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ABSTRACT

Evidence suggests that many firms in lower-income countries stagnate because they cannot access growth-conducive markets. We hypothesize that overlooked informational barriers distort market access, excluding productive but "information-poor" suppliers. To investigate, we gave a random subset of medium-sized Liberian firms vouchers for a week-long program targeting equal-opportunity access to the input purchases of government, companies, and other organizations—a market that makes up upwards of 80 percent of global GDP. The program exclusively teaches "sellership": how to navigate large buyers' complex, formal sourcing procedures. Firms that participate win three times as many formal contracts a year later. The impact is heterogeneous: informational sales barriers bind for about a quarter of Liberian firms. Three years post-training, these firms continue to win desirable contracts, are more likely to operate, and employ more workers. We use a simple model of managers' time-constraints to illustrate a possible explanation for why informational market access barriers can persist and generate poverty-trap-like dynamics among firms, even absent credit constraints. Our results help rationalize common demand-side policies in public procurement that nonetheless appear to scratch at the surface of a bigger distortion.

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1 Introduction

Firms in poor countries often grow slowly (Bloom *et al.*, 2010; Hsieh & Klenow, 2014; Verhoogen, 2023). A large body of work investigates explanations rooted in production contraints—the cost firms incur to produce goods and services (see surveys by McKenzie & Woodruff, 2023; Quinn & Woodruff, 2019).[1] More recently, another strand of research has shifted focus to demand constraints. Access to bigger and more quality-sensitive markets can raise firm growth (Verhoogen, 2008; Donaldson & Hornbeck, 2016; Jensen & Miller, 2018; Hornbeck & Rotemberg, 2019; Goldberg & Reed, 2023), and smaller firms in particular often benefit from selling to large buyers (Hoekman & Sanfilippo, 2018; Abebe *et al.*, 2022; Alfaro-Urena *et al.*, 2022).

But why are some firms better able to access desirable markets than others? Traditional market access barriers—lack of infrastructure, high tariffs, and so on—exclude sellers in particular locations or of particular "types".[2] However, ability to market products appears to vary substantially even across quite similar firms that are located near each other, hinting at an important role for overlooked categories of access barriers.

The literature on information frictions points towards one (Jensen, 2007; Allen, 2014; Startz, 2021; Atkin *et al.*, 2017b): buyers' sourcing practices. Purchases by governments, companies, and other organizations make up upwards of 80 percent of global GDP by some estimates (Aigheyisi & Edore, 2015; Sarangi, 2018; Bosio *et al.*, 2022), and their input procurement procedures are often extremely complex. Governments routinely require intricate forms that are many hundreds of pages long for small contracts, and other organizational buyers also procure through complex formal processes.[3] Perhaps not surprisingly, few suppliers bid, even on tenders for simple goods and services. About a quarter of EU public procurement contracts and 45 percent of the value of federal U.S. procurement are awarded to a sole bidder (Kang & Miller, 2022; Titl, 2023). Meanwhile, recent

[1] Quinn & Woodruff (2019), McKenzie & Woodruff (2023), and Verhoogen (2023) point out that the results have been mixed. Policy interventions that have raised growth or productivity by loosening production constraints have typically been tailored to individual firms and/or very expensive.

[2] De Loecker & Goldberg (2014)'s review covers much of the existing literature on traditional market access barriers; see Donaldson & Hornbeck (2016) and Bold *et al.* (2021) for examples close to this paper.

[3] Liscow *et al.* (2023)'s data e.g. show that 300+ "bid letting" forms are not uncommon even for purchases of fairly simple goods and services in U.S. public procurement, but the EU and U.S. are not outliers. In Chile a recent ∼USD 75,000 bid on a tender for a medical exam table contains 88 PDFs, many of which are certificates requiring notary certification (see `http://mercadopublico.cl/` for details). The situation is often worse in developing countries. An assessment of Uganda's, by WTO/UNCTAD, reports: "...participation in public procurement...is very minimal. Suppliers who would like to participate...find the procurement procedures irrational and cumbersome. They are sometimes excluded when the procurement is too big and they are apprehensive of unfamiliar procedures. They are not well informed. This renders the process difficult and open to abuse" (Wittig, 2003, p. 6).

studies provide compelling evidence that many small, counterfactual suppliers can successfully supply large domestic and international buyers (Ferraz *et al.*, 2016; Atkin *et al.*, 2017a; Carrillo *et al.*, 2023).[4]

In this paper we test the hypothesis that input procurement procedures *themselves* exclude productive-but-information-poor firms from growth-conducive markets. We do so by teaching randomly chosen Liberian firms how to market their products to large buyers through formal tenders. This is to our knowledge the first attempt to investigate how informational barriers to accessing a particular market causally affects performance. We quantify what share of potential suppliers in a low-income country like Liberia procedural complexity in buyers' sourcing "binds" for.

Experimental variation comes from a program that takes buyers' incentives (as reflected in prevailing sourcing procedures) as given, instead teaching "outsider" firms how to construct good bids on tenders. The program is simple: seven days long; exclusively focused on participating and succeeding in formal procurement markets; and similar to a public training program for SMEs in Italy (OECD, 2016).[5]

The paper has four parts. First we estimate the average impact a year later on the quantity and quality of contracts won. Next we show how this varies across firms. In the third part of the paper we examine the corresponding impact on contracts won and measures of growth itself—workers employed and firm survival—*three* years after firms are shown how to market their products to large buyers. We compare this long(er)-run growth effect for firms whose sales are information-constrained in the short-run vs. others. In the final part of the paper we use a simple model of managers' time-constraints to illustrate a possible explanation for why such informational market access barriers can persist and generate poverty-trap-like dynamics.

The 1,192 suppliers in our sample are established firms in Monrovia, Liberia's capital city: medium-sized by local standards, with four employees on average; formally registered; and active. The sample is drawn from a registry maintained by Building Markets, the non-profit we work with. The firms come from a wide range of sectors, including "Construction and Renovation" (23 percent), "Food and Beverages" (15 percent), "Home Essentials" (13 percent), and "Handicrafts and Artisans" (12 percent). Like most firms in poor countries, they have little experience supplying to large buyers and instead sell mostly to final consumers. Eleven percent recently held a contract awarded through a

[4]They do this through (conditionally) randomized contract "drops"—a powerful research methodology that removes the need for suppliers to navigate buyers' sourcing behavior to learn how to "make" sales.

[5]Appendix Table A.1 displays examples of tenders in Liberia. The training is run by a non-profit, and not sector-specific. One part covers fundamentals of bidding and common buyer preferences such as favoring "green" suppliers. (Most firms in our sample use little energy and would be considered "green", but few were aware of this before taking the training.) A second part provides practice and feedback on mock bids.

formal bidding process. The *Winning-contracts* training aims to change this.

The research team first visited the firms in the treatment group in mid-2016, giving their managers a free voucher to attend the training and information about otherwise similar firms which took the training in the past.[6] About 20 percent of firms in the treatment group participated in the training because of the encouragement (voucher+information). The first and second endlines took place in 2017 and 2019.

In the first part of our empirical analysis, we show that firms bid on and win more and better contracts a year after being taught how to market their products to large buyers. They supply more buyers, and win more contracts also through other means than formal tenders—suggesting increased market-access "capability" (in Verhoogen (2023)'s terminology), rather than mere box-ticking on a tender form. They also triple their probability of supplying to international buyers, and win much larger contracts. This appears to improve bottom-line performance: trained firms earn about USD 10,000 in revenue from contracts over six months above and beyond a control group mean of about USD 5,000.

In the second part of our analysis, we estimate that informational barriers to market access bind for about a quarter of firms. Productivity is widely dispersed in countries like Liberia (Hsieh & Klenow, 2009; Syverson, 2011), and we do not a priori expect such barriers to ultimately constrain all or a majority of firms. To categorize firms, we use baseline characteristics to predict how bidding activity itself responds to the treatment through a double-LASSO regularization procedure (Chernozhukov *et al.*, 2018). Thereafter we compare treated firms of each responsiveness category to control group firms of the same type. After one year, contract-winning knowledge affects the four types of outcomes we focus on—measures of bids and contracts won, new buyers, quality of contracts won, and firm performance—to a large (and statistically significant) extent for top-quartile firms (only).

We then show, in the third part of our analysis, that this quartile of firms continue to benefit *three* years after learning how to sell their products to large buyers. They continue to win desirable contracts and, most notably, employ more workers and are more likely to operate three years after the week-long training. The other treated firms continue not to benefit from, but also aren't harmed by, Winning-contracts training after three years.

In the fourth and last part of our analysis, we illustrate a possible explanation for why informational market access barriers persist despite the remarkable benefits to some firms of a simple remedy such as the training we study. We model time-constrained firms as spending their time either serving final consumers or fulfilling large contracts. They differ in their initial ability to bid on and win large contracts, which determines whether the

[6] We measure the initial characteristics of firms in the sample frame using periodical surveys conducted by the non-profit. These were also used to stratify the randomization.

time and effort required to bid outweighs potential benefits. This establishes an ability-threshold; "sellership-capable" firms above this threshold allocate some time to bidding on contracts, while those with contract-winning ability below the threshold focus solely on serving final consumers. Winning-contracts training improves firms' ability to win contracts. However, only firms whose sellership ability was initially relatively high surpass the "bidding threshold". The short- and longer-run impact of the training thus depends on initial sellership knowledge, potentially generating poverty traps among firms, even if they aren't subject to credit constraints (Dasgupta & Ray, 1986; Banerjee & Newman, 1993; Banerjee & Duflo, 2005; Buera *et al.*, 2011; Balboni *et al.*, 2021).

Our results suggest, perhaps not surprisingly, that suppliers and buyers are collectively better off when more suppliers can effectively bid on contracts. Unlike other work (most notably Carrillo *et al.* (2023)[7]), we do not study allocative efficiency—our goal is instead to estimate what share of firms are excluded from formal markets because of a particular barrier to access. But the initially-constrained firms we identify continue to bid on formal contracts three years post-training, and large buyers continue to award them contracts.[8] The simple model we present illustrates one possible mechanism through which productive firms with the potential to supply large buyers may not learn how to "make" sales on their own—a need to spend their time serving less growth-conducive buyers.

Only one particular baseline characteristic stands out in the double-LASSO procedure predicting how bidding activity responds to the treatment, and it is consistent with an important role for the ease with which managers can bid on contracts: whether the firm has access to the internet.[9] We cannot rule out other interpretations, but the other (group of) predictors instead—and also broadly consistent with our model—tend to capture prior attempts bidding on formal contracts (see also Banerjee *et al.*, 2019).[10] Notably, however,

[7] Carrillo *et al.* (2023) study allocative efficiency in a public procurement context where the government randomly allocates contracts to participating firms. In their setting (Ecuador), a notably high number of firms participate in each auction (10 on average, 4 at the median). They show compelling evidence that, in such a setting, a counterfactual efficient allocation of contracts would only marginally increase welfare. The results in this paper suggest that the high participation in Ecuadorian procurement auctions relative to many other contexts may in fact be *due* in part to its randomization system.

[8] To quantify the allocative efficiency consequences of the entry barrier we uncover, future research can measure (i) the extent to which "insider" (but out-of-sample) firms lose out from no longer winning the relevant contracts, and (ii) how much more time buyers need to select winners when more suppliers bid.

[9] This finding also makes clear that, among "outsider" firms in Liberia—like the firms in our sample—it is difficult even for those with good access to information to learn how to win formal contracts on their own initiative. Instead, information- and communications technology complements such knowledge.

[10] Banerjee *et al.* (2019) show evidence that, although microcredit has been found not to increase revenues and assets on average (Meager, 2019), it appears to do so for households who were already running a small business, especially over time—consistent also with Meager (2022)'s quantile results (see also Fiala, 2018). Our results are also consistent with liquidity or credit constraints *interacting* with managers' time constraints—firms below the contract-winning ability threshold may need to focus on serving final con-

the firms which benefit from learning how to sell to large buyers are not more likely to take the week-long training when offered. This suggests that the across-firm correlation between informational market access barriers and managers' ability to invest time and attention in new revenue streams is low or, alternatively, that firms deviate from optimal behavior as conventionally defined (see e.g. Hortacsu & Puller, 2008; Cho & Rust, 2010; Goldfarb & Xiao, 2011; Anderson *et al.*, 2018; DellaVigna & Gentzkow, 2019; Kremer *et al.*, 2019; Dube *et al.*, 2018; Almunia *et al.*, 2024).[11] It also helps rationalize common *demand-side* policies in public procurement, such as preference programs for disadvantaged firms, and less common ones, such as randomizing which suppliers are awarded contracts (Best *et al.*, 2023; Carrillo *et al.*, 2023; Carril & Guo, 2023).

This paper uncovers an overlooked informational barrier facing disadvantaged firms and begins to characterize the extent to which it excludes productive suppliers from growth-conducive markets. We build on research documenting how complex application procedures and knowledge barriers constrain qualified-but-underrepresented *individuals'* educational, labor market, and social assistance choices (see e.g. Jensen, 2010; Bettinger *et al.*, 2012; Kling *et al.*, 2012; Chetty & Saez, 2013; Carranza *et al.*, 2022; Hardy & McCasland, 2023; Abebe *et al.*, 2021; Bassi & Nansamba, forthcoming). We connect the information-constrained decision-making literature with work on market access and firm growth. We thus begin to unpack how a particular form of inequality-of-opportunity—variation in informational market barriers across suppliers—distorts input markets.[12]

We also contribute to the literature on the causes and consequences of market access. We do so by providing a first look at the role of access barriers that are qualitatively dis-

sumers because they are closer to running out of money (Akcigit *et al.*, 2021; Hardy *et al.*, 2022). This would further reinforce the poverty-trap dynamics we illustrate in the time-constraints model.

[11] Baseline beliefs about the firm's future bidding on/winning contracts diverge substantially from end-line data on actual contract-bidding/winning: very few firms bid anywhere near as much as they expect to, even after training. The training itself and subsequent bidding experience does not counteract firms' "over-confidence". This, and also 106 firms that our Chernozhukov *et al.* (2018)-procedure classify as quartile 1, 2, or 3—those who do not benefit from the training—nevertheless choosing to take it, are consistent with a role for non-standard belief-formation, though other explanations are possible too.

[12] Prior studies document classical information frictions—constrained contracting, matching, and search—in low-information markets (see e.g. Aker, 2010; Allen, 2014; Jensen & Miller, 2018; Hansman *et al.*, 2020; Startz, 2021; Hjort & Tian, 2024). Like this paper, Jensen (2007), Mitra *et al.* (2018), and Colonnelli *et al.* (2024) analyze how *sellers'* access to information affects market outcomes: Colonnelli *et al.* (2024) e.g. show experimental evidence from Uganda that "changing firms perceptions about the integrity of public entities increases firms' total number of bids and total government contracts won" (p. 1). We know of one other paper that experimentally varies firms' sellership ability—Anderson *et al.* (2018)—but their interest is not barriers to accessing a market. They study micro-sized *retail* entrepreneurs and analyze the impact of an intensive 10-week training. However, Anderson *et al.* (2018)'s results are consistent with ours in that they find remarkably large impacts on sales and profits in South Africa. Some similarly hands-on consulting programs studied in the literature—e.g. in Bruhn *et al.* (2018); Anderson & McKenzie (2022)—include marketing among multiple modules in a tailored or broad training package.

tinct from the physical and legal ones studied in existing research.[13] We show that informational barriers constructed by buyers help explain why productive firms in developing countries rarely participate in growth-conducive value chains. That access to buyers can be important for firm growth is most clearly shown in studies that exploit random or quasi-random allocation of contracts (Ferraz *et al.*, 2016; Atkin *et al.*, 2017a; Carrillo *et al.*, 2023). This paper to our knowledge provides the first direct evidence on why some firms are able to sell goods and services to a particular market while similar firms in the same location are not.

2 Context and Experimental Design

In this section we describe the context Liberian firms operate in, and the design of the experiment we use to investigate how informational barriers to marketing goods and services affect their sales.

2.1 Sample

The sampling frame is a directory of active firms in Liberia akin to the Yellow Pages. The directory is maintained by the non-profit we work with, Building Markets, and listed more than 4,000 firms in 2017. To be included in the sample, firms had to have at least one employee in addition to the owner; be located in Monrovia, the capital city; and have not already taken the Winning-contracts training.[14]

Relative to all firms in Liberia's economic census, firms with between five and 20 employees are over-represented in our sample, while the smallest and bigger firms are underrepresented. This is shown in Panel A of Table 1. The firms in the sample span many different sectors, the largest being "Construction and Renovation" (23 percent), "Food and Beverages" (15 percent), and "Home Essentials" (13 percent). We show this and other summary statistics from before the experiment started in Panel B. These data come from periodical surveys the non-profit carries out to keep track of the firms in its directory. The mean number of employees is four, but there is substantial variation in this measure

[13] In addition to the more empirical work cited above—see Verhoogen (2008), Foster *et al.* (2016), and Pozzi & Schivardi (2016) for examples, and Syverson (2011); De Loecker & Goldberg (2014) for overviews of related literatures—there is a burgeoning theoretical literature on how demand forces affect firm dynamics (see e.g. Drozd & Nosal, 2012; Gourio & Rudanko, 2014; Arkolakis *et al.*, 2018), and a growing body of work on industrial policy (see e.g. Lane, 2020; Juhász *et al.*, forthcoming; Juhász & Steinwender, forthcoming).

[14] In addition, since a lot of firms closed down after the 2014-2016 West African Ebola outbreak, only firms that had been in contact with the non-profit after April 2015 (when the outbreak subsided) were included in the sampling frame.

of firm size. Eighty-nine percent of the firms have at least one Liberian owner. Thirty percent of the managers speak at least one local language in addition to Liberian English.

The firms in the sample have little experience supplying to large buyers. Seventeen percent bid on one or more tenders in the six months before being interviewed, and 11 percent won one or more tenders. The average success rate—tenders won relative to tenders the firm bid on—is 29 percent.

2.2 Procurement by large buyers in Liberia

The non-profit we work with attempts to record all formal tenders in Liberia. In 2016, it recorded 1,381 tenders. A little more than half are from public sector buyers such as ministries; a small minority from private companies; and the remainder from international organizations and NGOs. Most tenders are posted publicly: 57 percent in newspapers and another 31 percent online. Appendix Table A.1 displays examples of tenders from different types of buyers.

2.3 The Winning-contracts training

We randomly assigned firms in the sample to treatment (772 firms) and control (420 firms) groups. The randomization was stratified on number-of-employees bins, sector, and the geographical zone within Monrovia in which the firm is located. The treatment and control groups are balanced, as shown in Table 1.

The research team visited the treatment group firms starting in June 2016 and gave each one a voucher allowing one person from the firm to attend the Winning-contracts training for free.[15] The firms were also asked to answer a survey and given information about the training. This information included the training's content, as well as statistics on how participation correlated with bidding and various measures of success for firms like theirs in the past, as measured in data from the non-profit's periodical surveys.[16] Firms in the control group did not receive a visit from the research team at baseline and were not provided with a voucher, but could seek out the training on their own initiative, at a cost of USD 50. Four control firms decided to do so.

[15] The voucher did not have an expiration date and could be used when desired.

[16] As specified in the pre-analysis plan, the voucher was combined with different statistics on how participation correlated with bidding on and winning contracts in the past in several different sub-treatments used to encourage firms to attend the training. However, we do not observe differences in effects of these sub-treatments in either take-up or effect of the treatment. In the analysis presented here, all sub-treatments are combined.

The training content focuses exclusively on how to bid on and win formal contracts. It is not aimed at raising a firm's productivity: neither of the two training sessions are sector-specific, and there is no mention of management practices, financial planning, product development, or take-up of new technologies.

The first training session lasts five days and is referred to as *General Procurement* training. This session teaches participants the fundamentals of the process of bidding on tenders: how to find tenders and how to bid. The General Procurement session also provides information about supplier and bid characteristics that many buyers require or put weight on when awarding a contract. Examples include environmental awareness, ethical behavior, and sensitivity to cultural differences or persons with disabilities. Clarifying these is an important aspect of the training because many participants say that they find such auxiliary buyer preferences confusing. For example, most small and medium-sized firms in Liberia use little energy and therefore would be considered "green" businesses, but many fail to mention this in their bids.

Completing the first week of training is required to participate in the second training session, called *Bid Compilation* training. This session lasts two days and offers a hands-on toolkit for producing bids. Participants do exercises in which they examine a mock tender, prepare a draft bid, learn how to communicate with buyers at different stages of the tender process, and undergo evaluation of their bid.

Almost all firms in the sample that took the training did so from June 2016 to November 2016.[17] The non-profit offered two to three training sessions per month depending on demand, and a total of eight training sessions. On average 32 attendees from firms in 11 different sectors participated in each training session.

2.4 Data

Our analysis is based on data collected in three rounds: baseline, first endline, and second endline. Firms listed in the non-profit's directory are asked to answer a phone survey every three to six months. The data collected through these phone surveys were made available to the research team. We refer to the last round before the data collection for the experiment itself as the baseline data.

The research team visited the firms in the treatment group starting in June 2016 to give them the training voucher. We attempted to re-interview all firms in the full sample for the first endline survey between March and June 2017. Out of the 1,192 firms in the sample, we successfully (re-) surveyed 789 firms: 284 in the control group, and 505 in the

[17] Three firms took the training in January 2017.

treatment group. The survey team's use of a battery of tracking techniques—both phone and in-person search, GPS devices, flexible scheduling of interviews, etc—kept attrition low. Lastly, the research team carried out a second endline survey from April to May 2019. 628 firms were surveyed: 222 in the control group, and 406 in the treatment group. There was no differential attrition across the treatment and control groups in either of the two endlines.[18] Our results are generally robust to a Lee (2009) bounds estimation approach to probing attrition concerns.[19]

3 Reduced Informational Barriers to Selling Goods and Services: Average Impact

In this section we show that the opportunity to learn how to sell goods and services to large buyers enables Liberian firms to bid on and win more and higher-quality contracts.

Where relevant we show both Intent-to-treat (ITT), or reduced form, and Treatment-on-the-treated (TOT), or IV results. The latter come from regressions like the following:

$$\mathrm{y}_i = \beta_0 + \beta_1 \text{Winning-contracts Training}_i + \gamma \mathrm{X}_i + \epsilon_i \tag{1}$$

Here y_i is a firm i outcome measured at endline. X_i is a set of controls measured before the experiment, including fixed effects for a firm's sector(s), location, and size-bin. We show results both with and without controls included. Winning-contracts Training$_i$ is an indicator variable equal to one for firms that participate in the training, and β_1 is the coefficient of interest.

3.1 Take-up of training

The treatment—the voucher and encouragement to attend the training—increases the probability that a firm participates by 19-20 percentage points, as recorded in the non-

[18] This is shown in the last two columns of Panel B of Table 1 for the first endline (corresponding results for the second endline are available from the authors), and holds despite the firms which answered each endline survey being slightly different from firms which did not (as shown in appendix table A.2 and A.3).

[19] While this method is non-parametric and relaxes exclusion restriction assumptions that other approaches make (such as Heckman's sample selection approach (Heckman, 1979)), it does impose monotonicity in treatment selection. The implied assumption that firms which received the treatment are more likely to be observed than control firms is clearly reasonable in our context. The results from Lee (2009) bound checks show that our findings are generally robust—despite our moderate sample size, many remain statistically significant, including the central result that treatment increases the number of contracts won, and that the overall impact is highly heterogeneous and driven by the most "bidding responsive" firms. Tables A.9 and A.10 in the Appendix show these results.

profit's attendance sheet. This is shown in columns (1) and (2) of Appendix Table A.4.[20] Given this relatively high but incomplete take-up, the ITT estimates of impact are scaled down in magnitude relative to the TOT estimates that follow, but generally of similar statistical significance.

3.2 Number of contracts won

Recall that small- and medium-sized Liberian firms rarely bid on formal contracts. The control group firms in our sample bid on 0.43 tenders during the past six months on average. Winning tenders is even more rare: control group firms won an average of 0.27 contracts through a formal bidding process in the past six months. For this reason—and because control group firms weren't informed about the research and training activities until endline[21]—Winning-contracts training almost surely shifted contracts across groups *within our sample* to a very limited extent. Instead, increased contract winning by the treatment group firms would have come at the expense of the (few) "insider firms" that won most formal contracts in the status quo.[22]

Enhanced contract-winning knowledge markedly increases the number of contracts firms bid on and win a year later. We show this in Panel A of Table 2. First, as seen in columns (1) and (2), firms that are induced to participate in Winning-contracts training by the randomized encouragement bid on 0.56 more tenders over a six month period—an increase of more than 150 percent compared to the control group. We find a large positive impact also on the total number of contracts won. Trained firms win more than one additional formal contract over the course of six months—an increase of over 200 percent—as we show in columns (3) and (4). It thus appears that firms that learn how to market their products to large buyers can access a market that otherwise comparable firms cannot.

The benefits of enhanced contract-winning knowledge extend beyond a greater ability to win tenders. To see this, we look at contracts won through other means than a tender process—those that do not require a formal bid—in columns (7) and (8) of Table 2.

[20] Those in the control group were not encouraged to attend the training, but four control group firms independently decided to pay to participate. Referring to the IV results as TOT estimates is thus somewhat loose. We measure attendance for the first part of the Winning-contracts training, the General Procurement session. Note also that, following Abadie *et al.* (2023), we present robust standard errors as there are neither sampling design nor experimental design reasons for clustering in our context, although our results are robust to clustering at the sector level.

[21] Recall that the research team did not collect data from control group firms until the endline.

[22] One way to explore this conjecture is to exploit geographical variation: we find that control firms that are located geographically close to treated firms are not less likely to win contracts at endline. Results available from the authors.

Trained firms win 200 percent more non-tender contracts. This suggests that Winning-contracts training does not merely flag particular boxes to tick or buzz-words to use, but rather conveys a deeper form of knowledge necessary to effectively convey appeal and qualifications to large buyers.

Treated firms also appear to win substantially more contracts through formal bidding processes—0.27 more compared to a mean of 0.15—as shown in columns (5) and (6). This estimate is not statistically significant, however.

3.3 Contracts won from new buyers

Learning how to market goods and services to large firms and organizations enables Liberian firms to win contracts from many more buyers. We show this in Panel B of Table 2. Firms that participate in the Winning-contracts training more than double the number of buyers they supply; triple their probability of supplying international buyers; and roughly double their probability of supplying both private sector and government/non-profit buyers. That contract-winning knowledge enables firms to win contracts from new *types* of buyers is especially noteworthy.

3.4 Quality of contracts won

The training increases not only the quantity, but also the quality of contracts firms win, as we show in Panel C of Table 2. Treated firms that take the Winning-contracts training more than double their chances of winning long-lasting (six months or more) contracts. They also triple their probability of winning a contract in the top quartile of the contract-value distribution observed in our baseline data; more than triple the value of their biggest contract; and more than quadruple the size of their biggest contract as measured by employees needed to fulfil it.

3.5 Firm performance

Reduced informational barriers to selling to large buyers appears to ultimately improve firms' performance considerably. With the results in panels A – C of Table 2 in mind, this is not surprising. It is for example well-established that exporting often enables firm "upgrading" (Atkin *et al.*, 2017a; Verhoogen, 2023), and there is growing evidence that supplying to foreign buyers operating in the home market can similarly benefit firms in poor countries (Abebe *et al.*, 2022; Alfaro-Urena *et al.*, 2022).

The estimates in Panel C suggest that the total value of contracts won is around USD 10,000, or 200 percent, higher in treated firms that take the Winning-contracts training.[23] These benefits greatly outweigh the costs of administering the training.[24]

We also find that the training increases the number of employees firms need to fulfil their formal contracts by 400 percent—an increase of four workers from a mean of one. Interestingly, firms' *total* number of employees is unaffected a year after the training. The longer-run picture is somewhat different, as we return to in Section 5.

The evidence we have presented in Section 3 shows that the opportunity to learn how to access large buyer markets is remarkably beneficial for small- and medium-sized Liberian firms a year after the training.

4 Reduced Informational Barriers to Selling Goods and Services: Heterogeneity in Impact One-Year-Out

In this section we show evidence that informational barriers to accessing large buyer markets "bind" for about a quartile of the firms in our sample. The average impact of the Winning-contracts training is in large part driven by these firms.

There is wide dispersion in productivity in developing countries (Hsieh & Klenow, 2009; Syverson, 2011). We therefore do not expect contract-winning knowledge to constrain the growth of all or a majority of firms. To investigate, we estimate regressions of this form:

$$\begin{aligned} \mathrm{y}_i = \beta_0 + \beta_1 &\text{Winning-contracts training}_i \\ + \beta_2 &\text{Winning-contracts training}_i \times \text{Category}_i + \gamma \mathrm{X}_i + \epsilon_i \end{aligned} \tag{2}$$

To categorize firms, we use the full set of suitable baseline characteristics. We estimate the best linear predictor of the conditional average treatment effect on a firm's bidding activity through the split-sample LASSO regularization procedure developed in Chernozhukov *et al.* (2018). Each firm is in a particular quartile of the distribution of the training's predicted impact on the number of tenders bid-on (see Appendix A.1 for details). We then compare the one-year-out outcomes we considered in Section 3 for treated firms relative

[23] Although remarkably large, this estimate is only marginally statistically significant, perhaps because—as is common in firm surveys—many managers were unwilling to answer questions about the value or sources of their contracts. We treat such missing values as zeroes. Firms in the treatment group were 21 percent more likely not to answer value-of-contracts-won questions, suggesting that we may be underestimating the impact on contract revenue.

[24] The non-profit who runs the training estimates the cost of running the training at USD 1,740 per firm.

to control group firms of the same quartile.[25]

Reduced informational barriers to selling to large buyers consistently benefit "Quartile 4" firms across all four categories of outcomes we consider. Recall that these are measures of respectively bids and contracts won, new buyers, quality of contracts won, and firm performance. For one of the individual outcomes we focus on—the number of tenders the firm bids on—finding the largest impact for Quartile 4 firms is somewhat mechanical because we categorize firms by their bidding activity response to the training. However, our goal here is simply to quantify what proportion of medium-sized Liberian suppliers informational market access barriers appear to bind for.

Contract-winning knowledge does not benefit quartile 1 and 2 firms. There are signs of some outcomes improving for Quartile 3 firms, but the estimated treatment effects are consistently large and statistically significant only for top-quartile firms. We show these results graphically for about half of the outcomes in Figure 1, and the corresponding linear regression results that capture how the estimated treatment effects differ for Quartile 4 compared to the rest of the sample for all outcomes in Appendix Table A.5.

Since the quartile of firms that are most constrained by large buyers' sourcing procedures in large part drive the average treatment effects shown in Section 3, it is not surprising that these firms' estimated response is large. A year after learning how to sell goods and services in the formal contracts market, they are for example 70 percent more likely to win a formal tender and earn about USD 12,000 or 75 percent more in revenue from formal contracts over six months.

5 Reduced Informational Barriers to Selling Goods and Services: Heterogeneity in Impact Three-Years-Out

Quartile 4 firms—the group of firms that win more and better contracts one year after the Winning-contracts training—continue to benefit *three* years after the training. They do so across all four categories of outcomes we consider. We show group-specific treatment effects on measures of bids and contracts won, new buyers, quality of contracts won, and firm performance three years after the training in Figure 2 (and in Appendix Table A.7). The firms that did not benefit a year after the training—quartiles 1-3—continue not to do so three years after the training. Quartile 4 firms in contrast continue to benefit as measured through many (but not all) of the outcomes we consider. The improvements

[25]Note that we find no heterogeneity in take-up of the training across the four quartiles. This simplifies interpretation of the heterogeneity-in-impact results we present next. We discuss implications of this important finding in Section 7.

are generally somewhat smaller than in the shorter run, but Quartile 4 firms appear to continue bidding on more tenders, winning contracts from international buyers, and employing more workers to fulfil their formal contracts.[26] We also see marginally significant impacts on measures of firm *growth* three years after the week-long training. We show this in Figure 3. Our estimates indicate that Quartile 4 firms employ about one or 30 percent more workers in total, and are about 12 percent more likely to operate, relative to comparable control group firms, three years after learning how to sell to large buyers.

6 Conceptual Framework

In this section, we present a simple model that illustrates a possible explanation for (i) why the benefits of increased contract-winning knowledge vary across firms and (ii) why the underlying informational market access barriers persist despite the existence of seemingly simple remedies such as the training we study.

6.1 Firms

Suppose that a firm's time and resources are allocated to two different activities: serving final consumers and fulfilling contracts from corporations, government, and other large buyers. T is a firm's total available time and s and b are the time spent on each activity, respectively. Profits from serving final consumers are π_S and profits from contracts π_B. Firms maximize the following profit function:

$$\pi = \pi_S \log(s) + \pi_B \log(b + 1) \tag{3}$$

Contracts are more profitable than supplying final customers ($\pi_B > \pi_S$), but also more time-consuming. This is represented by the parameter h, which represents "contract ability"—how much time it takes the firm to win and successfully fulfill contracts:

$$s + \frac{b}{h} \leq T \tag{4}$$

[26] In addition to the results on sustained winning, we also find no evidence that treated firms—including those in Quartile 4—are less likely to have won a contract from individual buyers or groups of buyers three years after the training conditional on having won one also after one year (results available upon request).

The firms' optimization problem is then

$$\begin{aligned} &\max_{s,b} \pi_S \log s + \pi_B \log(b+1) \\ &\text{s.t. } s + \frac{b}{h} \leq T, s \geq 1, b \geq 0. \end{aligned} \tag{5}$$

The optimal amount of time spent on final consumers and contracts depends on h and is given by the following:

$$\text{if } h \leq \underline{h} \text{ then } \begin{cases} b^e = 0 \\ s^e = T \end{cases} \tag{6}$$

and

$$\text{if } h > \underline{h} \text{ then } \begin{cases} b^e = r_B T h - r_S \\ s^e = r_S(T + \frac{1}{h}) \end{cases} \tag{7}$$

where $\underline{h} = \frac{r_S}{r_B T}$ and

$$r_B = \frac{\pi_B}{\pi_S + \pi_B} \text{ and } r_S = \frac{\pi_S}{\pi_S + \pi_B} \text{ with } r_B + r_S = 1.$$

Equations (6) and (7) show that if a firm has low contract ability h, then it instead spends all its time T serving final consumers. If its contract ability h is not so low, then it allocates some time to contracts ($b^e > 0$) and some time to serving final customers. The higher its contract ability, the more time the firm allocates to bidding on and fulfilling contracts.

6.2 Dynamic ability and firm poverty traps

Consider now the possibility that h evolves over time. A reasonable dynamic is:

$$h_{t+1} = w_h h_t + w_b b_t \tag{8}$$

Suppose that when a firm does not bid on contracts ($b_t = 0$), their contract ability depreciates in the next period—that is, $w_h < 1$. Additionally suppose that firms are myopic, so that they make time-allocation decisions (b and s) based on current levels of ability—they do not internalize future benefits of current bidding activity materializing through changes in their ability to win contracts in the future.

By substituting b_t from (6) and (7) into (8) we get:

$$h_{t+1} = f(h_t) = \begin{cases} [w_h + w_b T r_B] h_t - w_b r_S \; if \; h_t \geq \underline{h} \\ w_h h_t \; if \; h_t < \underline{h} \end{cases} \tag{9}$$

Further substituting this into b_{t+1} from (6) and (7) gives:

$$b_{t+1} = g(b_t) = \begin{cases} [w_h + w_b T r_B] b_t + (w_h - 1) r_S \; if \; h_{t+1} \geq \underline{h} \\ 0 \; if \; h_{t+1} < \underline{h} \end{cases} \tag{10}$$

If we suppose that $(w_h + w_b r_B T) > 1$, then the functions $h_{t+1} = f(h_t)$ and $b_{t+1} = g(b_t)$ described by equations (9) and (10) above have increasing returns to scale and there exists a poverty trap among firms. The function $h_{t+1} = f(h_t)$ is plotted in Figure 4 below.

Firms will evolve differently based on their initial contract ability h_0. Panel A of Figure 4 illustrates this. If h_0 is below $\underline{h}$, the firm does not bid on any contracts and its ability to win and fulfill contracts decreases period after period. If a firms starts with an initial contract ability h_0 between $\underline{h}$ and the intersection between the curve and the 45 degree line h^* ($h^* = \frac{w_b r_s}{w_h + w_b T r_b - 1}$), then it bids on a few contracts but not enough to maintain its ability to win contracts, which deteriorates period after period. Finally, if a firm starts with an initial contract ability h_0 above h^*, then the firm bids on enough contracts such that its ability to win and fulfill contracts increases period after period.

The corresponding function $b_{t+1} = g(b_t)$ is plotted in Panel B of Figure 4. If a firm starts with any level of b that is smaller than the threshold b^*, then it converges to an equilibrium where it does not bid on (or win) any contracts, and only serves final consumers. If instead it starts with a level of b that is above the threshold b^*, then the firm bids on more and more contracts and spends a decreasing amount of its time serving final consumers over time.

6.3 Training

The Winning-contracts training teaches firms how to bid on and win formal contracts. We illustrate this with an increase in the firm's ability h. We have:

Corollary 1. *A training that improves firms' ability to bid on and win contracts will benefit firms that have greater such ability to begin with more, in both the short- and the longer-run.*

The proof of Corollary 1 is in Appendix A.6.

The effect of training is illustrated in Figure 4. If it increases a firm's ability to a level above $\underline{h}$ but below h^*, then the firm will begin bidding on some contracts but over time its ability slowly decreases, and in the long term such a firm will converge to an ability level below $\underline{h}$ where it does not bid on contracts. If instead a firm start with a contract ability h high enough that the training allows them to go above h^*, then the training will shift the firm into a contract ability range in which it rationally continues to bid on and win more contracts over time.

7 Discussion

Two predictors of firms' response to contract-winning knowledge stand out and both are consistent with the framework discussed in Section 6. Recall from Section 4 that we use baseline data to categorize firms, and that (only) the top quartile bid on (and win) more contracts in response to the training. The split-sample LASSO prediction results are in Table 3. The characteristic that *best* predicts increased bidding is a specific one: access to and use of the internet in the firm.[27] A salient interpretation is that managers are time-constrained and therefore bid on more contracts (once they learn how to do so) if their technology facilitates preparation of bids and communication with buyers. Internet access predicting impact also suggests that, in Liberia, information technology does not itself allow firms to overcome informational barriers to marketing their products. Instead it positively interacts with sellership knowledge.

The other predictor of firms' bidding response to the training that stands out is various measures of size and experience in the formal contract market: Quartile 4 firms are bigger and somewhat more experienced bidding on and winning tenders.[28] Together with the heterogeneity in treatment effects from sections 4 and 5, this finding supports the prediction in Corollary 1—that increased ability to bid on and win contracts will benefit firms that have greater such ability to begin with more, in both the short- and the longer-run. The framework in Section 6 shows how informational market access barriers can consequently generate a poverty trap for firms, even in the absence of credit constraints.

Interestingly, firms which benefit from Winning-contracts training are not more likely to choose to participate. Figure 5 shows the (lack of) correlation between take-up and bidding responsiveness.[29] A possible explanation is that firms are equally likely to already exhaust all "relevant" time—time that can be used to pursue new revenue streams—whether or not informational market access barriers constrain their size and performance.

[27] Appendix Table A.6 is identical to Appendix Table A.5, except that we interact Winning-contracts training$_i$ with a variable capturing the firm's internet access at baseline instead of the Quartile 4 indicator. The estimated treatment effects are consistently large in magnitude and statistically significant only for firms with internet access. Appendix Table A.8 is similarly analogous to Appendix Table A.7. As in the first endline, the estimated treatment effects are consistently large in magnitude and statistically significant only for firms with internet access.

[28] A full comparison of Quartile 4 firms and firms in quartiles 1-3 is in Table 4. Quartile 4 firms are larger; have somewhat more experience bidding on and winning tenders; are more likely to use the internet; and are more likely to be in some sectors than others (especially construction). The latter result is "descriptive" in the particular sense that when sector is included in the LASSO prediction results together with internet usage, sector is not picked up as a predictor of firms' bidding response. In other words, internet usage varies across sectors but is itself a better predictor of firms' response, as shown in Table 3.

[29] Indeed, repeating the split-sample LASSO prediction procedure from Section 4 with take-up rather than bidding responsiveness as the outcome shows that take-up is not correlated with *any* observable baseline characteristics.

This may be the case even though somewhat bigger and more experienced firms (and those with internet access) *benefit* more from increased contract-winning knowledge: the owner or manager of such firms may for example be able to delegate bidding on contracts, while only owners/managers themselves generally pursue new revenue streams (see e.g. Akcigit *et al.*, 2021). Another possible explanation for the surprising pattern is that firms display non-standard objective functions, belief-formation, or decision-making (see e.g. Dube *et al.*, 2018; DellaVigna & Gentzkow, 2019; Kremer *et al.*, 2019; Almunia *et al.*, 2024). One-hundred-and-six firms from quartiles 1, 2, and 3—those which do not subsequently change their bidding activity—not only were able to, but also *chose*, to participate in Winning-contracts training. This suggests that behavioral forces such as non-standard belief-formation may play a role. The same is arguably true for direct measures of beliefs: very few firms in our sample bid on or win anywhere near as many contracts as they expect to. Firms for example expect to bid on 2.3 contracts over the course of six months, but—even after taking the Winning-contracts training—in fact bid on only 0.6 contracts.[30] However, we cannot rule out other explanations.

Our findings point to two take-aways. First, informational market access barriers bind for about a quarter of "outsider" firms in Liberia, and in particular ones with *some* prior experience and success in the formal contracts market and technology access. Second, despite these strengths and sustained benefits from doing so, the extent to which such firms "organically" learn how to navigate large buyers' complex sourcing practices appears limited. After all, informational market access barriers bind for such firms in the first place and their use of an effective week-long program teaching such sellership is moderate and no-greater-than-other-firms'. These take-aways may help rationalize common demand-side policies in public procurement, such as bid subsidies and other preference programs for disadvantaged firms, and less common ones, such as randomizing which suppliers are awarded contracts (Carrillo *et al.*, 2023; Best *et al.*, 2023; Carril & Guo, 2023).[31]

[30] There are two ways we can measure this. First, at endline we can compare what firms said they have been doing to what they will do in the future: firms on average report (i) having bid on 0.5 tenders during the past six months, but that they expect to bid on 2.2 tenders in the upcoming six months, and (ii) having won 0.5 tenders during the past six months, but that they expect to win 1.7 tenders in the upcoming six months. Second, among firms in the treatment group (for which we also recorded beliefs data at baseline), we can compare what they said they will do at baseline to what they report actually having done at endline: firms on average report (i) expecting to bid on 2.3 tenders at baseline but actually having bid on only 0.6 tenders at endline, and (ii) expecting to win 1.8 tenders at baseline but actually having won only 0.45 tenders at endline. Finally, exposure to Winning-contracts training doesn't appear to be "overconfidence-correcting"—the gap between expected own future bidding activity and own past bidding is if anything greater for firms in the treatment group (but imprecisely estimated). There could be many explanations for this, but non-standard belief-formation is perhaps most plausible given that treatment group firms have recent bidding experience and are asked about expected bidding in the near future.

[31] A stated policy goal of the Government of Liberia is to steer public procurement contracts towards smaller, domestic firms. In 2014, they passed the "Small Business Empowerment Act", which mandates

8 Conclusion

In this paper we uncover an overlooked part of the explanation for why small- and medium-sized firms in poor countries rarely win contracts from large, growth-conducive buyers. We do so through a randomized experiment. We show that a training that teaches how to sell goods and services to governments, corporations, and other large buyers significantly improves Liberian firms' performance. The quartile of initially disadvantaged firms for which (we document that) informational barriers to accessing the large-buyer market *themselves* bind win more and better contracts both one and three years after the week-long training program. Three years out these firms also employ more workers and are more likely to operate. Our findings suggest that overlooked categories of access barriers such as buyers' sourcing practices exclude firms in poor countries from value chains.

In Liberia and many other countries, very few suppliers bid even on formal contracts for simple goods and services (see e.g. Wittig, 2003; Kang & Miller, 2022; Titl, 2023; Liscow *et al.*, 2023). It is perhaps not surprising that enabling information-poor firms to effectively bid on more and better contracts in such a context appears to improve allocative efficiency. Among the quarter of "outsider" firms for which informational market access barriers bind—those with some prior experience in the formal contracts market and access to the internet—we find sustained higher *bidding* activity, indicating that the training did not redirect their attention towards pursuing contracts that they ultimately did not have the ability to fulfill and to benefit from. We also find that such firms continue to *win* more and better contracts three years after the training, indicating that *buyers* also were not "fooled". If improved sellership persuaded buyers to mistakenly award contracts that would normally have gone to larger, out-of-sample suppliers to unqualified treated suppliers instead, then they presumably would not continue to award contracts to such suppliers over time.

This paper's results are to our knowledge the first evidence of a market access barrier of a different nature than the physical and legal ones studied in existing research, thus helping to shed light on why ability to market products varies substantially across similar firms that are located near each other. An important future research goal is to directly test for underlying drivers and ultimate, downstream consequences of large buyers' sourcing practices. Another is to investigate how best to level the playing field among potential suppliers to large buyers, given the evidence that qualified "outsider" firms are are un-

all government entities to allocate at least 25 percent of their total procurement budget to Liberian-owned small and medium-sized firms. However, very few government entities are in compliance with the law. Such purely "instructive" policies may be ineffective if complex sourcing procedures or other market access barriers bind.

likely to overcome informational market access barriers organically.

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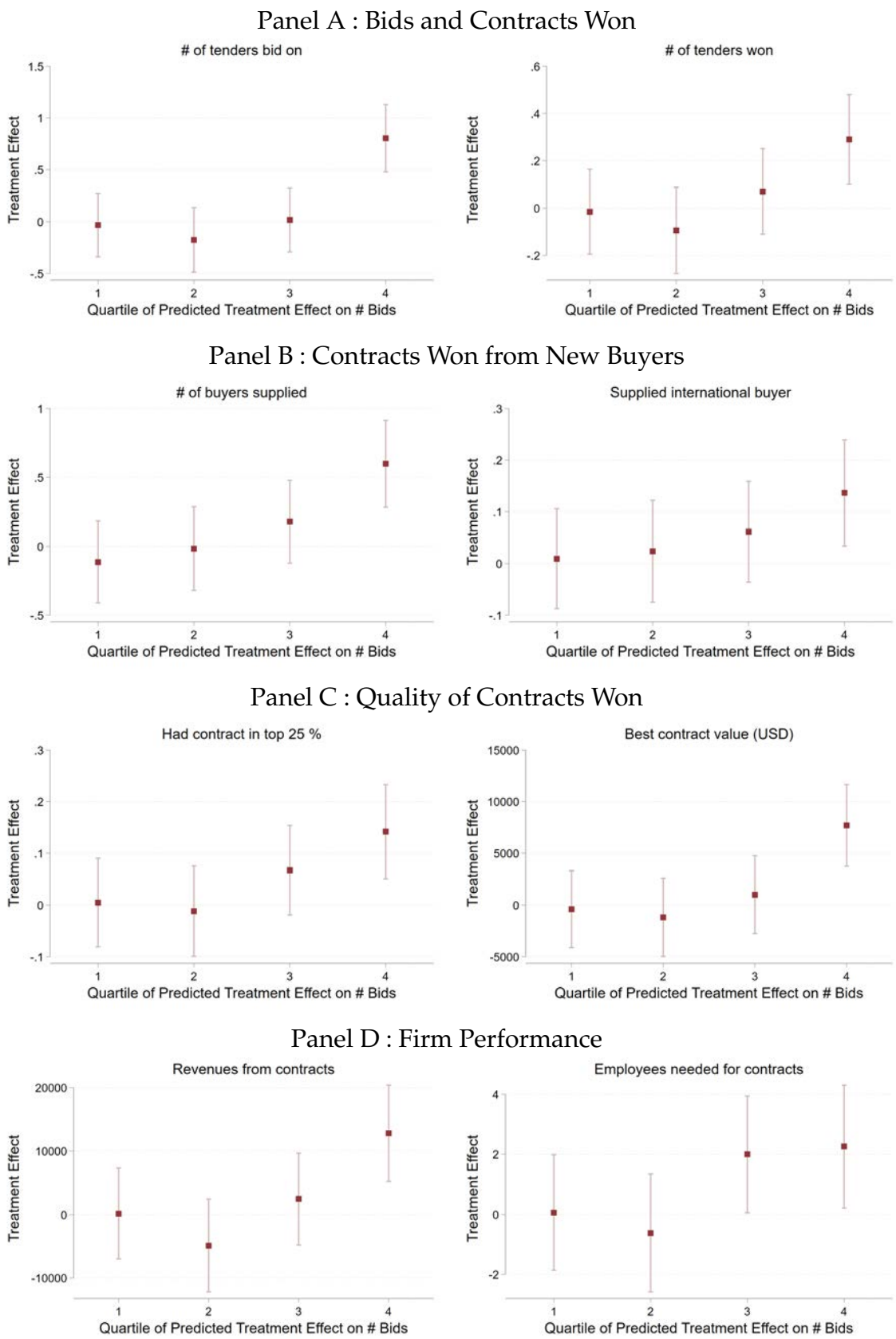
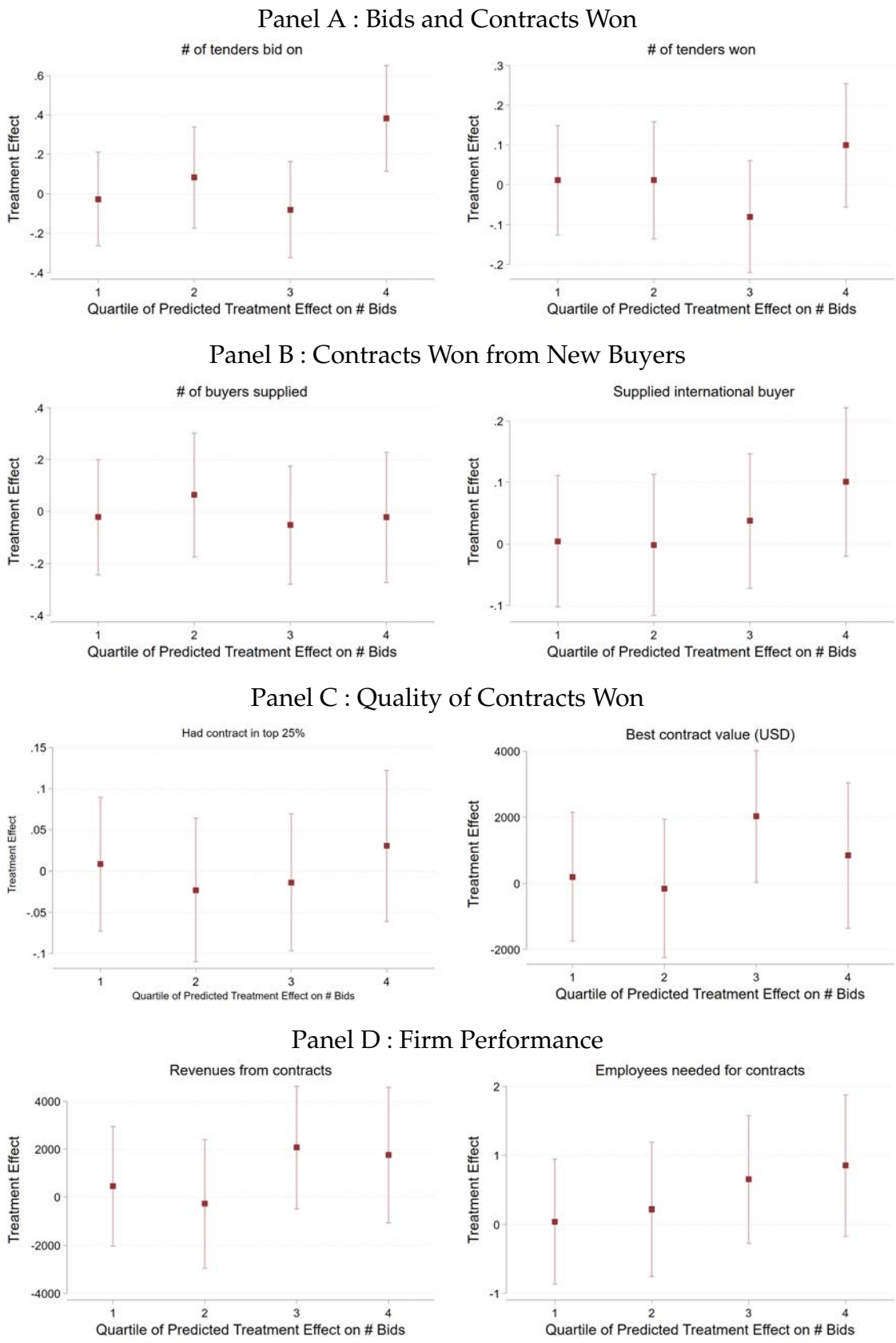
FIGURE 1: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE ONE YEAR OUT



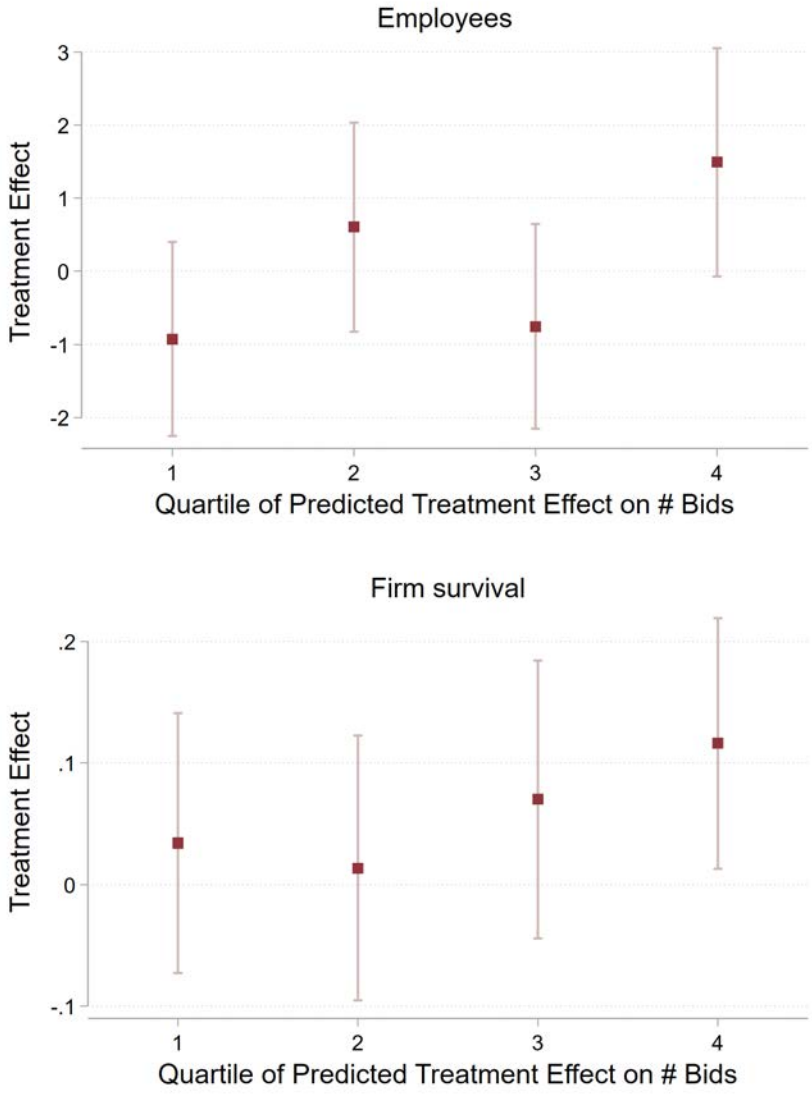
Notes: Each of the panels in this exhibit presents the heterogeneous impact of the contract-winning training on different firm outcomes one year out. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We then look at the heterogeneity in the impact of the training by comparing firms across 4 quartiles of the predicted treatment effect distribution. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. All outputs are referring to the period of 6 months preceding the interview.

FIGURE 2: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE THREE YEARS OUT



Notes: Each of the panels in this exhibit presents the heterogeneous impact of the contract-winning training on different firm outcomes three years out. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We then look at the heterogeneity in the impact of the training by comparing firms across 4 quartiles of the predicted treatment effect distribution. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. All outputs are referring to the period of 6 months preceding the interview.

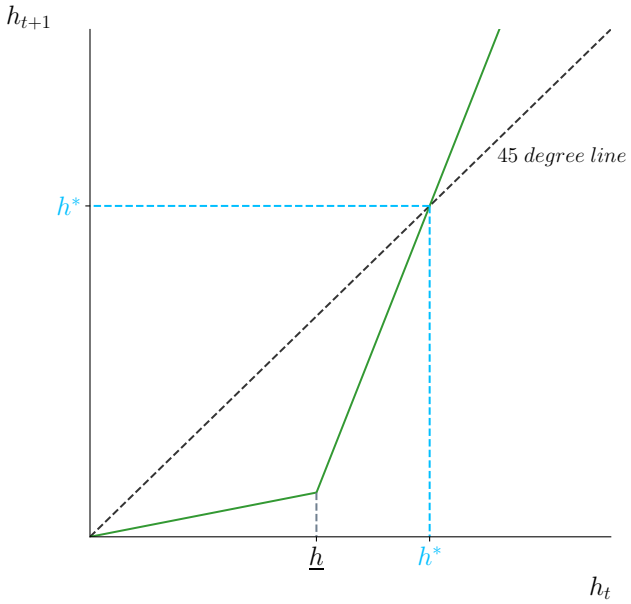
FIGURE 3: HETEROGENEOUS IMPACT ON FIRM GROWTH OF CONTRACT-WINNING KNOWLEDGE THREE YEARS OUT



Notes: Each of the figures in this exhibit presents the heterogeneous impact of the contract-winning training on measures of firm growth three years out. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We then look at the heterogeneity in the impact of the training by comparing firms across 4 quartiles of the predicted treatment effect distribution. The figure on top shows the impact the training on employees hired by the firm. The figure below shows the impact of the training on firm survival three years after training. All outputs are referring to the period of 6 months preceding the interview.

FIGURE 4: POVERTY TRAP

Panel A : Ability



Panel B : Number of Tenders Applied To

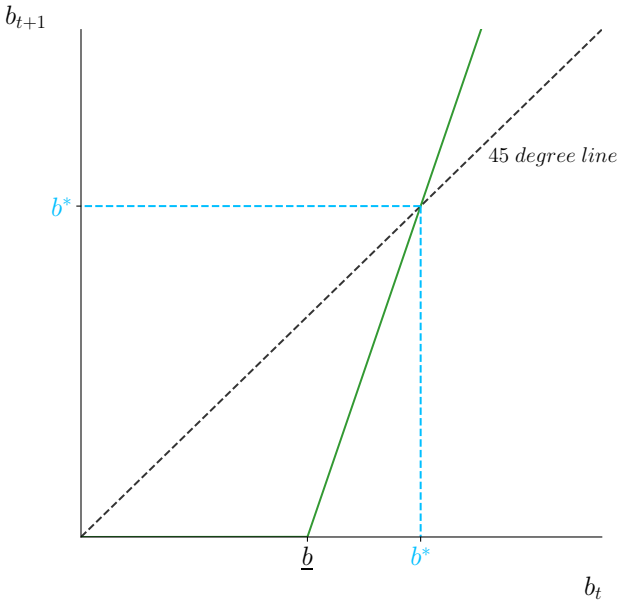
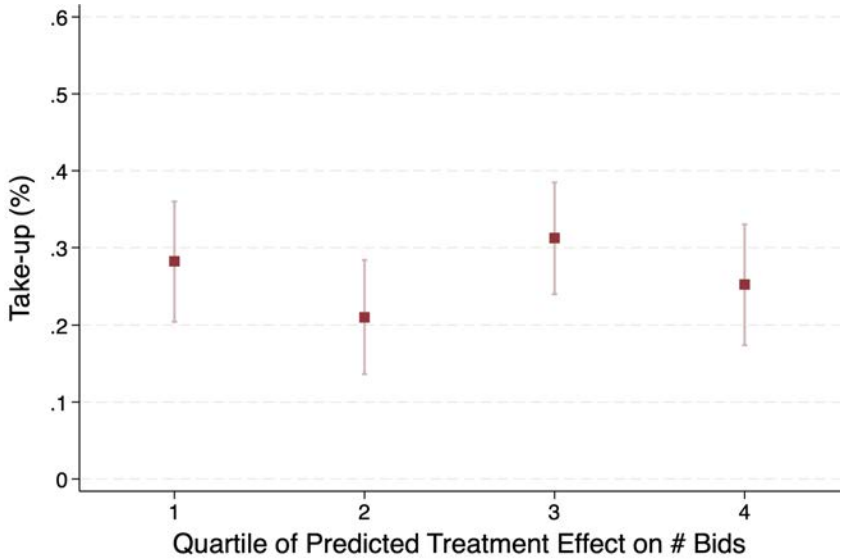


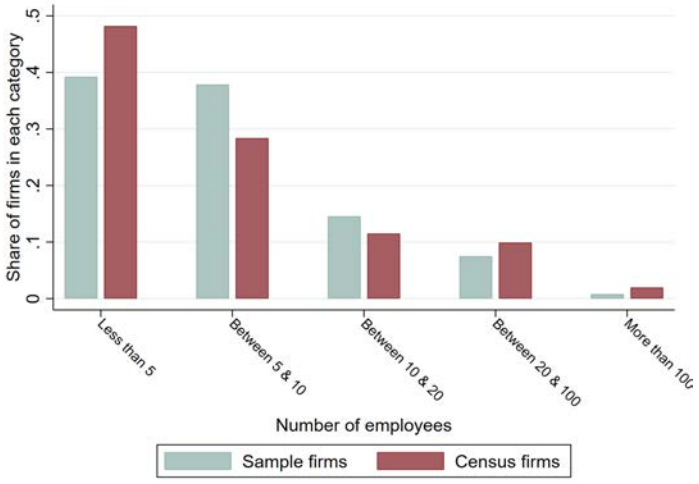
FIGURE 5: TAKE-UP OF CONTRACT-WINNING TRAINING PER QUARTILES OF TREATMENT EFFECT



Notes: This exhibit presents the take-up rate of the contract-winning training. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We compare take-up rates across 4 quartiles of the predicted treatment effect distribution.

TABLE 1: SIZE DISTRIBUTION AND BALANCE TABLE OF SAMPLE FIRMS

Panel A : Size Distribution of Firms



Panel B : Balance Table of Treatment and Control Firms

	Full Sample			Restricted Sample		
	CG Mean	Diff. (T - C)	Std. Error	CG Mean	Diff. (T - C)	Std. Error
Total Number of Employees	4.24	0.27	0.26	4.22	0.14	0.31
Bid on a tender in the past 6 months	0.17	-0.02	0.02	0.17	-0.04	0.03
Number of tenders bid on in the past 6 months	0.43	-0.07	0.09	0.44	-0.09	0.11
Won a tender in the past 6 months	0.11	-0.01	0.02	0.12	-0.02	0.03
Number of tenders won in the past 6 months	0.27	0.08	0.06	0.33	0.13	0.08
Proportion of tenders won (conditional on applying)	0.29	-0.04	0.06	0.30	-0.04	0.07
Ever won a contract lasting 6 months or more	0.73	-0.03	0.07	0.74	0.02	0.09
Speaks at least one Liberian local language	0.30	-0.01	0.03	0.29	-0.05	0.03
Internet Usage (0= Never ; 1= Every Day)	0.45	-0.01	0.02	0.45	-0.01	0.03
Owner is Liberian	0.89	-0.02	0.02	0.91	-0.01	0.02
Firm's Sector						
Construction and Renovation	0.23	-0.00	0.03	0.24	-0.01	0.03
Food and Beverages	0.15	-0.02	0.02	0.17	0.02	0.03
Home Essentials	0.13	0.00	0.02	0.14	0.02	0.02
Handicrafts and Artisans	0.12	0.00	0.02	0.12	0.01	0.02
Business and Consulting Services	0.10	0.00	0.02	0.11	0.02	0.02
Printing and Copying	0.07	-0.00	0.02	0.07	-0.02	0.02
Health, Medicine, Recreation, and Leisure	0.06	0.00	0.01	0.08	0.03	0.02

Notes : Panel A in this exhibit compares the size of firms in the sample with other firms listed in the non-profit's directory who have more than one employee and are located in Monrovia. The bars show the share of firms in our sample in each category and the share of the comparison sample. Panel B in this exhibit presents balance between firms of the treatment and control groups. "Full Sample" refers to the total sample at baseline, "Restricted Sample" refers to firms who responded to the endline survey. The data is based on phone interviews conducted by the non-profit. The number of employees includes the owner or manager of the firm, and unrealistic values are dropped in the data cleaning process.

TABLE 2: AVERAGE IMPACT OF CONTRACT-WINNING KNOWLEDGE ONE YEAR OUT

PANEL A: BIDS AND CONTRACTS WON

	# of tenders bid on		Total # of contracts won		# of tenders won		# of contracts won w/o tender	
	Treatment-on-the-Treated							
Winning-Contracts Training	0.52*	0.56*	1.18***	1.01***	0.24	0.27	0.94***	0.74**
	(0.30)	(0.29)	(0.38)	(0.35)	(0.17)	(0.17)	(0.31)	(0.29)
	Intent-to-Treat							
Voucher + Encouragement	0.14*	0.15*	0.31***	0.26***	0.06	0.07	0.24***	0.19**
	(0.08)	(0.08)	(0.09)	(0.09)	(0.04)	(0.05)	(0.08)	(0.08)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.35	0.35	0.48	0.48	0.15	0.15	0.33	0.33
Observations	789	789	789	789	789	789	789	789

PANEL B: CONTRACTS WON FROM NEW BUYERS

	# of buyers supplied		Supplied international buyer		Supplied private sector		Supplied government or non-profit	
	Treatment-on-the-Treated							
Winning-Contracts Training	0.64**	0.56**	0.25***	0.20**	0.26**	0.18*	0.20*	0.17
	(0.30)	(0.28)	(0.09)	(0.09)	(0.10)	(0.10)	(0.11)	(0.11)
	Intent-to-Treat							
Voucher + Encouragement	0.17**	0.15*	0.07***	0.05**	0.07**	0.05*	0.05*	0.04
	(0.08)	(0.08)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.40	0.40	0.10	0.10	0.12	0.12	0.17	0.17
Observations	789	789	789	789	789	789	789	789

PANEL C: QUALITY OF CONTRACTS WON

	Had a contract of more than 6 months		Had contract in top 25%		Best contract value (USD)		Best contract employment	
	Treatment-on-the-Treated							
Winning-Contracts Training	0.33**	0.28**	0.20**	0.19**	6306.44*	7353.03**	2.54**	2.99**
	(0.13)	(0.12)	(0.09)	(0.08)	(3560.17)	(3610.96)	(1.09)	(1.22)
	Intent-to-Treat							
Voucher + Encouragement	0.08***	0.07**	0.05**	0.05**	1634.52*	1920.44**	0.66**	0.78**
	(0.03)	(0.03)	(0.02)	(0.02)	(916.57)	(976.95)	(0.28)	(0.33)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.23	0.23	0.08	0.08	3022.51	3022.51	0.62	0.62
Observations	789	789	789	789	789	789	789	789

PANEL D: FIRM PERFORMANCE AND GROWTH

	Revenues from contracts		Employees needed for contracts		Employees	
	Treatment-on-the-Treated					
Winning-Contracts Training	8527.83	10683.90*	3.30*	4.04**	-0.13	-0.61
	(7266.45)	(6486.68)	(1.74)	(1.80)	(1.36)	(1.23)
	Intent-to-Treat					
Voucher + Encouragement	2210.27	2790.39	0.86*	1.05**	-0.04	-0.17
	(1879.89)	(1765.82)	(0.45)	(0.48)	(0.36)	(0.35)
Controls	NO	YES	NO	YES	NO	YES
Control Mean	5030.20	5030.20	1.00	1.00	5.89	5.89
Observations	789	789	789	789	733	733

Notes : Standard errors are in parentheses and are robust. This exhibit shows results from estimating Equation (1). Each of the panels in this exhibit present the Treatment-on-the-Treated (the IV estimate) and the Intent-to-Treat (the reduced form) estimates of the effect of contract-winning training on bids and contracts won by firms one year out. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline. All outputs are referring to the period of 6 months preceding the interview, except the number of employees. The lower number of observations for the employees is due to the data cleaning process.

TABLE 3: RESULTS OF LASSO PROCEDURE

Variable	Times_Kept	Average_Coefficient
How often do you use the Internet for business purposes?	194	0.0959
Total number of employees	120	0.00290
Do you have a prepared business plan?	105	-0.0250
Have you responded to a tender or submitted a bid in the past 6 months?	80	0.0328
Have you ever had a contracts for an international client?	38	0.0329
Have you won a tender in the past six months?	37	0.0837
Have you ever had a contracts for an NGO?	9	0.0273
Do you own any assets that may be used as collateral for credit?	8	-0.0213
The business has a female owner	0	.
At least one of the owners has an Americo-Liberian name	0	.
Do you have a business bank account?	0	.
Have you ever received a loan from a bank or any other entity?	0	.
Of the total number of employees how many are family members of the owner(s)?	0	.
Do you import?	0	.
Have you ever had a contracts for the government?	0	.

Notes : This table presents the results of the LASSO procedure developed in section 5.3.2. The LASSO estimation predicts what variables, interacted with treatment, best explain the heterogeneity if the effect observed. In addition to the set of variables presented here, the LASSO regressions all include sector and geographic controls. The first column shows the number of times each variable was kept out of the 200 LASSO estimations. The second column shows the average coefficient of each variables, across LASSO procedures. The set of variables represents firm characteristics that are usually thought to affect a firm's chances to win a tender (size, ability, connections, etc.). Changing this set, either by dropping some variables or adding additional variables, does not alter the results.

TABLE 4: COMPARISON OF QUARTILE 1,2,3 VS QUARTILE 4

	Quartile 4	Quartiles 1-3	Difference	P-Val.
Total Number of Employees	5.03	3.88	-1.15***	0.00
Bid on a tender in the past 6 months	0.50	0.11	-0.40***	0.00
Number of tenders bid on in the past 6 months	1.51	0.20	-1.32***	0.00
Won a tender in the past 6 months	0.25	0.07	-0.18***	0.00
Number of tenders won in the past 6 months	0.69	0.11	-0.57***	0.00
Proportion of tenders won (conditional on applying)	0.45	0.42	-0.03	0.68
Ever won a contract lasting 6 months or more	0.52	0.22	-0.31***	0.00
Speaks at least one Liberian local language	0.25	0.34	0.09**	0.02
Internet Usage (0= Never ; 1= Every Day)	0.81	0.35	-0.45***	0.00
Owner is Liberian	0.89	0.92	0.03	0.15
Firm's Sector				
Construction and Renovation	0.46	0.19	-0.27***	0.00
Food and Beverages	0.03	0.19	0.17***	0.00
Home Essentials	0.05	0.15	0.10***	0.00
Handicrafts and Artisans	0.03	0.15	0.12***	0.00
Business and Consulting Services	0.26	0.05	-0.20***	0.00
Printing and Copying	0.15	0.06	-0.09***	0.00
Health, Medicine, Recreation, and Leisure	0.01	0.07	0.06***	0.00

Notes : This exhibit compares the characteristics of firms in the top quartile of the predicted treatment effect distribution to firms in the bottom three quartiles. The data is based on phone interviews conducted by the non-profit. The number of employees includes the owner or manager of the firm.

A Appendix

A.1 Lasso Procedure

Following the LASSO procedure in Chernozhukov *et al.* (2018), we estimate the best linear predictor of the CATE of the treatment on the number of tenders a firm bids on as follows:

1. We first split the full sample into two parts, the *auxiliary* sample and the *main* sample. The two are used respectively as the training set and the hold-out set.

2. We then use a LASSO regression of the number of bids on baseline observables estimated on the control group part of the auxiliary sample to predict the number of bids for the full auxiliary sample (control and treatment). A second LASSO regression of number of bids on (i) the predicted output of the first LASSO regression and (ii) the interaction of treatment and baseline observables selects variables which best predict the heterogeneity of the treatment effect observed.

3. We then test the predictive power of the heterogeneity variables selected in the auxiliary sample in step 2 on the main sample. Predicted number of bids is generated on the main sample using the variables selected in step 2 with their associated coefficients from the auxiliary sample. The observed number of bids in the main sample is regressed on the predicted number of bids based on the auxiliary sample. This allows us to test whether variables selected in step 2 accurately describe the observed heterogeneity in treatment effects.[32]

4. Finally, we run a cross-validation procedure wherein the main sample is used as the training set and the auxiliary sample as the hold-out set.

The results of this procedure depends on the random split of the sample. We thus bootstrap by repeating the procedure 100 times. Since each of these includes two estimations, the total number of LASSO estimations is 200. Out of these 200 estimations, 196 were validated by the test for the hold-out set heterogeneity variables as good predictors of heterogeneity. Table 3 shows how many times each firm characteristic was selected in the set of variables that best explain heterogeneity in treatment effects in the training set. Internet access is by far the variable selected the most times, 194.

[32] A variable is said to accurately describe the observed heterogeneity if the p-value of its coefficient on the main sample is smaller than 0.01.

A.2 Tables

TABLE A.1: SAMPLE TENDER DESCRIPTIONS

Buyer Type	Name of Entity	Description
International Government	US Embassy	*"The Embassy of the United States of America hereby invites interested reputable and qualified packing and shipping companies to submit proposals for the providing of packing services for miscellaneous items to include employee's household effects to the U.S. Embassy in Monrovia."*
NGO	UNDP	*"The United Nations Development Programme (UNDP) kindly requests qualified and eligible vendors to submit quotation for the Supply and Delivery of Laptops and Ipads for the UNDP Country Office in Liberia. Quotations submitted by email must be limited to a maximum of 4MB, virus-free and no more than 3 email transactions."*
Liberian Government	Ministry of Internal Affairs	*"The Ministry of Internal Affairs (MIA) now invites sealed bids from eligible and qualified bidders for the Supply of Stationery (A4, Papers, Cartridges, Carbon papers, and other stationery materials) for County Administration."*
Liberian Private	Clinical RM	*"ClinicalRM is seeking Expression of Interest from Liberian companies for the installation, maintenance and troubleshooting of electrical works and components at various sites in Monrovia, and Gbarnga. In addition to electrical works, interested companies must be able to install, service and repair generators at sites the previously listed locations according to manufacturer standards and quality."*

Notes : This exhibit present descriptions of tenders from the tender registry maintained by the non-profit that we work with. Each tender is characterized by type of Buyer and we selected the tender description of one tender from each Buyer type. These tenders are advertised to firms in our sample by the non-profit.

TABLE A.2: ATTRITION IN THE 1ST FOLLOW UP

	Interviewed	Not Interviewed	Difference	P-Val.
Total Number of Employees	7.08	7.41	0.33	0.82
Bid on a tender in the past 6 months	0.21	0.17	-0.04	0.10
Number of tenders bid on in the past 6 months	0.71	0.55	-0.15	0.21
Won a tender in the past 6 months	0.13	0.09	-0.04*	0.06
Number of tenders won in the past 6 months	0.33	0.19	-0.14*	0.09
Proportion of tenders won (conditional on applying)	0.32	0.27	-0.05	0.46
Ever won a contract lasting 6 months or more	0.73	0.82	0.09	0.21
Speaks at least one Liberian local language	0.32	0.27	-0.05*	0.08
Internet Usage (0= Never ; 1= Every Day)	0.49	0.47	-0.02	0.34
Owner is Liberian	0.92	0.87	-0.04**	0.02
Firm's Sector				
Construction and Renovation	0.25	0.20	-0.05**	0.04
Food and Beverages	0.16	0.16	0.00	0.97
Home Essentials	0.13	0.12	-0.01	0.69
Handicrafts and Artisans	0.12	0.11	-0.01	0.58
Business and Consulting Services	0.10	0.08	-0.02	0.22
Printing and Copying	0.08	0.06	-0.03	0.11
Health, Medicine, Recreation, and Leisure	0.06	0.07	0.01	0.33

This table presents differential attrition between firms who responded to endline interviews and firms who did not for the first followup. The data is based on phone interviews conducted by the non-profit. The number of employees includes the owner or manager of the firm.

TABLE A.3: ATTRITION IN 2ND FOLLOW UP

	Interviewed	Not Interviewed	Difference	P-Val.
Total Number of Employees	6.98	7.36	0.38	0.77
Bid on a tender in the past 6 months	0.20	0.19	-0.01	0.56
Number of tenders bid on in the past 6 months	0.67	0.65	-0.03	0.81
Won a tender in the past 6 months	0.12	0.12	-0.00	0.94
Number of tenders won in the past 6 months	0.29	0.29	0.01	0.94
Proportion of tenders won (conditional on applying)	0.30	0.34	0.04	0.43
Ever won a contract lasting 6 months or more	0.72	0.79	0.07	0.29
Speaks at least one Liberian local language	0.35	0.26	-0.09***	0.00
Internet Usage (0= Never ; 1= Every Day)	0.48	0.49	0.01	0.63
Owner is Liberian	0.93	0.87	-0.06***	0.00
Firm's Sector				
Construction and Renovation	0.27	0.19	-0.07***	0.00
Food and Beverages	0.16	0.15	-0.00	0.87
Home Essentials	0.14	0.12	-0.02	0.26
Handicrafts and Artisans	0.12	0.11	-0.01	0.61
Business and Consulting Services	0.08	0.10	0.02	0.23
Printing and Copying	0.08	0.07	-0.01	0.38
Health, Medicine, Recreation, and Leisure	0.06	0.06	0.00	0.99

This table presents differential attrition between firms who responded to endline interviews and firms who did not for the second follow up. The data is based on phone interviews conducted by the non-profit. The number of employees includes the owner or manager of the firm.

TABLE A.4: EFFECT OF VOUCHER + ENCOURAGEMENT ON TRAINING TAKE-UP

	Winning-Contracts Training	
	(1)	(2)
Voucher + Encouragement for Training	0.19***	0.20***
	(0.02)	(0.02)
Controls	NO	YES
Control Group Mean	0.01	0.01
Observations	1192	1143

Standard errors are in parentheses and are robust. This table presents coefficients of the regression of training take-up as recorded by the non-profit on encouragement. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline.

TABLE A.5: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE ONE YEAR OUT

	PANEL A: BIDS AND CONTRACTS WON							
	# of tenders bid on		Total # of contracts won		# of tenders won		# of contracts won w/o tender	
Voucher + Encouragement x Quartiles 1, 2, and 3	-0.00	-0.05	0.22**	0.13	0.02	-0.00	0.20**	0.13
	(0.07)	(0.07)	(0.11)	(0.10)	(0.04)	(0.04)	(0.09)	(0.09)
Voucher + Encouragement x Quartile 4	0.66***	0.80***	0.62***	0.71***	0.24*	0.31**	0.39**	0.40**
	(0.22)	(0.24)	(0.21)	(0.23)	(0.13)	(0.15)	(0.17)	(0.18)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.35	0.35	0.48	0.48	0.15	0.15	0.33	0.33
Observations	789	789	789	789	789	789	789	789
	PANEL B: CONTRACTS WON FROM NEW BUYERS							
	# of buyers supplied		Supplied international buyer		Supplied private sector		Supplied government or non-profit	
Voucher + Encouragement x Quartiles 1, 2, and 3	0.08	0.01	0.05**	0.03	0.06*	0.04	0.04	0.02
	(0.09)	(0.08)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Voucher + Encouragement x Quartile 4	0.49***	0.58***	0.13**	0.13*	0.11*	0.09	0.10	0.13*
	(0.18)	(0.19)	(0.06)	(0.07)	(0.06)	(0.06)	(0.07)	(0.08)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.40	0.40	0.10	0.10	0.12	0.12	0.17	0.17
Observations	789	789	789	789	789	789	789	789
	PANEL C: QUALITY OF CONTRACTS WON							
	Had a contract of more than 6 months		Had contract in top 25%		Best contract value (USD)		Best contract employment	
Voucher + Encouragement x Quartiles 1, 2, and 3	0.08**	0.04	0.03	0.02	91.03	127.74	0.30	0.36
	(0.03)	(0.03)	(0.02)	(0.02)	(753.06)	(813.60)	(0.22)	(0.24)
Voucher + Encouragement x Quartile 4	0.13*	0.18**	0.14**	0.14**	7508.24**	7835.29**	2.04**	2.18**
	(0.08)	(0.08)	(0.06)	(0.07)	(2926.60)	(3084.52)	(0.93)	(1.02)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.23	0.23	0.08	0.08	3022.51	3022.51	0.62	0.62
Observations	789	789	789	789	789	789	789	789
	PANEL D: FIRM PERFORMANCE AND GROWTH							
	Revenues from contracts		Employees needed for contracts		Employees			
Voucher + Encouragement x Quartiles 1, 2, and 3	-251.16	-115.21	0.56*	0.64*	0.07	-0.26		
	(1818.79)	(1642.88)	(0.34)	(0.36)	(0.37)	(0.37)		
Voucher + Encouragement x Quartile 4	11580.88**	12377.12**	2.09	2.42	-0.14	0.16		
	(5313.16)	(5412.43)	(1.51)	(1.67)	(0.86)	(0.89)		
Controls	NO	YES	NO	YES	NO	YES		
Control Mean	5030.20	5030.20	1.00	1.00	5.89	5.89		
Observations	789	789	789	789	733	733		

Notes: Standard errors are in parentheses and are robust. This exhibit shows results from estimating Equation (1). Each of the panels in this exhibit presents the heterogeneous impact of the contract-winning training on different firm outcomes one year out. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We then look at the heterogeneity of the impact of the training by comparing firms in the top quartile (Q4) of the predicted treatment effect distribution to firms in the bottom 3 quartiles. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline. All outputs are referring to the period of 6 months preceding the interview, except the number of employees. The lower number of observations for the employees is due to the data cleaning process.

TABLE A.6: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE ONE YEAR OUT FOR FIRMS WITH VS. WITHOUT INTERNET ACCESS

	PANEL A: BIDS AND CONTRACTS WON							
	# of tenders bid on		Total # of contracts won		# of tenders won		# of contracts won w/o tender	
Voucher + Encouragement	-0.09	-0.16**	0.13	0.02	-0.05	-0.08	0.18	0.10
	(0.08)	(0.08)	(0.15)	(0.14)	(0.05)	(0.05)	(0.12)	(0.12)
Voucher + Encouragement x Internet	0.48**	0.66***	0.38	0.54**	0.24**	0.32**	0.14	0.22
	(0.19)	(0.20)	(0.24)	(0.25)	(0.11)	(0.13)	(0.20)	(0.20)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.35	0.35	0.48	0.48	0.15	0.15	0.33	0.33
Observations	789	789	789	789	789	789	789	789
	PANEL B: CONTRACTS WON FROM NEW BUYERS							
	# of buyers supplied		Supplied international buyer		Supplied private sector		Supplied government or non-profit	
Voucher + Encouragement	-0.02	-0.11	0.05	0.02	0.03	0.01	0.03	0.01
	(0.12)	(0.12)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Voucher + Encouragement x Internet	0.41**	0.56***	0.04	0.06	0.08	0.09	0.04	0.09
	(0.20)	(0.21)	(0.06)	(0.06)	(0.07)	(0.07)	(0.07)	(0.08)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.40	0.40	0.10	0.10	0.12	0.12	0.17	0.17
Observations	789	789	789	789	789	789	789	789
	PANEL C: QUALITY OF CONTRACTS WON							
	Had a contract of more than 6 months		Had contract in top 25%		Best contract value (USD)		Best contract employment	
Voucher + Encouragement	-0.02	-0.07*	0.02	0.01	-316.60	-506.55	-0.06	-0.02
	(0.04)	(0.04)	(0.02)	(0.02)	(818.07)	(891.97)	(0.20)	(0.26)
Voucher + Encouragement x Internet	0.22***	0.31***	0.07	0.10*	4192.15*	5337.26**	1.56**	1.77**
	(0.08)	(0.08)	(0.05)	(0.06)	(2314.91)	(2477.22)	(0.65)	(0.73)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.23	0.23	0.08	0.08	3022.51	3022.51	0.62	0.62
Observations	789	789	789	789	789	789	789	789
	PANEL D: FIRM PERFORMANCE AND GROWTH							
	Revenues from contracts		Employees needed for contracts		Employees			
Voucher + Encouragement	-2273.95	-2415.87	-0.07	-0.07	0.08	-0.57		
	(2815.53)	(2611.00)	(0.31)	(0.37)	(0.47)	(0.47)		
Voucher + Encouragement x Internet	9717.45*	11481.81**	2.00*	2.48**	-0.28	0.91		
	(5057.44)	(5157.88)	(1.08)	(1.22)	(0.90)	(0.89)		
Controls	NO	YES	NO	YES	NO	YES		
Control Mean	5030.20	5030.20	1.00	1.00	5.89	5.89		
Observations	789	789	789	789	733	733		

Notes: Standard errors are in parentheses and are robust. This exhibit shows results from estimating Equation (1). Each of the panels in this exhibit presents the treatment effect varies with Internet on different firm outcomes one year out. Internet is a continuous variable from 0 to 1 with 1 indicating that a firm uses Internet for business purposes everyday and 0 indicating that a firm never uses Internet. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline. All outputs are referring to the period of 6 months preceding the interview, except the number of employees. The lower number of observations for the employees is due to the data cleaning process.

TABLE A.7: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE THREE YEARS OUT

	PANEL A: BIDS AND CONTRACTS WON							
	# of tenders bid on		Total # of contracts won		# of tenders won		# of contracts won w/o tender	
Voucher + Encouragement	-0.00	-0.03	0.10	0.04	-0.00	-0.02	0.10	0.07
x Quartiles 1, 2, and 3	(0.06)	(0.06)	(0.08)	(0.09)	(0.04)	(0.04)	(0.07)	(0.08)
Voucher + Encouragement	0.30*	0.43**	-0.04	-0.12	0.07	0.10	-0.10	-0.22
x Quartile 4	(0.18)	(0.20)	(0.19)	(0.20)	(0.10)	(0.10)	(0.16)	(0.18)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.28	0.28	0.41	0.41	0.11	0.11	0.30	0.30
Observations	628	628	628	628	628	628	628	628
	PANEL B: CONTRACTS WON FROM NEW BUYERS							
	# of buyers supplied		Supplied international buyer		Supplied private sector		Supplied government or non-profit	
Voucher + Encouragement	0.03	-0.03	0.03	0.01	0.05	0.03	0.03	0.01
x Quartiles 1, 2, and 3	(0.07)	(0.07)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Voucher + Encouragement	-0.03	-0.06	0.12*	0.09	0.16**	0.12*	0.08	0.08
x Quartile 4	(0.14)	(0.14)	(0.07)	(0.08)	(0.06)	(0.07)	(0.08)	(0.09)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.31	0.31	0.10	0.10	0.12	0.12	0.17	0.17
Observations	628	628	628	628	628	628	628	628
	PANEL C: QUALITY OF CONTRACTS WON							
	Had a contract of more than 6 months		Had contract in top 25%		Best contract value (USD)		Best contract employment	
Voucher + Encouragement	0.03	0.02	-0.00	-0.01	664.52	755.36*	0.25	0.25
x Quartiles 1, 2, and 3	(0.04)	(0.04)	(0.02)	(0.02)	(475.19)	(451.23)	(0.15)	(0.17)
Voucher + Encouragement	-0.02	0.05	0.04	0.03	1139.10	1030.00	0.46	0.69
x Quartile 4	(0.09)	(0.09)	(0.07)	(0.08)	(1227.12)	(1480.99)	(0.59)	(0.66)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.27	0.27	0.07	0.07	1228.07	1228.07	0.27	0.27
Observations	628	628	628	628	628	628	628	628
	PANEL D: FIRM PERFORMANCE						FIRM GROWTH	
	Revenues from contracts		Employees needed for contracts		Employees		Firm survival	
Voucher + Encouragement	795.08	862.92	0.30*	0.30	-0.14	-0.39	0.03	0.03
x Quartiles 1, 2, and 3	(589.91)	(581.58)	(0.17)	(0.19)	(0.41)	(0.39)	(0.03)	(0.03)
Voucher + Encouragement	2188.09	1919.97	0.64	0.92	1.38*	1.52*	0.12**	0.10*
x Quartile 4	(1447.82)	(1761.44)	(0.69)	(0.77)	(0.82)	(0.88)	(0.05)	(0.06)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	1503.27	1503.27	0.32	0.32	5.79	5.79	0.77	0.77
Observations	628	628	628	628	591	591	897	897

Notes: Standard errors are in parentheses and are robust. This exhibit shows results from estimating Equation (1). Each of the panels in this exhibit presents the heterogeneous impact of the contract-winning training on firm outcomes three years out. For each firm in the sample, a predicted treatment effect on numbers of bids submitted is computed using baseline firm characteristics. We then look at the heterogeneity of the impact of the training by comparing firms in the top quartile (Q4) of the predicted treatment effect distribution to firms in the bottom 3 quartiles. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline. All outputs are referring to the period of 6 months preceding the interview, except the number of employees. The lower number of observations for the employees is due to the data cleaning process. Note that in the data, contracts won in the second follow-up have smaller value (in USD as well as number of employees needed for contracts), which is likely due to Liberia's recession between the two data rounds.

TABLE A.8: HETEROGENEOUS IMPACT OF CONTRACT-WINNING KNOWLEDGE THREE YEARS OUT FOR FIRMS WITH VS. WITHOUT INTERNET ACCESS

	PANEL A: BIDS AND CONTRACTS WON							
	# of tenders bid on		Total # of contracts won		# of tenders won		# of contracts won w/o tender	
Voucher + Encouragement	0.03	-0.01	0.13	0.05	0.03	0.01	0.11	0.04
	(0.06)	(0.06)	(0.11)	(0.11)	(0.03)	(0.04)	(0.11)	(0.11)
Voucher + Encouragement x Internet	0.04	0.19	-0.17	-0.10	-0.05	-0.02	-0.12	-0.09
	(0.16)	(0.17)	(0.20)	(0.22)	(0.10)	(0.10)	(0.18)	(0.20)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.28	0.28	0.41	0.41	0.11	0.11	0.30	0.30
Observations	628	628	628	628	628	628	628	628
	PANEL B: CONTRACTS WON FROM NEW BUYERS							
	# of buyers supplied		Supplied international buyer		Supplied private sector		Supplied government or non-profit	
Voucher + Encouragement	0.08	0.01	0.04	0.02	0.03	0.02	0.04	0.03
	(0.08)	(0.08)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)
Voucher + Encouragement x Internet	-0.15	-0.09	0.01	0.02	0.09	0.07	-0.01	0.00
	(0.15)	(0.16)	(0.07)	(0.07)	(0.07)	(0.08)	(0.08)	(0.09)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.31	0.31	0.10	0.10	0.12	0.12	0.17	0.17
Observations	628	628	628	628	628	628	628	628
	PANEL C: QUALITY OF CONTRACTS WON							
	Had a contract of more than 6 months		Had contract in top 25%		Best contract value (USD)		Best contract employment	
Voucher + Encouragement	-0.03	-0.04	-0.00	-0.02	71.53	-65.41	0.12	0.06
	(0.05)	(0.05)	(0.02)	(0.02)	(620.27)	(467.56)	(0.18)	(0.15)
Voucher + Encouragement x Internet	0.09	0.16*	0.01	0.05	1454.47	1989.03*	0.34	0.66
	(0.09)	(0.09)	(0.05)	(0.06)	(1089.35)	(1060.54)	(0.43)	(0.48)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	0.27	0.27	0.07	0.07	1228.07	1228.07	0.27	0.27
Observations	628	628	628	628	628	628	628	628
	PANEL D: FIRM PERFORMANCE						FIRM GROWTH	
	Revenues from contracts		Employees needed for contracts		Employees		Firm survival	
Voucher + Encouragement	186.08	13.16	0.10	0.07	-0.41	-0.66	-0.01	0.00
	(710.33)	(622.18)	(0.18)	(0.16)	(0.52)	(0.49)	(0.04)	(0.04)
Voucher + Encouragement x Internet	1917.25	2430.61*	0.55	0.82	1.26	1.52	0.14*	0.11
	(1408.36)	(1416.68)	(0.51)	(0.57)	(0.96)	(0.97)	(0.07)	(0.07)
Controls	NO	YES	NO	YES	NO	YES	NO	YES
Control Mean	1503.27	1503.27	0.32	0.32	5.79	5.79	0.77	0.77
Observations	628	628	628	628	591	591	897	897

Notes: Standard errors are in parentheses and are robust. This exhibit shows results from estimating Equation (1). Each of the panels in this exhibit presents the treatment effect varies with Internet on firm outcomes three years out. Internet is a continuous variable from 0 to 1 with 1 indicating that a firm uses Internet for business purposes everyday and 0 indicating that a firm never uses Internet. Panel A presents the effect of the training on bids and contracts won by firms, Panel B focuses on the effect on contracts won from buyers not previously supplied to, Panel C looks at the effect on different measures of contract quality and Panel D shows the effect on overall firm performance. Controls include employment, counties of operation, gender of the owner, sectors, languages used for business, geographical zone and the number of submitted bids. All controls are measured before baseline. All outputs are referring to the period of 6 months preceding the interview, except the number of employees. The lower number of observations for the employees is due to the data cleaning process. Note that in the data, contracts won in the second follow-up have smaller value (in USD as well as number of employees needed for contracts), which is likely due to Liberia's recession between the two data rounds.

TABLE A.9: LEE BOUNDS ESTIMATION FOR AVERAGE TREATMENT EFFECTS

	Lower Bound	Upper Bound	Confidence Interval
# of tenders bid on	0.12	0.26	[-0.01, 0.45]
# of contracts won	0.29	0.39	[0.12, 0.62]
# of tenders won	0.06	0.16	[-0.02, 0.24]
# of contracts won w/o tender	0.23	0.30	[-0.09, 0.50]
# of buyers supplied	0.15	0.23	[0.01, 0.45]
Supplied international buyer	0.07	0.11	[0.00, 0.19]
Supplied private sector	0.06	0.10	[0.01, 0.18]
Supplied govt or non-profit	0.05	0.08	[-0.01, 0.16]
Had a contract of more than 6 months	0.08	0.11	[0.02, 0.20]
Had contract in top 25%	0.05	0.08	[0.01, 0.12]
Best contract value	1519	2187	[-160, 4600]
Best contract employment	0.64	1.09	[0.17, 1.50]
Revenues from Contracts	2098	4652	[-1100, 7500]
Employees needed for contracts	0.83	1.67	[0.07, 2.23]
Employees	-0.15	0.18	[-0.94, 1.35]

Notes: This table displays Lee bounds estimates of average treatment effects. It shows the lower and upper bounds of the treatment effect on the entire set of firms as well as confidence intervals of the treatment effect.

TABLE A.10: LEE BOUNDS ESTIMATION FOR TOP QUARTILE FIRMS

	Lower Bound	Upper Bound	Confidence Interval
# of tenders bid on	0.28	0.40	[0.02, 0.93]
# of contracts won	0.49	0.59	[0.23, 1.13]
# of tenders won	0.13	0.20	[-0.01, 0.47]
# of contracts won w/o tender	0.36	0.43	[0.15, 0.73]
# of buyers supplied	0.32	0.42	[0.11, 0.82]
Supplied international buyer	0.06	0.08	[-0.05, 0.21]
Supplied private sector	0.10	0.13	[0.03, 0.27]
Supplied govt or non-profit	0.08	0.10	[-0.02, 0.24]
Had a contract of more than 6 months	0.14	0.17	[0.04, 0.30]
Had contract in top 25%	0.09	0.11	[0.01, 0.25]
Best contract value	3431	4908	[382, 11000]
Best contract employment	1.33	1.77	[0.38, 3.54]
Revenues from Contracts	5943	8429	[743, 20,000]
Employees needed for contracts	1.71	2.62	[0.18, 5.18]
Employees	-0.14	0.02	[-1.74, 2.56]

Notes: This table displays Lee bounds estimates of treatment effects on firms in the top two quartiles. It shows the lower and upper bounds of the treatment effect on the entire set of firms as well as confidence intervals of the treatment effect.

A.3 Framework Proofs

A.4 Proof of Equations (6) and (7)

We start with the interior solution for the optimization problem in (5). The substitution of the tight time bundle $s + \frac{b}{h} \leq T$ into the profit function yields

$$\underset{b}{\text{Max}} \quad \pi_S \log\left(T - \frac{b}{h}\right) + \pi_B \log(b+1).$$

The first-order condition with respect to b generates

$$-\frac{\pi_S}{T - \frac{b}{h}} \frac{1}{h} + \frac{\pi_B}{b+1} = 0.$$

By rearrangement,

$$b^* = \frac{\pi_B}{\pi_B + \pi_S} Th - \frac{\pi_S}{\pi_B + \pi_S}. \tag{A.1}$$

By using the concept of profit ratio from operating different businesses $r_B = \frac{\pi_B}{\pi_B + \pi_S}$ and $r_S = \frac{\pi_S}{\pi_B + \pi_S}$ with $r_B + r_S = 1$, we reach the expression (7). After substituting (A.1) back into the time constraint function, the business of serving final consumers gets the following time allocation

$$s^* = r_S \left(T + \frac{1}{h}\right). \tag{A.2}$$

To ensure $b^* = r_B Th - r_S > 0$, h has to exceed $\frac{r_S}{r_B T}$. Otherwise, $b^* = 0$ due to the high time costs of operating the productive business. Given h goes positive infinite, s^* converges to $r_s T$ where we assume that $r_s T > 1$, meaning that even when the firms are extremely proficient at winning contracts, their profits from serving customers are high enough that they still spend one hour of their time supplying customers.

A.5 Proof of Equations (9) and (10)

When $h \geq \frac{r_S}{r_B} \frac{1}{T} = \underline{h}$, we substitute $b_t^* = r_B T h_t - r_S$ into equation (8). It yields

$$h_{t+1} = (w_h + w_b r_B T)\, h_t - w_b r_S. \tag{A.3}$$

When $h < \frac{r_S}{r_B} \frac{1}{T} = \underline{h}$, b_t does not contribute to the accumulation of the firm's ability next period

$$h_{t+1} = w_h h_t. \tag{A.4}$$

By applying equation (7) to period $t+1$,

$$b^*_{t+1} = r_B T h_{t+1} - r_S.$$

The substitution of equation (10) into (7) when $h \geq \frac{r_S}{r_B}\frac{1}{T} = \underline{h}$ gives

$$b^*_{t+1} = r_B T \left\{ \left(w_h + w_b r_B T \right) h_t - w_b r_S \right\} - r_S.$$

By rearrangement,

$$b^*_{t+1} = w_h r_B h_t T + w_b T r_B \left(r_B T h_t - r_S \right) - r_S.$$

With $b^*_t = r_B T h_t - r_S$,

$$b_{t+1} = w_h \left(b_t + r_S \right) + w_b T r_B b_t - r_S.$$

By rearrangement,

$$b_{t+1} = \left(w_h + w_b T r_B \right) b_t + \left(w_h - 1 \right) r_S \text{ if } h_t > \underline{h}. \tag{A.5}$$

A.6 Proof of Corollary 1

Suppose the training raises a firm's ability to apply to contracts from h_{before} to $h_{\text{after}} = h_{\text{before}} + d$, with $d > 0$. To show that improving firms' ability to apply to contracts will benefit more firms that have higher abilities to begin with, we calculate the difference in the time that firms allocate to bidding on contracts $\Delta b = b_{\text{post}} - b_{\text{before}}$.

We present three cases based on a firm's initial level of ability h_{before} and the effect of training d:

- **Case 1:** The firm has an initial level of ability below the threshold that would allow it to start applying to contracts ($h_{before} < \underline{h}$, see Figure 4) and the effect of training is not big enough that the firm lands above the threshold to start applying ($h_{after} < \underline{h}$), then:

  $$b_{\text{before}} = 0 \text{ and } b_{\text{after}} = 0.$$

  As a result $b_{\text{after}} - b_{\text{before}} = 0$, and there are no positive effects on winning contracts after training.

- **Case 2:** The firm has an initial level of ability below the threshold that would allow it to start applying to contract ($h_{before} < \underline{h}$), but in this case the effect of training is

big enough that the firm lands above the threshold to start applying ($\underline{h}$<h_{after}), then:

$$b_{\text{after}} = r_B T\left(h_{\text{before}} + d\right) - r_S > 0$$
$$b_{\text{before}} = 0$$

So that $b_{\text{after}} - b_{\text{before}} = r_B T\left(h_{\text{before}} + d\right) - r_S > 0$

- **Case 3:** The firm has an initial ability of h_{before} that exceeds the threshold $\underline{h}$, which means that the firm is already applying to contracts. Training will thus have the following effect the equation $b_{\text{after}} - b_{\text{before}} = r_B T d > 0$.

These results show that in the short run, the effect of the training is increasing in initial level of ability h.

The long-run effects can then be computed by comparing where firms land in the long term equilibrium. Since the short term effect of training on b is increasing in the initial ability of the firm, the long-run effect of training will depend on whether the firm lands below or above the intersection of the function $b_{t+1} = g(b_t)$ with the 45 degree line (see Panel B of Figure 4. Firms who land below b^* will converge to an equilibrium where they do not apply to tenders, while firms who land above b^* will converge to an equilibrium where they will apply to more and more contracts as time goes by.