see variation in business owner's WTP. Second, while non-zero valuations were high, the share of respondents with valuations above the maximum price at which we plan to offer UGPass was relatively low. That suggests that we are likely to have a sufficiently strong first stage on take-up to study downstream outcomes.

Second, we conducted a more formal pilot with additional business owners who met our criteria. We moved to this second stage of piloting when UGPass became available for download and installation; in this stage of the pilot, we offered free installation of UGPass, including sign-up assistance, to be conducted immediately. Roughly 80% of respondents agreed to allow us to immediately install UGPass, suggesting that the combination of a zero price and set up assistance will almost certainly create a strong first stage in the study.

This phase of piloting was also useful in allowing us to learn prior to the survey about potential technical challenges to installation. We have worked with NITA to resolve some of these; to deal with others, which cannot be resolved in the short-term, we have added a few additional screening criteria. For example, UGPass install is currently difficult for individuals with three names; NITA is working with another Ugandan governmental organization to resolve this, as it is an issue affecting all national IDs, but it is not expected to be resolved in the short-term. Correspondingly, we will screen these individuals out of our sample. We do not expect these additional screens to have meaningful implications for external validity.

4. Analysis

Statistical model

We will estimate the effect of contracting priming and the randomized price draw on primary and secondary outcomes using the following intent-to-treat (ITT) specification:

$$y_i = \beta_0 + \beta_1 I(P_i = 0) + \beta_2 C_i + \beta_3 I(P_i = 0) * C_i + X_i + \epsilon_i$$

where y_i is the outcome of interest, $I(P_i = 0)$ is an indicator taking the value of one if the randomly drawn price was equal to 0 in the willingness to pay exercise, C_i is assignment to the contracting priming treatment, and $I(P_i = 0) * C_i$ indicates being assigned to a zero price and receiving contracting priming. X_i are

stratification fixed effects and a vector of baseline controls. ϵ_i is a random error term.[4] β_1 is our main coefficient of interest and tests whether receiving a zero price for UGPass affects usage and business-related outcomes. β_2 tests whether receiving contracting priming when randomly assigned a non-zero price affects usage and business-related outcomes. β_3 tests for interaction effects between receiving a zero price for UGPass and contracting priming.

We will also estimate the impact of contract priming on willingness to pay using the following intention-to-treat (ITT) specification:

$$WTP_i = \alpha_0 + \alpha_1 C_i + \boldsymbol{X_i} + \epsilon_i$$

Where WTP_i is the respondent's maximum price the respondent would be willing to pay for UGPass and C_i is defined as above. $\boldsymbol{X_i}$ are stratification fixed effects and a vector of baseline controls. ϵ_i is a random error term. We interpret a statistically significant α_1 as evidence that priming on contracting affects willingness to pay.

All regressions will be estimated using ordinary least squares (OLS). We will estimate standard errors robust to heteroskedasticity. Baseline controls will be selected using post double selection lasso.

As a robustness check we will perform a two-stage-least squares regression where we will instrument for whether someone received UGPass with the random price drawn for them in the willingness to pay exercise, conditional on their own willingness to pay (Berry et al., 2020). We will also implement this specification if our expectations about a high share of compliers prove inaccurate.

There will be no imputation for missing values in our follow-up survey. Missing data from baseline will be replaced with the sample median and a missing dummy indicator included to account for this. We will winsorize monetary values at the 99th percentile, excluding the respondent's willingness to pay.

Multiple outcome and multiple hypothesis testing

In addition to reporting standard p-values, we will also report p-values corrected for multiple hypothesis testing based on sharpened FDR (false discovery rate) q-values *(*Benjamini et al., 2006*).* This correction will be implemented across the two primary outcomes.

Where specified in the outcome variable list, we will group several related variables into index variables following (Anderson, 2008). We will construct the indices in three steps. First, we will re-code all contributing outcomes so that higher values correspond to treatment effects in the same direction ("better" outcomes). Second, we will standardize the individual outcomes using the control group mean and standard deviation for that outcome. Third, we will calculate the average of the standardized constituent outcomes, weighted by the inverse covariance matrix. We will estimate the covariance matrix and hence the weights using only observations that have non-missing values for all outcomes in the index. Where a specific outcome value is missing for a respondent, we calculate the value of the index for that respondent using the remaining outcomes.

Heterogeneous Effects

We will examine heterogeneity by:

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[4] The only exception is when we have WTP as an outcome; then, the estimating equation will include only C_i (as price is drawn after the BDM is complete).

1. Gender
2. Existing use of contracting in the business
3. Business size/profitability
4. Entrepreneurial mindset
5. Concerns about fraud
6. Prior knowledge of UGPass

We plan to look at heterogeneous effects across six different baseline business and entrepreneur characteristics that we believe are related to the likely effect of UGPass on the business. First, past research has shown that women business owners have smaller networks and are less centrally located in those networks (Jayachandran, 2021). As such, their ability to grow and run profitable businesses may be more constrained by relational contracting than that of male business owners. Women are also often particularly vulnerable to fraud and misconduct (Annan, 2022; Ashraf et al., 2019). Given these findings, we expect women to be a key beneficiary of improved systems to verify the identity of suppliers and customers and so potentially see larger impacts on their supplier network and business profits.

Second, businesses that already use contracting in some form might have more to gain by the improved verification and authentication services of UGPass. Examining heterogeneity by this dimension will allow us to test whether the treatments and offer of UGPass is resulting in firms starting to contract for the first time, or leading firms that already contract to expand their supplier network. Additionally, larger businesses, as measured by business size or profitability, might be expected to value more formalized contracts and may be able to improve their business outcomes further when provided with a contracting solution. Entrepreneurs with a higher score on an entrepreneurial mindset index may be likely to see the potential of contracting for their business and be better able to translate use of UGPass into changes in their supplier network and improvements in their business outcomes. We will look at heterogeneity by the respondent's concerns about fraud, as individuals who are most concerned about fraud may be more responsive to using UGPass to expand their supplier network and improve their business profit. Last, those who have already heard of UGPass may be more willing to use UGPass to expand their supplier network and improve their business profits.

5. Interpreting Results

The question of why MSMEs stay small in developing countries is an important one. The inability to verify the identity of potential business contacts is a potentially important barrier to firm growth and productivity. In the absence of strong institutional environments, relational contracting allows firms to operate by substituting social capital for enforcement. At the same time, it seems likely that an inability to shift away from relational contracting may constrain growth, keeping small firms small, and that these constraints may disproportionately burden female entrepreneurs. By studying the potential for a technological innovation tailor-made for identity verification, UGPass, we hope to answer questions about the potential of such a technology to enhance firm networks and firm growth.

Our treatments and primary outcomes are designed to answer key questions about the effects of contracting technology on supplier networks and business profitability. If we see an effect of being offered UGPass for free on supplier networks, this would imply that UGPass is allowing business to expand away from a dependence on relationship based networks. If we see that the contracting nudge enhances this effect, we would have firmer support that the mechanism through which UGPass does this is an improved

ability to write contracts. If we see an effect of receiving UGPass for free on business profits, we would have evidence that relational supplier networks limited business growth and profitability. On the other hand, if we see effects on supplier networks but not on profit, this could imply that relational contracts were not a constraint to business efficiency, or that effects on business profits may take longer to materialize following changes in the supplier network. Finally, if we do not see effects on supplier networks or profits, we will attempt to unpack this null result using our secondary outcomes and differentiate between explanations such as lack of interest in or need for contracting, UGPass not being the right tool to change contracting, network effects meaning that UGPass is not the right tool at launch and technical problems limiting UGPass' ability to improve contracting. We discuss this next.

To determine if contracting is a constraint for businesses, we will ask a variety of questions about their current contracts, or lack of, whether they think their business would benefit from contracting, their interest in contracting and what their constraints are to adopting contracts. Significant decreases in perceptions of barriers to contracting would be consistent with a view by respondents that UGPass is an appropriate tool; null results on interest in contracting and perceptions of barriers would lead us to conclude that UGPass may not target the most important hindrances to contracting.

To determine if businesses value UGPass for contracting, we will utilize the WTP and randomized nudge to contracting. Truthful revelation of willingness to pay should reveal whether businesses identify contracting as a constraint to growth and value technology to overcome it; through our contracting priming treatment, we seek to force a more explicit consideration of this channel. If primed respondents are willing to pay more than non-primed respondents, we will conclude that businesses value technology that can improve the quality and formality of contracts. We will additionally look at whether businesses attempted to use UGPass for any identity or signing purpose, and at intention to use UGPass in this manner. We will also look at whether businesses perceive UGPass as valuable for contracting. This will provide further evidence as to whether respondents perceive UGPass as the right tool to overcoming contracting friction. These intermediate outcomes should allow us to differentiate between a true null effect and intermediate changes that have not (yet) resulted in changes in supplier networks or business growth.

To determine whether the usefulness of UGPass was limited by its recent launch, we will study the number of others that the respondent knows using UGPass and attempts to get others to start using it. If respondents know few people who use UGPass and made attempts to get others to use it, this would imply that UGPass is a potentially useful tool to overcome contracting frictions, but was hindered by the importance of network effects in its use.

If respondents make an effort to install UGPass, and see it as a valuable solution to contracting frictions, but face issues in using it, we would conclude that implementation challenges may have hindered adoption and downstream benefits. To determine if this is the case, we will collect detailed data on attempts to use UGPass and other potential technical challenges to use; data from our government partner is also expected to include information on certain types of signatures failures, which will serve as an objective measure of certain types of technical challenges. This data will allow us to distinguish between respondents being uninterested in vs. unable to use UGPass.

Additionally, it may be the case that our focus on contracting is too narrow; there are other ways in which UGPass may allow individuals to verify identities or strengthen their businesses, such that we see effects on profits but not on supplier networks or other intermediate measures of contracting. We will study this by capturing use of UGPass for other types of activities beyond those related to contracting. Correspondingly,

our secondary outcomes include a larger suite of business-related variables, including broad measurements of growth. Our power calculations suggest that we are well positioned to measure meaningful changes in outcomes like monthly profits. If we find null or muted results on our intermediate variables but significant changes on broader business outcomes, we would explore the alternate pathways through which UGPass might affect businesses, such as through access to financial services or increased formalization.

Regardless of our final results, this study is extremely well positioned to affect policy. Many governments around the world are in the process of rolling out various types of digital ID systems, from India to Malawi. Uganda is one of the first countries to roll out a digital ID in Sub-Saharan Africa, and the first that we are aware of to roll out a signature verification technology. Our project is directly relevant to policy makers in Uganda and elsewhere who are interested in the potential users and benefits of this type of digital identity verification service, including NITA, our partner in this research. Our research will provide new evidence as to how digital signature authentication can facilitate business to business contracts, and hence improve firm growth and productivity, a priority for policy makers everywhere. Additionally, we aim to inform policy makers as to the demand and willingness to pay for a digital ID amongst a key interest group that they have identified, MSMEs. This will help policy makers make the best decisions around the pricing and advertisement of digital IDs.

6. Limitations and challenges

Our WTP experiment focused on randomization of contracting information and price will be tightly controlled and administered by enumerators following prompts on a tablet. As such, we do not expect major threats to compliance.

With regards to take up and usage, however, our experiment is more akin to an encouragement design. As such, the primary threat to internal validity will be an insufficient first stage. We are limited in options for randomization; UGPass is being rolled out nationwide in Uganda, and we cannot plausibly deny anyone access to the service. We expect, however, to be able to induce variation in effective take up by manipulating the price distribution in the BDM mechanism. Based on our scoping work to date, there is high interest in UGPass, such that we think sufficient people will want to receive UGPass for free and that set-up assistance will ensure they successfully sign up. However, there is also evidence of enough variation in willingness to pay to expect that the market price of $5 will price a sufficient share of respondents out of obtaining UGPass. As such, we believe that our proposed design will provide strong encouragement to sign up for UGPass. In addition, we have been conservative in our expected usage rates of UGPass in our power calculations, and have a large sample size, so that we will be powered to detect even small effects on usage of UGPass.

Final limitations relate to the roll-out of UGPass by NITA (the arm of the Ugandan Government that developed UGPass). We plan to time the launch of our study closely after the launch of UGPass nationwide, in March 2024. This is so that people will not already have UGPass and so that we can make use of a reserved number of free licenses provided by NITA. As such, the study may have to be delayed if the launch of UGPass is delayed. However, we think this is unlikely given that a final version of the UGPass app has already been developed and is available to download and test. We have been using this test version of UGPass in our scoping activities. Delays to the launch of UGPass are therefore likely to be relatively minor, if at all, and so would not negatively affect the study.

It is also possible that there are technical problems with UGPass at launch. As part of our scoping activities, we have been testing the installation of UGPass in the field to ensure everything works as expected, and to ensure we can carry out the free set up assistance part of our intervention. Our close communication with NITA means that we are confident that we can ensure UGPass is working as it should before we launch the study.

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8. Administrative information