Health Certification in the Market for Sex Work: A Field Experiment in Dakar, Senegal

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Abstract

In markets where suppliers possess important, unobservable information, theory predicts that credible certification can improve welfare. I study sex work "legalization and regulation", a common program that provides government certification of female sex workers' health. Adapting a standard information disclosure model, I show that when sex workers' health status is unobservable, certified providers should earn higher prices, and as long as certification costs are low, all suppliers should obtain certification. I test these predictions using a novel randomized experiment among uncertified female sex workers in Dakar, Senegal. In a randomly selected treatment group, I offered a one-time certification incentive that reduced monetary certification costs to zero. Contrary to the theoretical prediction, take-up of this incentive was very low: only 7 percent of the treatment group obtained certification, relative to 2 percent in control. Moreover, I find no evidence for a large price premium to certified sex workers. To explain this finding, I present new evidence that sex workers' health status is partially observable and already priced into the sex market: sex workers earn 19 percent lower prices when they have visible STI symptoms. As a result, the value of certification is limited for both clients and sex workers. These results, combined with evidence for high non-monetary costs related to stigma, suggest that complementary services for uncertified sex workers are needed to achieve sexually transmitted infection control.

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1 Introduction

Female sex workers (FSWs) are disproportionately affected by sexually transmitted infections (STIs). In developing countries, estimates of STI prevalence among FSWs have ranged from 28 to 84 percent (Cwikel et al., 2008). Many of these infections are curable, but female sex workers often do not seek health care even when they have symptoms. Because female sex workers are a core population in the epidemiology of STIs, high STI prevalence in the population helps maintain the wider STI epidemic (Aral, 2000). A common solution aimed at STI control is a health certification program known as "legalization with regulation." Under this policy, which is used in over 20 countries, FSWs can avoid some criminal penalties if they obtain certification by registering with a government clinic or agency, undergoing regular gynecological check-ups, and treating any diagnosed STIs.[1]

On first examination, legalization and regulation appears to be well grounded in economic theory. We would expect sex markets to suffer from the asymmetric information problem famously described by Akerlof (1970). Under this assumption, sex workers know more about their STI status than their clients. Even if clients are willing to pay more to transact with a sex worker who does not have an STI, they have no way of verifying whether a given sex worker is STI-free. Sex workers then have limited incentives to invest in remaining STI-free, and there are more STIs in the market than under the Pareto optimum. Certification mitigates this problem by providing a credible mechanism for the sex worker to disclose her health status. An information disclosure model adapted from Leland (1979) and Spence (1973) predicts that when sex workers' STI status is unobservable, certified providers should earn higher prices, and when certification costs are low enough, all suppliers should choose to get certified.

Despite the theoretical informational benefits of certification, participation in legalization programs remains low in most settings (Sirotin et al., 2010; Gertler and Shah, 2011). Senegal has had a legalization and regulation policy, operating through registration at public STI clinics, since 1969.[2] Yet local estimates suggest that certified sex workers represent just 20 percent of the sex worker population (Tucker, 2012). As with any social program (Moffitt, 1983), there are three possible explanations for low take-up: (i) eligible participants do not know about certification; (ii) the costs associated with participation are high; or (iii) the benefits of participation are low.

I conducted a novel randomized experiment that addressed the first two constraints. In a sample of 291 uncertified sex workers, I provided information about certification and offered a one-time, monetary certification incentive to a randomly selected treatment group. Take-up of this incentive, which was approximately equal to a day's wage for the median sex worker, was surprisingly low:

[1] Some legalization programs use laboratory testing for STIs, but many others, including the one described in this paper, diagnose STIs based on clinical symptoms. The medical literature has shown that this approach is effective in significantly reducing STI prevalence among sex workers (Ndoye et al., 1998; Ghys et al., 2001; Steen and Dallabetta, 2003).

[2] Under the program, certified sex workers cannot be prosecuted for prostitution. However, public soliciting, deriving financial gain from prostitution, and other activities related to sex work remain illegal (Mgbako and Smith, 2009).

only 7 percent of the treatment group got certified, relative to 2 percent of the control group. This low participation rate does not appear to be driven by the time and transportation costs of certification: the incentive amount was equal to the reimbursement given for participation in surveys, which carried equivalent time and transportation costs. In contrast to certification rates, 93 percent of individuals randomized completed the endline survey.

Given this result, I investigate the benefits of certification, and find no evidence that the market values certification.[3] The price premium to certified sex workers appears to be statistically and economically insignificant in both causal and descriptive analysis. Using detailed transaction-level panel data I collected, I show that the experimental intention-to-treat effect is near zero. Then, I study differential, within-individual price changes over time for participants who got certified versus those who did not. While this analysis is descriptive, I control for a large part of the selection bias using individual fixed effects. Certification is not significantly associated with higher prices in any specification. With reasonable controls, the point estimate is negative. Clients asked about certification in just 11 percent of transactions, providing further support that certification is not valued in the market.

The lack of a large certification premium can be explained, in part, by evidence that sex workers' STI status is partially observable. I present new evidence that prices respond to an individual sex workers' STI status even in the absence of certification. Controlling for individual fixed effects and types of sex acts exchanged, sex workers with visible STI symptoms receive a 19 percent discount on transaction prices. This effect appears to be driven by client willingness-to-pay: in contrast to visible STI episodes, STI episodes that are not visible to the client have no significant effect on prices.

I augment this analysis by studying how market outcomes vary with sex workers' biologically confirmed STI status using data from 2,721 female sex workers in Ecuador. I show that in Ecuador as well, sex workers with visible STIs earn lower prices at the transaction level, relative to both uninfected sex workers and those with invisible STIs. There is no such association between invisible STIs and prices. While this is a cross-sectional analysis, the results are robust to the inclusion of numerous controls for sex worker demographics, work location, and types of sex act exchanged. In addition, I provide further evidence that the association between prices and visible STI symptoms is demand-driven: this association is weaker among clients who already have STIs.

This result may be surprising given that the most important unobservable STI is HIV. However, clients may plausibly believe that the risk of acquiring HIV through exchanging sex in Senegal and Ecuador is very low. This conclusion follows from the combination of low general population HIV prevalence (0.5 percent in in Senegal and 0.3 percent in Ecuador)(UNAIDS, 2015) and longstanding, free access to antiretroviral therapy in Senegal, which reduces the likelihood of HIV transmission (Cohen et al., 2011). Therefore, it is reasonable to believe that STIs that produce visible symptoms are a greater concern for clients in these settings.

[3] I also show that, in practice, the legal benefits of participation are small due to limited enforcement of prostitution laws. At baseline, only 3.4 percent of the sample reported recent detention or arrest, and fewer than 1 percent did jail time. Moreover, recent arrest and jail time do not predict take-up.

The absence of a certification premium due to partial observability of sex workers' STI status can explain low take-up of Senegal's certification program in general; however, it does not explain the low response to the moderate financial incentive offered in this experiment. To complete the analysis of low take-up, I analyze the non-monetary costs of certification. While the monetary costs of the program are low, I find that stigma costs associated with registering are extremely high for a large proportion of FSWs. In a stated willingness-to-accept elicitation, 44 percent of respondents said there was no incentive amount that could convince them to register. Self-stigma (i.e, unwillingness to accept a "sex worker" identity) is highly predictive of refusal to register.

Finally, I consider whether certification may be helpful in limiting the infectious disease externality of sex work. Given low take-up, the effectiveness of the program for STI control depends largely on targeting. The program must reach those at highest risk of acquisition and transmission of STIs. However, I present evidence that FSWs who self-select into the program are at relatively low risk for acquiring and transmitting STIs. While experiencing recent STI symptoms at baseline is predictive of take-up, it is only predictive among health-seeking types: women who were already engaged in numerous health-protective behaviors that reduce their risk of both acquiring and transmitting STIs.

This paper contributes to the literature on the economics of sex work, in particular understanding how client demand responds to STI risk. This paper is the first to show a given sex worker's prices respond to her own STI status, conditional on individual fixed effects. By distinguishing between visible and invisible STI symptoms, I present convincing evidence that this effect is driven primarily by client demand. Previous work has focused largely on sex workers' preferences and incentives, showing that clients who demand unprotected or anal sex compensate sex workers for the increased riskiness of the transaction (e.g., Gertler et al. (2005); Arunachalam and Shah (2013)). Robinson and Yeh (2011) show that female sex workers in Kenya are less likely to exchange sex on days when they have STI symptoms, but it is not clear whether this is a demand effect or a productivity effect (i.e., supplying sex is painful when the sex worker has an STI). Using the same dataset from Ecuador as this paper,Arunachalam and Shah (2013) show that sex workers earn lower prices where the local STI prevalence is higher, which is consistent with the notion that clients are willing to pay for a lower risk of acquiring an STI.

This paper also contributes to a large literature on information disclosure mechanisms that aim to alleviate asymmetric information problems (see Dranove and Jin (2010) for a review). It is a general prediction of this literature that certified providers should earn higher prices and, as long as certification costs are negligible, almost all suppliers choose to obtain certification. I present a new example of the failure of this prediction: in the understudied market for sex work, I find no evidence for a certification price premium and very low take-up of certification, despite zero monetary certification costs.[4]

In addition, this paper contributes to a growing subset of the certification literature exploring

[4]Logan and Shah (2013) analyze informal solutions to asymmetric information problems in the online male sex work market in the United States, and highlight the importance of sex worker photos as a signalling mechanism. However, there is no third-party certification in the market they analyze.

how markets may differentially respond to different types and sources of information. Several studies have found evidence for the intuitive idea that certification has a greater impact on the market when the *added* informational value is higher. For example, Elfenbein et al. (2015) show that seller quality certification on the online marketplace eBay affects demand more among sellers with less established reputations, as measured by the customer feedback score. In other words, certification and seller reputation are substitutes. Jin and Leslie (2009) and Xiao (2010) find similar results analyzing mandatory restaurant hygiene grade cards and accreditation of childcare operators, respectively. Dranove and Sfekas (2008) identify the informational channel for this effect, using a structural model to show that hospital report cards had an impact only when the results were a "surprise" relative to consumers' prior beliefs about hospital quality. In a similar vein, I show that when a seller attribute is partially observable, consumers may place limited informational value on third-party certification, and as a result the certification has no impact on the market. I find that clients are willing to pay more to transact with a sex worker who has no visible STI symptoms, but there is no evidence for a certification premium even among sex workers with no symptoms.

From a policy perspective, this study makes several contributions to the literature on sex worker registration programs. Senegal's program is similar to regimes prevalent in Latin America, Europe and Asia (Sirotin et al., 2010; Gertler and Shah, 2011; Liu and So, 1996; Harcourt et al., 2010), and as the only program of its kind in Africa, it has been discussed as a model for other programs on the continent. This study provides the first rigorous evidence on barriers to take-up of registration programs. I show that many sex workers are unwilling to register even when provided information about the program and offered a moderate incentive to do so. This result rules out lack of information or minor hassle costs as the primary barriers to registration for a large proportion of uncertified sex workers. I present evidence that resistance to registration is related to stigma toward female sex workers, a widespread phenomenon. The results suggest that take-up of registration will continue to be low in most settings.

Second, I demonstrate the importance of selection bias in understanding simple comparisons between certified and uncertified sex workers. Previous studies relying on simple comparisons have found that certified sex workers earn significantly higher prices (e.g. Sirotin et al. (2010) in Tijuana, Mexico).[5] In contrast to previous work, my data include panel variation in registration status, allowing for the use of individual fixed effects to analyze prices, and I find no evidence for a price premium for registration.[6] In previous studies, registration was also associated with improvements

[5]Gertler and Shah (2011) is an exception to this: they exploit geographic variation in law enforcement prosecution of uncertified sex workers in Ecuador. They focus on the causal effect of registration on STI rates, and find lower STI rates in regions where enforcement is greater in the riskier street sector, but higher STI rates where police conduct raids on brothels and nightclubs. However, they also study prices and quantities exchanged, and find that greater enforcement led to increased prices and lower quantities exchanged for both protected and unprotected sex. Taken together, the results are more consistent with a direct effect of police activities on the supply of sex rather than an effect of registration per se.

[6]In addition to selection bias, the difference may stem from contextual factors: it is possible that there is a certification premium in Tijuana, but not in Senegal. However, HIV prevalence among female sex workers in Tijuana is substantially lower than in Senegal, so to the extent that HIV is the most important unobservable STI, we would

in risk behaviors (Liu and So, 1996; Kerrigan et al., 2006; Harcourt et al., 2010; Sirotin et al., 2010; Gaines et al., 2013). For example, in early studies in the Philippines, certified sex workers reported more consistent condom use despite comparable levels of HIV-related knowledge, and in Mexico, certified sex workers were less likely to have an STI (Liu and So, 1996; Amadora-Nolasco et al., 2001; Sirotin et al., 2010).[7] However, I show that sex workers who select into registration are "health-seeking types" who were engaged in preventive behaviors even before registering. Thus, while the biomedical literature has shown that regular screening and testing of STIs reduces the STI burden (World Health Organization, 2012), the impacts of registration programs on risk behaviors remain to be tested.

Finally, my results on low take-up and targeting have wider implications for public health policy. In particular, if FSWs at the highest risk of acquiring and transmitting STIs are less likely to participate in registration programs, alternate services for screening and treatment of STIs are needed to achieve STI control. It appears that Senegal has made significant progress on this front: at baseline, nearly 30 percent of the sample reported a well visit (i.e, seeing a health care provider for gynecological care even when they did not have symptoms) in the past month. Nevertheless, in order to reach World Health Organization recommendations for prevention and treatment of STIs among FSWs (World Health Organization, 2012), further research is needed to understand how best to encourage female sex workers to participate in either registration or alternate health care.

The remainder of the paper proceeds as follows. In Section 2, I lay out a conceptual model to provide a framework for the empirical results. In Section 3, I provide background on sex work in Senegal, the registration program, and the experimental design. Section 4 describes the data and estimation strategy. Section 5 presents the experimental results; results on the certification premium, client willingness to pay for sex workers' health, and the existence of asymmetric information in the market. Section 6 shows evidence on non-monetary certification costs. Section 7 discusses policy implications of the study, including results related to targeting. Section 8 concludes.

2 Model

In this section, I develop a conceptual model to guide the empirical results. First, I show that a standard signaling model based on Leland (1979) and Spence (1973) generates two key theoretical predictions, which I test in this paper: (i) the unobservable nature of sexually transmitted infections generates a price premium for certified female sex workers; and (ii) if certification costs are low, most sex workers should choose to obtain certification.

Then, I analyze a market with partially observable information. In particular, I consider symptoms that reveal a sex workers' STI to the client with some probability. I show that the price premium and take-up of certification vary with the probability of symptoms conditional on having an STI. As the probability of symptoms increases and the degree of asymmetric information falls,

expect the premium to be even lower in Tijuana.

[7] The result in Mexico was largely explained by demographic and behavioral characteristics, which is also suggestive of selection bias.

take-up of certification falls and the price premium for certified sex workers disappears.

2.1 Unobservable Health Status

Model Set-up

Each sex worker is either healthy or infected with an STI. Let $\theta \in \{\theta_H, \theta_S\}$ denote her health status, which is unobservable. She has some probability of being healthy $q(\rho) = Pr(\theta_H|\rho)$, where $\rho \in [0, \bar{\rho}]$ is a level of health investment and $q(\rho)$ is continuous and strictly increasing in ρ. I assume that regardless of health investments, there is uncertainty around health status: $q(\rho = 0) > 0$ and $q(\bar{\rho}) < 1$. Sex workers who make the minimal health investment may still be healthy, and sex workers who make the maximal health investment can still be infected with STIs.

For ease of exposition, I will assume that the level of health investment ρ is exogenously given and cannot be changed. This simplification does not generate substantively different results from a model where health investments are optimally determined according to sex workers' preferences. For this reason, I call individuals with higher ρ "health seekers". I assume that there is at least one agent who chooses $\bar{\rho}$. I also assume that there are agents who choose $\rho < \bar{\rho}$. That is, if $f(\cdot)$ denotes the density of ρ, $f(\bar{\rho}) < 1$.

Health investment carries a cost. The cost of supplying one unit of sex at a given investment level is $c(\rho)$. I assume $c(0) = 0$ and $c(\bar{\rho}) > 0$, and c continuous in $[0, \bar{\rho}]$. I also assume the cost is weakly increasing: $c'(\rho) \geq 0$. Both the health production function $q(\rho)$ and the cost function $c(\rho)$ are homogenous across agents. Therefore, the only source of heterogeneity across agents is the level of health investment ρ, which is driven by sex workers' individual preferences.

On the demand side, clients value health according to some value function $v(\theta)$. I assume that the value of a transaction with a healthy sex worker is strictly greater than the value of a transaction with a sex worker who has an STI: $v(\theta_H) > v(\theta_S)$. Both q and ρ are unobservable to clients; therefore, the value of a transaction depends on clients' beliefs about the probability that the sex worker is healthy, denoted by μ. The subjective expected value of a transaction is then $\mathrm{E}(v(\theta)) = \mu v(\theta_H) + (1 - \mu)v(\theta_S)$. I normalize $v(\theta_S) = 0$ and $v(\theta_H) = 1$ to obtain demand $p^D \leq \mu$.

In addition to making private investments ρ, sex workers can choose to participate in a health program. Clients observe the participation decision, denoted by $h \in \{h_0, h_1\}$, and form beliefs about the probability of health conditional on h, $\mu(h)$. FSWs who participate in the program are "certified." Participation in the program sets the probability of health to that under the maximal ρ: $q(h_1) = q(\bar{\rho}) := \bar{q}$. It also carries a health care cost γ. Health care is not subsidized through the program, so $\gamma = c(\bar{\rho})$. Recall the previous assumption that at least one agent chooses $\bar{\rho}$. Thus, there is at least one agent for whom the health care cost associated with participation in the program is equal to her health investment in the absence of the program. In Section 4.2, I show that this assumption is reasonable in the Senegalese context.

Equilibrium

Since normalized demand is just the client's belief about health μ, in any perfect Bayesian equilibrium, clients will pay $\mu^*(h_1)$ to certified sex workers and $\mu^*(h_0)$ to uncertified sex workers, where beliefs μ^* are derived from equilibrium strategies using Bayes' rule where possible. Now, the health program ensures that the probability of health is $\bar{q} = q(\bar{\rho})$. Therefore, $\mu^*(h_1) = \bar{q}$ and any equilibrium must satisfy:

$$p = \begin{cases} \bar{q} & \text{if } h_1 \\ \mu^*(h_0) & \text{if } h_0 \end{cases}$$

for some $\mu^*(h_0)$. Given client demand, sex workers' utility from a transaction is:

$$U(h) = \begin{cases} \bar{q} - \gamma & \text{if } h_1 \\ \mu^*(h_0) - c(\rho) & \text{if } h_0 \end{cases}$$

Certification take-up

Sex workers choose to participate when $U(h_1) > U(h_0)$, or when the marginal benefit of participating is greater than the marginal cost of participating:

$$\bar{q} - \mu^*(h_0) > \gamma - c(\rho)$$

I do not model the benefits of legalization (i.e. protection from prosecution for certified sex workers). In Section 4.2, I show that in the Senegalese context, the benefits of legalization appear to be nominal, since enforcement of laws against prostitution is limited.

Separating Equilibrium

As specified above, for all certified sex workers in equilibrium, it must be the case that the marginal benefit of participating in the health program is greater than $\gamma - c(\rho)$. Since γ is constant and $c(\rho)$ is monotonically increasing, this implies that health-seeking types are more likely to participate: there is some $\hat{\rho}$ such that $\rho \leq \hat{\rho}$ for all uncertified sex workers. Bayes' rule then requires that $\mu^*(h_0) = Pr(\theta_H | h_0, \rho \leq \hat{\rho})$. There is an equilibrium where $\hat{\rho}$ satisfies:

$$\bar{q} - Pr(\theta_H | h_0, \rho \leq \hat{\rho}) = \gamma - c(\hat{\rho}) \tag{1}$$

and the marginal benefit curve intersects the marginal cost curve from below:

$$\frac{\partial}{\partial \hat{\rho}}(Pr(\theta_H | h_0, \rho \leq \hat{\rho})) < c'(\hat{\rho}) \tag{2}$$

Figure 1 illustrates an example of a separating equilibrium. The curvature of marginal benefit and marginal costs curves is for illustrative purposes only; I have not made any assumptions on the

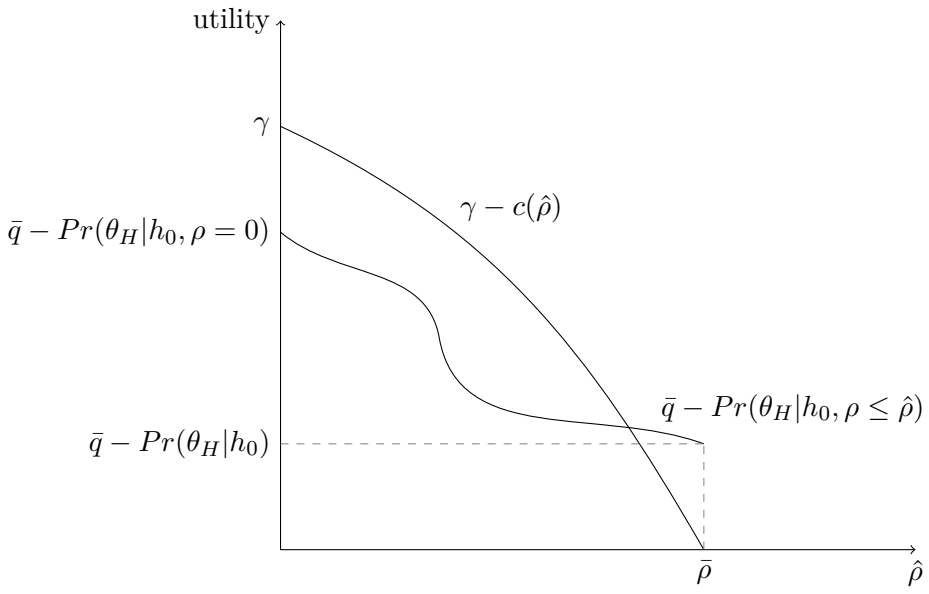

Figure 1: Example: separating equilibrium.

shape of these curves, only that they are weakly decreasing.[8]

Result 1 *In any separating equilibrium, $\bar{q} > \mu^*(h_0)$. That is, there is a price premium for certified sex workers.*

Since $\rho \in [0, \bar{\rho}]$, $\bar{q} = q(\bar{\rho})$ is the maximum achievable probability of health. Therefore we have $\bar{q} \geq \mu^*(h_0)$ for any rational belief $\mu^*(h_0)$. In a separating equilibrium, from the characterization in (1), it must be the case that this inequality is strict:

$$\mu^*(h_0) = Pr(\theta_H|h_0, \rho \leq \hat{\rho}) < q(\bar{\rho})$$

The lefthand term decreases with $\hat{\rho}$. At the maximal $\hat{\rho} = \bar{\rho}$, this term is just the share of sex workers in the market with θ_H if no sex workers register, $Pr(\theta_H|h_0)$. This must be less than $q(\bar{\rho})$ because (i) I assumed that there are agents with $\rho < \bar{\rho}$ (i.e., $f(\bar{\rho}) < 1$); and (ii) $q(\rho)$ is strictly increasing.

Pooling equilibrium

There is no pooling equilibrium in which all sex workers remain uncertified. Consider an outcome in which all sex workers choose $h^* = 0$. Then we must have $\mu^*(h_0) = Pr(\theta_H|h_0)$. It is profitable for sex workers to deviate to h_1 if:

[8] In this example, the separating equilibrium is unique; however, this need not be the case. The following assumptions are sufficient for uniqueness: weak convexity of $c(\rho)$; the distribution of ρ is such that $F(\hat{\rho}) = Pr(\theta_H|h = 0, \rho \leq \hat{\rho})$ is either weakly concave or weakly convex (i.e., no inflection points); and $\bar{q} - Pr(\theta_H|h_0, \rho = 0) < \gamma$.

$$\bar{q} - Pr(\theta_H|h_0) > \gamma - c(\rho)$$

But, as shown above, $\bar{q} - Pr(\theta_H|h_0) > 0$. And, by assumption $\gamma - c(\bar{\rho}) = 0$. Therefore deviation to h_1 is profitable for all sex workers with $\rho = \bar{\rho}$. Thus, this result follows from the assumption that there is at least one agent with $\rho = \bar{\rho}$. This result is easy to see in Figure 1: the marginal cost curve intersects the x-axis at $\bar{\rho}$, while the marginal benefit curve remains strictly above the x-axis. Thus, the two curves cannot intersect at $\bar{\rho}$.

Result 2 *If the cost of obtaining health certification is small, there is a pooling equilibrium in which all sex workers get certified.*

Suppose all sex workers are certified. FSWs will deviate to h_0 if

$$\bar{q} - \mu^*(h_0) < \gamma - c(\rho)$$

Let $\mu^*(h_0) = Pr(\theta_H|h_0, \rho = 0)$. This belief makes sense: for given any $\mu^*(h_0)$, the sex worker most likely to deviate is the sex worker with the most to gain, i.e. the maximal $\gamma - c(\rho)$. This occurs at $c(\rho) = 0$, and $c(\rho = 0) = 0$. Given $\mu^*(h_0)$, FSWs then have no incentive to deviate if:

$$\bar{q} - Pr(\theta_H|h_0, \rho = 0) > \gamma$$

The lefthand side of the above expression is the difference between the probability of health given maximal health investment, and the probability of health given minimal health investment. If this difference is larger than the cost of the health program, all FSWs are better off remaining certified. This condition might be satisfied when the baseline probability of STIs is high, and the health program is extremely effective. It might also be satisfied when the participation cost γ is very low.

A sufficient condition for uniqueness of the pooling equilibrium is that a separating equilibrium does not exist. This occurs when the marginal benefit of certification is everywhere greater than the marginal cost (for example, when the marginal cost is very low). An example of a unique pooling equilibrium is shown in Figure 2.

2.2 Partially Observable Health Status

Suppose now that there is a signal $\sigma \in \{\sigma_0, \sigma_1\}$ that fully reveals STI infection. That is, $Pr(\theta_S|\sigma_1) = 1$. The signal is never sent when the sex worker is healthy, but when the sex worker is infected with an STI, the signal is sent with some probability s:

$$Pr(\sigma_1) = \begin{cases} 0 & \text{if } \theta_H \\ s & \text{if } \theta_S \end{cases}$$

We can think of $\sigma = 1$ as visible STI symptoms. Figure 3 depicts a decision tree for the certification decision under partially observable information.

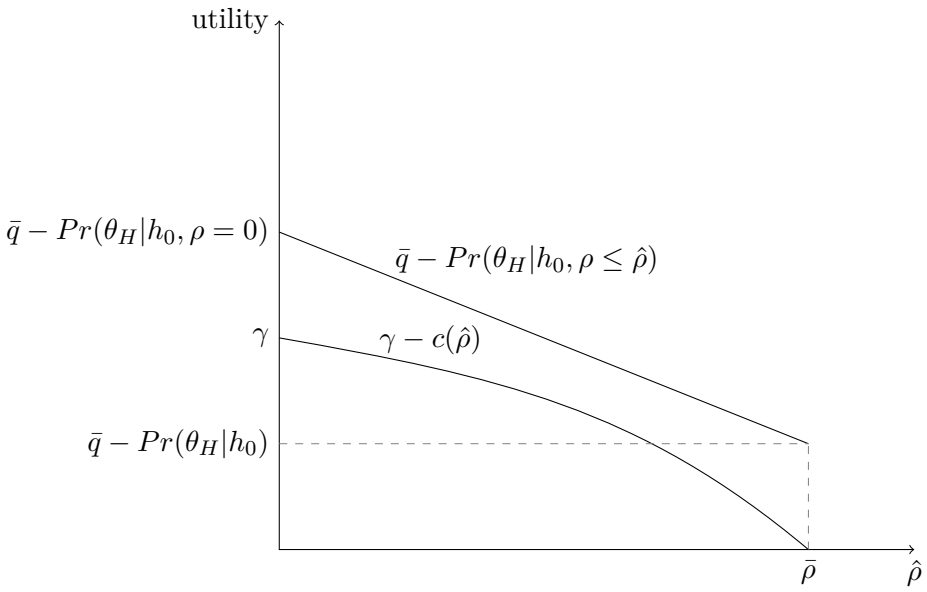

Figure 2: Example: unique pooling equilibrium

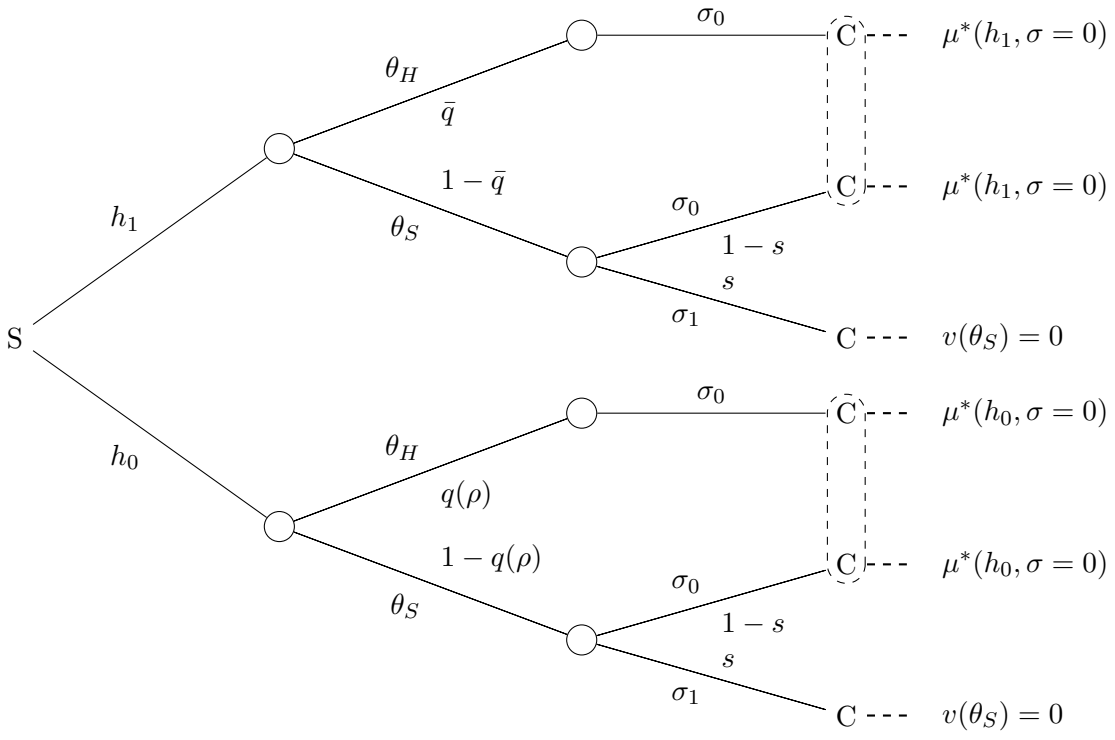

Figure 3: Certification Decision under Partially Observable Information

Equilibrium

In equilibrium, clients will pay $\mu^*(h, \sigma)$, where, as before, beliefs μ^* are derived from equilibrium strategies using Bayes' rule where possible. For σ_1, clients know with certainty that the sex worker is infected with an STI, so $\mu^*(h, \sigma_1) = 0 \; \forall \; h$.

For σ_0, demand depends on beliefs as before. Clients will pay $\mu^*(h_1, \sigma_0)$ to certified sex workers who do not have symptoms, and $\mu^*(h_0, \sigma_0)$ to uncertified sex workers who do not have symptoms. From Figure 3, we can see that the belief for certified sex workers must be:

$$\mu^*(h_1, \sigma_0) = \frac{\bar{q}}{\bar{q} + (1 - \bar{q})(1 - s)}$$

Hence, equilibrium demand is:

$$p = \begin{cases} \dfrac{\bar{q}}{\bar{q} + (1 - \bar{q})(1 - s)} & \text{if } h_1, \sigma_0 \\ \mu^*(h_0, \sigma_0) & \text{if } h_0, \sigma_0 \\ 0 & \text{if } \sigma_1, \forall \; h \end{cases}$$

for some $\mu^*(h_0, \sigma_0)$. This demand function generates the following result.

Result 3 *In any separating equilibrium, sex workers who have visible symptoms earn lower prices, regardless of certification status.*

This result is immediate for certified sex workers: $\bar{q}/[\bar{q} + (1 - \bar{q})(1 - s)] > 0$ since $\bar{q} > 0$. For uncertified sex workers, the result follows from the assumptions that those with the minimal health investment still have a non-zero probability of health: $q(\rho = 0) > 0$. Thus, even if only the lowest type remains uncertified, $\mu^*(h_0, \sigma_0) > 0$.

On the supply side, sex workers' utility now includes the possibility that the STI infection will be revealed, and if this occurs they will earn the minimal price ($p = 0$). From Figure 3, the expected utility from certification is:

$$\begin{aligned} \mathrm{E}\left[U(h_1)\right] &= [\bar{q} + (1 - \bar{q})(1 - s)]\mu^*(h_1, \sigma_0) - \gamma \\ &= \bar{q} - \gamma \end{aligned}$$

Note that the welfare of certified sex workers is, in expectation, equal to their welfare in the case of fully asymmetric information.[9] The expected utility for uncertified sex workers is:

$$\mathrm{E}\left[U(h_0)\right] = [q(\rho) + (1 - q(\rho))(1 - s)]\mu^*(h_0, \sigma_0) - c(\rho)$$

Certification take-up

Sex workers will get certified when the expected utility of participation $\mathrm{E}\left[U(h_1)\right]$ exceeds $\mathrm{E}\left[U(h_0)\right]$, the expected utility of remaining uncertified :

[9] This result holds only when utility is linear in money.

$$\bar{q} - \gamma > [q(\rho) + (1 - q(\rho))(1 - s)]\mu^*(h_0, \sigma_0) - c(\rho)$$

or, as before, the marginal benefit of obtaining certification exceeds the marginal cost:

$$\bar{q} - [q(\rho) + (1 - q(\rho))(1 - s)]\mu^*(h_0, \sigma_0) > \gamma - c(\rho)$$

Separating Equilibrium

In the case of unobservable health status, there was some $\hat{\rho}$ such that all individuals with $\rho > \hat{\rho}$ chose h_1. This followed from the fact that the marginal benefit of certification was the same for all ρ, while the marginal cost of certification was decreasing in ρ. Now in the partially observable case, the marginal cost of certification is still decreasing in ρ. However, the marginal benefit is also decreasing in ρ: health-seeking types benefit from a lower likelihood of experiencing symptoms σ_1 even when uncertified. Therefore, the added value of certification falls as ρ increases.

Nevertheless, there exists a similarly defined $\hat{\hat{\rho}}$ such that all individuals with $\rho > \hat{\hat{\rho}}$ will get certified, if the marginal cost of obtaining certification increases faster in ρ than the marginal benefit:

$$-sq'(\rho)\mu^*(h_0, \sigma_0) > -c'(\rho)$$

This condition simplifies to:

$$s\mu^*(h_0, \sigma_0) < \frac{c'(\rho)}{q'(\rho)}$$

Then Bayes' rule requires $\mu^*(h_0) = Pr(\theta_H | h_0, \sigma_0, \rho \leq \hat{\hat{\rho}})$ and there is an equilibrium where $\hat{\hat{\rho}}$ satisfies:

$$\bar{q} - [q(\hat{\hat{\rho}}) + (1 - q(\hat{\hat{\rho}}))(1 - s)]Pr(\theta_H | h_0, \sigma_0, \rho \leq \hat{\hat{\rho}}) = \gamma - c(\hat{\hat{\rho}})$$

or equivalently,

$$\bar{q} - [q(\hat{\hat{\rho}}) + (1 - q(\hat{\hat{\rho}}))(1 - s)]\frac{Pr(\theta_H | h_0, \rho \leq \hat{\hat{\rho}})}{Pr(\sigma_0 | h_0, \rho \leq \hat{\hat{\rho}})} = \gamma - c(\hat{\hat{\rho}}) \tag{3}$$

Result 4 *In any separating equilibrium, as the probability of symptoms increases, certification take-up falls: as* $s \to 1$, $\hat{\hat{\rho}} \to \bar{\rho}$.

To see this result, we will first consider how the separating equilibrium changes when we move from $s = 0$ to an arbitrary $s \in (0, 1)$. The case of $s = 0$ corresponds to unobservable health status. There is some $\hat{\rho}$, defined by equation (1), such that all individuals with $\rho \leq \hat{\rho}$ remain uncertified, while those with $\rho > \hat{\rho}$ obtain certification.

Now consider the sex worker with $\hat{\rho}$ when $s = 0$ moves to $s \in (0, 1)$. For the sex worker with $\hat{\rho}$, the marginal benefit of obtaining certification is now :

$$\bar{q} - [q(\hat{\rho}) + (1 - q(\hat{\rho}))(1 - s)]\frac{Pr(\theta_H|h_0, \rho \leq \hat{\rho})}{Pr(\sigma_0|h_0, \rho \leq \hat{\rho})}$$

or equivalently,

$$\bar{q} - \frac{Pr(\sigma_0|h_0, \hat{\rho})}{Pr(\sigma_0|h_0, \rho \leq \hat{\rho})} Pr(\theta_H|h_0, \rho \leq \hat{\rho})$$

Since a higher probability of health reduces the unconditional probability of symptoms, we have $Pr(\sigma_0|h_0, \hat{\rho}) > Pr(\sigma_0|h_0, \rho \leq \hat{\rho})$, which implies that the marginal benefit of certifying under partially observable health status is lower for the sex worker with $\hat{\rho}$ than it was under unobservable health status:

$$\bar{q} - \frac{Pr(\sigma_0|h_0, \hat{\rho})}{Pr(\sigma_0|h_0, \rho \leq \hat{\rho})} Pr(\theta_H|h_0, \rho \leq \hat{\rho}) < \bar{q} - Pr(\theta_H|h_0, \rho \leq \hat{\rho})$$

However, in both cases the marginal cost of certifying is $\gamma - c(\rho)$. Thus, when we move from unobservable health status to partially observable status, the sex worker with $\hat{\rho}$ will strictly prefer to remain uncertified. Therefore, it must be the case that $\hat{\rho} < \hat{\hat{\rho}}$. The threshold above which certification is valuable is higher when health status is partially observable, leading to lower take-up of certification.

When health status is fully *observable* (i.e, $s = 1$), the separating equilibrium condition (3) reduces to:

$$\bar{q} - q(\hat{\hat{\rho}}) = \gamma - c(\hat{\hat{\rho}})$$

This condition is satisfied only at the maximal health investment $\bar{\rho}$. All sex workers with $\rho < \hat{\hat{\rho}}$ will choose to remain uncertified, while sex workers with $\rho = \hat{\hat{\rho}}$ are indifferent between remaining uncertified and obtaining certification.

Result 5 *As the probability of symptoms increases, the certification premium for those without symptoms falls to 0.*

Given the characterization of $\mu^*(h_0, \sigma_0)$ in (3) above, the certification premium for sex workers with no symptoms is:

$$\frac{\bar{q}}{\bar{q} + (1 - \bar{q})(1 - s)} - \frac{Pr(\theta_H|h_0, \rho \leq \hat{\hat{\rho}})}{Pr(\theta_H|h_0, \rho \leq \hat{\hat{\rho}}) + (1 - Pr(\theta_H|h_0, \rho \leq \hat{\hat{\rho}}))(1 - s)}$$

As $s \to 1$, $(1 - s) \to 0$, and both terms of the above expression go to 1, and the difference goes to 0.

2.3 Summary of Model Predictions

The preceding sections first establish that a standard signaling model, with very few assumptions, generates two key theoretical predictions:

1. In any separating equilibrium, there is a price premium for certified sex workers.

2. If the cost of obtaining health certification is small, there is a pooling equilibrium in which all sex workers get certified.

Then, I showed that a model where sex workers' health status is partially observable due to visible STI symptoms generates three results:

3. In any separating equilibrium, sex workers who have visible symptoms earn lower prices, regardless of certification status.

4. In any separating equilibrium, as the probability of symptoms increases, certification take-up falls.

5. As the probability of symptoms increases, the certification premium for those without symptoms falls to 0.

In the remainder of the paper, I show that the evidence is more consistent with a world where health status is partially observable, and clients believe the probability of symptoms s is high. I present experimental evidence that certification take-up is low, which contradicts Result 2 and is consistent with Result 4. I show in both causal and descriptive analyses that there is no evidence for the certification premium described in Result 1; rather, the evidence is consistent with Result 5. And, I show evidence consistent with a price response to visible STI symptoms in both Senegal and Ecuador, consistent with Result 3.

3 Study Design

This paper is primarily based on data from a randomized field experiment I conducted in Dakar, Senegal, from October 2015 to June 2016. The final sample (after attrition) consists of 291 female sex workers who were uncertified at baseline. Participants were individually randomized via public lottery into treatment or control, and members of the treatment group were offered an encouragement to get certified consisting of (i) a persuasive informational session and (ii) a cash incentive to get certified.

3.1 Context

The sex worker registration program in Senegal has been in place since 1969. Sex workers can get certified at any public STI clinic in Senegal. In Dakar, the primary STI clinic is housed at the Institut d'Hygiène Sociale (IHS), a public hospital. Any woman can receive treatment at STI clinics, but FSWs must be over the age of 21 to get certified. There are no registration fees; however, each clinic visit carries a fee of 1,000 FCFA ($1.70). Administrative requirements for registration include a one-time interview with a social worker, informed consent, a copy of the national identity

card or passport, and 3 passport photos. The registration is valid for one month; thus, FSWs must attend monthly visits to keep their registration current.

The clinic has implemented syndromic case management of STIs, an algorithmic approach based on symptoms observable during a gynecological exam. This approach is considered effective in reducing STI prevalence in female sex workers, and is recommended by the World Health Organization when laboratory testing is not possible (Meda et al., 1999; Shahmanesh et al., 2008; World Health Organization, 2014).[10] If a clinic health care provider diagnoses a curable STI and recommends treatment, certification is suspended until the FSW can show that she has obtained any prescribed medications. STI treatment is not free: FSWs must pay for these treatments in order to keep their registration up to date.

HIV testing is performed annually. After an HIV diagnosis, FSWs are referred to the national HIV treatment program, which provides free medical care and antiretroviral therapy (ART). HIV-positive FSWs may stay certified as long as they respect the monthly clinic visits. The monthly visits emphasize adherence to HIV treatment; women receiving ART have a very low risk of transmitting HIV to male sexual partners (Cohen et al., 2011).

3.2 Sampling and Surveys

I implemented the study in partnership with a community-based organization, *Association AWA*, that provides services to certified and uncertified sex workers. From October 2015 to February 2016, participants were recruited using snowball sampling, a peer-referral recruitment method that is frequently used for hidden populations such as sex workers. Thirty one "seeds" were purposively selected among FSWs currently participating in HIV prevention projects with *AWA*. Of these, 21 were certified. These seeds were then asked to recruit three FSWs meeting eligibility criteria for the study. Those recruited were, in turn, be asked to recruit three more FSWs. Recruitment continued through this peer referral until the target sample size was obtained. Following standard practice, participants were compensated 5,000 FCFA ($8.50) for participation in the study and 2,500 FCFA ($4.25) for each recruited participant who was eligible and agreed to enroll in the study. In order to be eligible to participate, sex workers had to be uncertified and eligible for certification: 21 years of age or older and possessing a valid form of identification.[11]

Snowball sampling does not generate a representative sample. However, I consider this the policy-relevant sample for two reasons. Peer outreach is the primary method that service providers use to reach sex workers, and it is recommended by the World Health Organization (World Health Organization, 2011). Second, since severe stigma limits mass media promotion of policies affecting FSWs, this sample reflects the population most likely to be affected by policy changes. Consistent

[10] Syndromic management is somewhat less effective than laboratory testing, since many STIs are asymptomatic (World Health Organization, 2012; Bekker et al., 2014). However, there are no low-cost laboratory tests for most STIs, with the exception of HIV(World Health Organization, 2011)

[11] Other eligibility criteria were: (i) Born female, (ii) Report exchanging sex for money, gifts or goods within the past 6 months, (iii) Declare an intention to stay in Dakar for a period of 3 months, (iv) Mentally sound and capable of giving consent, (v) Speak French, Wolof or both, (vi) Present to the study with a valid recruitment coupon, (vii) Provide informed consent to participate in the study.

with this, in my sample, among those who had previously heard of the registration program at baseline, 86 percent heard about it from another sex worker.

All study activities were conducted at the offices of *Association AWA*.[12] The site is in a discreet location close to a busy market, ensuring that participants could come and go without attracting attention. Notably, the site is also a short walking distance (500m) from the primary registration clinic in Dakar, *Institut d'Hygiene Sociale* (IHS), so time and travel costs associated with study participation are roughly equivalent to time and travel costs associated with certification.

Following standard procedure for snowball sampling, participants completed informed consent and a baseline survey during their initial study visit. They returned two to four weeks later for randomization, and finally they completed an endline survey, generally one to three months after randomization.[13] Female sex workers are a highly mobile population that is difficult to track. We therefore allowed participants to complete missed visits whenever possible; as a result, there is some variation in time between visits. In total, from October 2015 to February 2016, we recruited and conducted baseline surveys for 400 female sex workers. Of these, 314 participants were eligible and randomized.[14] Between December 2015 and June 2016, 291 participants completed endline surveys, representing a 93 percent retention rate from randomization to follow-up.

3.3 Randomization

There are two groups in the study, treatment and control. Randomization was implemented via public lottery in a series of randomization sessions. After completing the baseline survey, participants received a randomization appointment two to four weeks later, which allowed them time to recruit other participants before randomization. We scheduled randomization sessions in groups of at least 10; however, in practice, due to missed appointments, randomization occurred in groups ranging from 3 to 25 participants.[15]

There were 33 randomization sessions over the course of approximately 4 months. The sessions were run by one member of the study staff and two trained peer educators. Then, participants drew their group assignment by drawing a colored ball from a sack. In total, 164 participants were randomized to treatment and 151 to control.[16] In all analyses, I account for varying treatment probabilities in each session (due to odd numbers of participants) using weighted regression (Gerber

[12]The use of an established community-based organization follows World Health Organization recommendations for network-based sampling(World Health Organization, 2011)

[13]A small number of participants completed their endline surveys 4+ months after randomization after missing their initial appointments.

[14]85 participants were lost to follow-up. One participant was determined to have been ineligible (under age 21) during data analysis.

[15]The final participant to be randomized was randomized alone. She drew her group assignment in the presence of study staff and peer educators to preserve the concept of a public lottery.

[16]In general, we included an even number of balls in the sack to ensure that participants had a 50 percent probability of being selected for treatment. Thus, despite the varying sizes of the randomization sessions, the ex ante assignment probability was constant. There is one exception to this: due to a miscommunication with the implementer, on December 14, approximately 75 percent of participants (14 of 18) were randomized to treatment instead of 50 percent.

and Green, 2012). Each observation i in session j is weighted by

$$w_{ij} = \frac{T_i}{p_j} + \frac{1 - T_i}{1 - p_j} \tag{4}$$

where T_i is the treatment assignment and p_j is the proportion of subjects assigned to treatment in session j.

As specified in a pre-analysis plan, I conduct all analyses on the sample that completed the entire study (n=291). Appendix A shows that there is no differential attrition across treatment and control groups. Appendix B shows balance across treatment and control groups. I evaluate balance in the analysis sample on 27 variables specified in a pre-analysis plan, using weighted regressions. There is a significant difference between treatment and control on one variable: whether any transactions were completed in a public place. Since the randomization was not stratified, this is consistent with chance, and I control for the unbalanced variable in evaluating treatment effects.

3.4 Encouragement

An encouragement intervention was delivered at the randomization session to members of the treatment group. The encouragement intervention involved two parts. First, the treatment group participated in a 30-minute persuasive discussion with the peer educators, who were certified sex workers. They shared their experience with the registration program, discussed the benefits of certification, and answered questions raised by participants. Those who indicated during the randomization session that they wished to register were given an appointment the following day for a peer educator to accompany them to the registration clinic and answer any questions about the process.

The second part of the encouragement was a cash incentive to register. We offered a total of 6,000 FCFA($10.20) to anyone who got certified within 15 days. This amount was designed to provide reimbursement of the 1,000 FCFA ($1.70) clinic visit fee and 5,000 FCFA($10.20) to the sex worker. In order to claim the incentive, participants had to return to the study offices and show their registration card to study staff. The study offices were open late and were a short walking distance (500m) from the primary registration clinic, so claiming the incentive did not require additional travel.

The randomization sessions proceeded as follows. First, prior to drawing their treatment assignment, all participants received basic, neutral information about the registration program, their legal rights in Senegal, and a brief education module on sexually transmitted infections. Following the public lottery, participants were divided by treatment, and trained peer educators delivered the encouragement intervention to the treatment group. Control group participants were reminded about compensation for the follow-up survey, and then allowed to leave.

4 Data and Estimation strategy

4.1 Data: Senegal

The baseline and endline surveys collected individual-level data and transaction-level data. The individual-level data covered demographics, income and labor supply, sex work history including number of clients and transactions, legal history and knowledge of the registration program, self-reported STI symptoms and health-seeking behavior, and alcohol and drug use. In addition, I collected detailed data on the five most recent sex transactions, including type of sex acts exchanged, price, numerous client characteristics, risk expectations, substance use by the sex worker and the client, whether violence was perpetrated, how the transaction was arranged, and where the transaction took place. Two versions of the endline survey were used. The first version of the survey was very similar to the baseline survey (except time invariant questions). We completed 54 endline surveys using this version. After it became clear that take-up of the incentive would almost certainly be very low, I added 21 questions to the survey to help understand the mechanisms for low take-up of the incentive. The modified survey was implemented beginning in February 2016 and was used for 238 participants. Since the large majority of participants are illiterate and given the sensitive nature of the data collected, surveys were administered by female enumerators with significant experience working with female sex workers in Senegal. All surveys were conducted in a private room with a closed door, and enumerators used a low tone of voice to maximize privacy.

4.2 Baseline characteristics

Table 1 shows summary statistics for the sample. Although the sampling procedure was not designed to generate a representative sample, participants in the study were similar to other samples of female sex workers in Sub-Saharan Africa, which are also typically convenience samples (Scorgie et al., 2012). Mean age is 37, mean education is 3.14 years, the majority of women are divorced, and they have on average 2.11 children under 18, reflecting the circumstances that typically precipitate sex work in sub-Saharan Africa. The participants appear to be well established in sex work, with a mean 8.36 years in sex work. 91 percent consider sex work their "main job" over the past 6 months. Moreover, 83 percent were aware of the registration program at baseline, suggesting that lack of knowledge about the program is unlikely to be a significant barrier.

At the median, income from sex work accounts for 83 percent of total monthly income. Median monthly income is 90,000 FCFA ($153.06). The 5,000 FCFA incentive I offered for registration is thus approximately 1/18th of median monthly income, or just over a day's wage. The 1,000 FCFA clinic visit fee associated with registration is just over 1/5 of a day's wage.

Finally, given that one of the stated benefits of the registration program is protection from prosecution, it is worth considering the implications of remaining uncertified for interactions with the legal system. It appears that even uncertified sex workers are largely able to operate without interference from police. At baseline, only 3.4 percent of the sample reported a recent arrest or detention, and less than 1 percent (two participants) reported recent jail time. Among those who

Table 1: Sample Demographics and Sex Work History (Senegal)

	Mean	S.D.	Med.	Min.	Max.	Obs.
Age	37.4	8.89	37	21	59	290
Divorced	0.63	0.48	1	0	1	291
Senegalese	1.00	0.059	1	0	1	291
Muslim	0.98	0.14	1	0	1	291
Years of education	3.11	3.55	2	0	14	291
Children under 18	2.12	1.72	2	0	10	288
Years in sex work	8.37	7.09	6	0	32	289
Main job is sex work	0.91	0.28	1	0	1	289
Ever heard of registration program	0.83	0.38	1	0	1	290
Hours in sex work, past week	6.92	8.77	5	0	84	291
Number of clients, past month	13.2	16.6	8	0	144	290
Income from sex work, past month (FCFA, thousands)	95.4	91.6	75	0	700	289
Total income, past month (FCFA, thousands)	109.9	93.0	90	0	700	289
Arrested, past month	0.034	0.18	0	0	1	290
Jail, past month	0.0069	0.083	0	0	1	290

This table presents summary statistics at baseline for 291 female sex workers comprising the analysis sample (participants who satisfied eligiblity criteria and completed the baseline survey, randomization, and endline survey). Responses of *Don't know* and refusals to respond are coded as missing. FCFA is the currency of Senegal. During the study period, the exchange rate was approximately 588 FCFA = $1.

were arrested or in jail, only 1 participant got certified, suggesting that the legal benefits of the program are nominal.

Table 2 shows summary statistics for the transaction-level data. The market for sex work in Senegal can be divided into two broad sectors: a local market and a sex tourism market. In the latter market, FSWs typically solicit in expensive hotels, bars and clubs, and report earnings of more than 50,000 FCFA ($85.03) per day (Homaifar and Wasik, 2005; Agence Nationale de la Statistique et de la Demographie, 2013). In the local market, in contrast, earnings are lower, and transactions are typically arranged through street soliciting, illegal brothels, or mobile phones (Do Espirito Santo and Etheredge, 2004; Homaifar, 2006).

There is qualitative evidence that women participating in the local market are less likely to be certified (Homaifar and Wasik, 2005), and indeed my sample appears to operate almost exclusively in the local market. The median transaction price is 5,000 FCFA, and 72 percent of transactions reported were carried out with regular clients, while fewer than 1 percent of transactions were completed with foreign clients. Clients asked about registration in just 11 percent of transactions. Some features of the transactions suggest a need for safer working conditions. Although anal sex is uncommon in this context, occurring in 6.7 percent of transactions, unprotected sex was reported in 17 percent of transactions. Participants report violence, which included violent threats, physical violence, sexual violence, and forced unprotected sex, in 5.1 percent of transactions.

Finally, Table 3 reports summary statistics on STIs and health care use at baseline. The women

Table 2: Transaction characteristics

	Mean	S.D.	Med.	Min.	Max.	Obs.
Transaction price (FCFA, thousands)	10.0	15.6	5	0	400	1453
Regular client	0.72	0.45	1	0	1	1440
Foreign client	0.0083	0.091	0	0	1	1438
Unprotected sex	0.17	0.37	0	0	1	1455
Anal sex	0.067	0.25	0	0	1	1455

This table presents summary statistics for transaction-level data collected during the baseline survey from 291 female sex workers comprising the analysis sample (participants who satisfied eligiblity criteria and completed the baseline survey, randomization, and endline survey). Each sex worker answered a series of questions about each of her last five sex transactions, generating a sample of 1,455 transactions. Responses of *Don't know* and refusals to respond are coded as missing. FCFA is the currency of Senegal. During the study period, the exchange rate was approximately 588 FCFA = $1. Client violence is equal to 1 if sex workers reported any of the following: threat of physical violence, physical violence, sexual violence, forced unprotected sex, threatened to report the sex worker to police.

Table 3: STIs and health care use

	Mean	S.D.	Min.	Max.	Obs.
Saw a doctor for STI symptoms, past month	0.21	0.41	0	1	291
If had STI symptoms, saw a doctor	0.81	0.40	0	1	77
Saw a doctor for a routine exam	0.29	0.46	0	1	290
Saw a doctor for any reason, past month	0.44	0.50	0	1	291

This table presents summary statistics at baseline for 291 female sex workers comprising the analysis sample (participants who satisfied eligiblity criteria and completed the baseline survey, randomization, and endline survey). Responses of *Don't know* and refusals to respond are coded as missing.

in the sample appear to have a high level of access to health care outside the registration program. In the sample as a whole, 21 percent saw a doctor for recent STI symptoms, which represents 80 percent of those who had recent STI symptoms. 29.2 percent reported a well visit in the past month at baseline. Overall, 44 percent of the sample reported a doctor visit in the past month. Registration does not act as a gateway to treatment. These data support the assumption in Section 2 that for a large proportion of the sample, the health care costs associated with registration are similar to health care costs they were incurring anyway, adding to the puzzle of low take-up.

4.3 Data: Ecuador

In addition to data from Senegal, this paper uses data collected in 2003 from female sex workers in eight cities in Ecuador.[17] Data were collected from 2,926 sex workers using targeted sampling. In collaboration with local female sex workers, nongovernmental organizations, and community-based organizations, researchers identified sites where female sex workers were likely to be concentrated and sampled from those locations. The data were collected via face-to-face interviews conducted by trained female sex workers. Importantly, the survey collected no identifying information. Transaction-level data were collected by asking sex workers to provide the details of their 3 most recent sex transactions, an approach commonly used in research on sex work (e.g., Gertler et al. (2005); Manian (2016)).

As discussed in Section 2, the goal is to test whether the association between prices and sex workers' STI status is moderated by the presence of visible symptoms, which would suggest that STIs may be partially observable. Blood samples were collected at the time of data collection and tested for three STIs: syphilis, gonorrhea, and chlamydia.[18] I classify these infections as either visible or invisible based on the biomedical characterization of each type of infection. The majority of syphilis infections in women are symptomatic and cause visible genital sores soon after infection (Chandrasekar, 2016). In contrast, 68 percent of gonorrhea infections and 75 percent chlamydia infections in women are estimated to be asymptomatic, and typical symptoms include pain and abnormal discharge, which would not be easily detectable by a client (Farley et al., 2003). Thus, syphilis infections are classified as visible, while chlamydia and gonorrhea infections are classified as invisible.

I conduct the analysis on a sample of 2,721 sex workers with a complete set of observations for all variables used. Table 4 presents summary statistics on the demographic composition, sex work history, and STI status of the sample. The sample is younger, better educated, and much more likely to be married than the Senegalese sample. Ecuador also has a registration program, and this sample

[17]The data were collected to serve as a baseline for the Frontiers Prevention Project (FPP), a cluster-randomized trial of an initiative aimed at populations at risk of seeing an acceleration of their HIV epidemics. Thus, the eight cities were selected primarily for logistical reasons related to the ability to implement the project (Gutiérrez et al., 2013). However, the cities selected include the country's largest city, Guayaquil, and the capital, Quito, and all represent urban environments.The remaining cities are Machala, Milagro, Daule, Esmeraldas, Santo Domingo and Quevedo.

[18]The samples were also tested for herpes simplex virus (HSV). I exclude HSV from the analysis because it is incurable, and a positive test is unlikely to reflect recent sexual behavior or symptoms.

Table 4: Sample Demographics and Sex Work History (Ecuador)

	Mean	S.D.	Min.	Max.	Obs.
Demographics:					
Age	27.7	7.87	13	66	2721
Married	0.48	0.50	0	1	2721
Any children	0.86	0.35	0	1	2721
Literate	0.96	0.19	0	1	2709
Highest grade completed	4.16	1.76	0	11	2721
Sex work history:					
Registered	0.83	0.38	0	1	2721
Years in sex work	4.16	4.96	0	40	2721
STI prevalence and knowledge:					
Any STI	0.079	0.27	0	1	2721
Syphilis	0.027	0.16	0	1	2675
Chlamydia	0.048	0.21	0	1	2664
Gonorrhea	0.011	0.10	0	1	2664
Ever heard of STIs	0.91	0.28	0	1	2682
Identified syphilis symptom	0.18	0.39	0	1	2721

This table presents summary statistics for 2721 female sex workers comprising the analysis sample (participants with a complete set of observations for all variables used in the analysis). Responses of *Don't know* and refusals to respond are coded as missing.

skews toward *registered* sex workers: nearly 83 percent of the sample is registered. Consistent with this, STI prevalence is much lower than in other developing country contexts (Cwikel et al., 2008). Just under 8 percent of the sample tests positive for syphilis, chlamydia, or gonorrhea. Chlamydia is the most common STI in the sample, followed by syphilis and gonorrhea. over 90 percent of the sample had previously heard of the concept of sexually transmitted infections, and close to one fifth identified genital sores, the primary symptom of syphilis, as an STI symptom without prompting.

The primary outcome of interest is the total price paid for a given sex transaction. While I have three price observations for each individual, there is only a single blood draw for each individual.[19] I do not know exactly when the STI was acquired or when symptoms may have been present. I therefore restrict the analysis to transactions conducted in the past month.

Transaction-level summary statistics are presented in Table 5. The mean transaction occurred 3.12 days prior to the survey, implying that STI test results at the time of the survey are a good proxy for STI status during the transaction. The vast majority of transactions include vaginal sex; just 2.3 percent include riskier anal sex, and 8.2 percent include oral sex. Sex workers reported that a condom was not used in 13 percent of transactions, which is on par with rates reported in Senegal. The bottom panel of Table 2 reports summary statistics for different types of work locations. 60 percent of transactions occurred in brothels. The higher-priced nightclub sector (Arunachalam and Shah, 2013) accounted for 20 percent of transactions, and 10 percent of transactions occurred in

[19]While follow-up data were collected in 2007, because the surveys were anonymous, those data cannot be matched to the data used in this paper (Gutiérrez et al., 2013).

Table 5: Transaction Summary Statistics (Ecuador)

	Mean	S.D.	Min.	Max.	Obs.
Days since transaction	3.12	5.06	0	31	7807
Price	7.04	7.36	0	95	7807
Vaginal sex	0.98	0.14	0	1	7804
Anal sex	0.023	0.15	0	1	7807
Oral sex	0.082	0.27	0	1	7807
No condom	0.13	0.34	0	1	7807
Work location:					
Brothel	0.60	0.49	0	1	7807
Night club	0.20	0.40	0	1	7807
Street	0.10	0.30	0	1	7807

This table presents summary statistics for 7807 sex transactions comprising the analysis sample (transactions occurring in the past month for participants with a complete set of observations for all variables used in the analysis).

the street.

4.4 Estimation strategy and identification

I begin by estimating the intention-to-treat (ITT) effect of the encouragement (persuasive information and incentive) on take-up of registration, using the following estimating equation:

$$D_i = \beta_0 + \beta_1 T_i + \beta_2 X_i + v_i \tag{5}$$

where D_i is registration since baseline, T_i is the treatment assignment, and X_i is a vector of variables with baseline imbalances (see Section 3.3). In all analyses of take-up, all observations are weighted by w_{ij}, defined in (4), to account for varying treatment assignment probabilities in different randomization sessions.

I then examine evidence for certification effects by studying differential price changes over time for individuals who got certified:

$$p_{tir} = \alpha_i + \beta_1 Certified_{tir} + \lambda_r + \lambda_r \times T + \epsilon_{tir} \tag{6}$$

where $Certified_{tir}$ is the registration status of individual i during transaction t and round r. In this analysis, I am pooling individuals who got certified in the treatment and control groups in order to improve power. As a result, β_1 is not causally identified. Nevertheless, I analyze whether the results are consistent with the existence of a certification premium. In Section 5.2, I argue that β_1 is likely an upper bound.

To understand the results on the certification premium, I estimate the effect of recent STI symptoms on prices using the following estimating equation in Senegalese data:

Table 6: Impact of incentive for registration

Dependent Variable:	Registration Take-up		
	(1)	(2)	(3)
Treatment	0.0450*	0.0458*	0.0478*
	(0.0256)	(0.0262)	(0.0266)
Constant	0.0284**	0.0282*	0.0286**
	(0.0140)	(0.0144)	(0.0145)
Baseline controls	No	No	Yes
Weighted	No	Yes	Yes
Observations	291	291	291

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses. The dependent variable is an indicator for obtaining certification between baseline and follow-up. *Treatment* is an indicator for assignment to the treatment group, which received (i) an informational intervention designed to be persuasive and (ii) an incentive to obtain certification. *Baseline controls* indicates inclusion of variables that were imbalanced at baseline due to chance. *Weighted* indicates inclusion of regression weights to account for randomization strata, as defined in equation (4).

$$p_{tir} = \alpha_i + \beta_1 STI_{tir} + \lambda_r + \lambda_r \times T + \epsilon_{tir} \tag{7}$$

where p_{tir} is the price of transaction t, individual i, in round $r \in (1, 2)$ and STI_{ir} is an indicator for having an STI episode during the past month in round r. I include individual fixed effects α_i, round fixed effects λ_r, and differential trends for treatment status ($\lambda_r \times T$) in all specifications. Standard errors are clustered at the individual level. The sample is restricted to transactions conducted in the past month to match the observation period for STIs.

I then augment this analysis using data from Ecuador by comparing transaction prices for female sex workers with a visible STI (syphilis) to those for female sex workers with invisible STIs (chlamydia and gonorrhea), conditional on controls. My preferred estimating equation is:

$$p_{tij} = \beta_0 + \beta_1 AnySTI_{ij} + \beta_2 AnySTI_{ij} * Visible_{ij} + \mathrm{W_{tij}}\gamma + \mathrm{X_{ij}}\delta + \eta_j + \epsilon_{tij} \tag{8}$$

where p_{tij} is the price of transaction t for sex worker i in city j, $AnySTI_i$ is an indicator for having any STI, $Visible_i$ is an indicator for having a visible STI, $\mathrm{W_{ti}}$ is a vector of transaction-level controls, $\mathrm{X_i}$ is a vector of individual-level controls, and η_j is a city fixed effect. β_2 is the coefficient of interest. I use wild cluster bootstrapped standard errors (Cameron et al., 2008) to account for the use of cluster sampling in a small number of cities (eight).

5 Results

5.1 Impact of incentive for registration

The encouragement had a statistically significant, but small, effect on take-up (Table 6). When controlling for baseline covariates, the incentive increased take-up by only 4.8 percentage points, relative to a 2.84% take-up rate in the control group (Column 3). This effect was much smaller than expected: based on preparatory discussions with the implementing partner and members of the sex worker community, I expected take-up above 50%.

The effect size is small relative to similarly sized incentives for health programs in other contexts. For example, Thornton (2008) offered incentives for individuals who had undergone HIV testing in Malawi to go pick up their HIV test results. In that study, an incentive equal to one-tenth of a day's wage increased take-up by approximately 30 percentage points, while a day's wage increased take-up by nearly 50 percentage points. In India, in-kind incentives with a value roughly equal to the opportunity cost of time associated with participating in a series of immunization camps (roughly two day's wages) increased immunization coverage by nearly 20 percentage points (Banerjee et al., 2010). I can rule out effects of this magnitude: the upper end of the confidence interval on the coefficient in Table 6, Column 3 is 10 percentage points.

Notably, the incentive amount of 5,000 FCFA was equal to the reimbursement given for participation in surveys. Transportation costs to the study site and registration site are essentially equivalent: the study site is located only 500m from the registration clinic. In practice, the time costs of surveys and registration were also similar. Registration takes about half a day. And while the actual survey took less than an hour, most participants arrived at the study site in groups and waited while everyone in the group completed their study activities, spending at least half a day at the study offices. Thus, for those who returned for the endline survey, the incentive must have been adequate to compensate for time and transportation costs associated with registration. This implies that the incentive successfully reduced the monetary costs of registration to zero (if not negative).

5.2 Certification premium

Extremely low take-up in the experiment, despite low monetary costs of certification, contradicts the theoretical prediction of the standard signaling model in Section 2 (Result 2). That prediction followed from result 1, that there is a price premium for certified sex workers. I test this prediction in this section.

In Table 7, I investigate evidence for a certification premium among the sex workers in my study who did register. First, in Column 1, I show the causally identified intention-to-treat (ITT) effect, comparing prices in the treatment and control groups at follow-up. This difference is negative and very small, indicating no causal impact of the treatment on prices. However, this is unsurprising: 93 percent of the treatment group is not certified.[20] Therefore, I turn to a descriptive analysis of

[20]Clearly, the causal parameter of interest is the local average treatment effect (LATE) of certification on those

Table 7: Prices and Registration

Dependent Variable:	Transaction Price			
	(1)	(2)	(3)	(4)
	ITT	FE	FE	FE
Treatment	20.34			
	(919.6)			
Actively registered		985.4	175.3	-428.9
		(840.2)	(1042.7)	(1383.7)
Constant	9315.1***	9841.9***	11066.4***	9449.2***
	(606.6)	(291.8)	(807.6)	(1780.4)
Round FE	No	Yes	Yes	Yes
Treatment controls	No	Yes	Yes	Yes
Month fixed effects	No	No	Yes	Yes
Sex act controls	No	No	No	Yes
Individual FE	No	Yes	Yes	Yes
Observations	1224	2588	2588	2583

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses, clustered at individual level. Analysis is conducted at the transaction level. The sample is restricted to transactions in the month prior to survey to maintain a comparable sample with Table 8. *Treatment* is an indicator for assignment to the treatment group, which received (i) an informational intervention designed to be persuasive and (ii) an incentive to obtain certification. *Actively registered* is an indicator for the sex worker having a valid registration when the transaction was completed. FE indicates individual fixed effects.

differential, within-individual price changes over time for those who got certified, at the transaction level. Again, there is no significant difference in prices for actively certified sex workers (Column 2), regardless of controls for time (Column 3). The raw differential change in prices for certified FSWs is positive, but small in magnitude. Given a mean price of 10,342 FCFA ($17.59) in the sample, the point estimate in Column 2 indicates that actively certified sex workers earned 9 percent more than uncertified sex workers. When I control for month fixed effects, the estimate falls in magnitude (Column 3). In the preferred specification controlling for type of sex exchanged and month fixed effects, the estimate is actually negative (Column 4). Registration is associated with a *discount* of approximately 3 percent. As previously noted, these estimates are descriptive. However, we should expect these estimates to represent an upper bound on the true certification premium. I show in Section 7 below that the women who got certified are "health-seeking" types who experienced a low-probability STI shock prior to certification. Therefore, reversion to the mean suggests that we should expect a differential increase in prices for these women. Combined with the fact that clients asked about registration in only 11 percent of transactions (Table 1), these results are most consistent with the conclusion that there is no certification premium in this market.

5.3 Prices and STI symptoms: Senegal

If we consider the model in Section 2, the price premium for certified sex workers follows from the assumption that health status is unobservable. If, however, health status is partially observable, the model implies that we may observe a low certification premium and low take-up. To obtain support for this interpretation of the results, I test the key prediction of the a model with partially observable health status: that sex workers with observable STI symptoms will earn lower prices.

Table 8 shows the association of prices with STI symptoms in the past month. First, recent STI symptoms are negatively but insignificantly associated with prices (Column 1). In the remainder of the table, I disaggregate by recent STI episodes that included visible symptoms (i.e., observable by the client), and those that included *only* invisible symptoms.[21] Recent *visible* episodes are significantly associated with a reduction in prices (Column 2). After controlling for type of sex act exchanged (Column 3), women earned, on average, 1918.8 FCFA ($3.26) less when they had a visible STI episode than when they did not. This corresponds to a 19 percent discount relative to the mean price. Column 4 shows that invisible episodes are not significantly associated with

who were induced to register by the encouragement. In principle, this object can be estimated through two-stage least squares, where treament assignment is used as an instrument for registration status. However, this estimate suffers from a weak instrument problem (Bound et al., 1995), because the compliance differential between treatment and control groups is just 4.5 percentage points, and it is significant only at the 10 percent level. The "first-stage" F-statistic is just 2.79, where a sufficiently strong instrument should have an F-statistic above 10 (Stock and Yogo, 2005). Because of the weak instrument, even very small direct effects that the encouragement may have had on prices, such as income effects, are amplified (Bound et al., 1995), and the estimate of the LATE is inconsistent. Therefore, I do not present LATE estimates.

[21] Visible symptoms were unusual or foul-smelling vaginal discharge and warts or sores in the genital area. Invisible symptoms were genital irritation, lower abdominal pain, and burning during urination. An episode is classified as visible if it inclued any visible symptoms. It is classified as invisible if it had invisible symptoms only. I collected these data on up to 3 episodes occuring in the past month.

Table 8: Prices and recent STI (Senegal)

Dependent Variable:	Transaction Price					
	(1)	(2)	(3)	(4)	(5)	(6)
Any STI	-1101.2					
	(1404.8)					
Visible STI		-2149.1**	-2048.6**	-1828.5*	-2131.9**	-2148.6**
		(974.7)	(1007.2)	(1023.2)	(979.4)	(985.7)
Invisible STI				2276.1		
				(3991.1)		
Actively registered					442.2	328.3
					(829.7)	(777.5)
Actively registered × Visible STI						561.8
						(1990.7)
Constant	11350.8***	10291.8***	10164.3***	10083.4***	10288.3***	10291.8***
	(869.3)	(391.5)	(1763.7)	(1876.3)	(389.3)	(393.9)
Month fixed effects	Yes	No	Yes	Yes	No	No
Sex act controls	No	No	Yes	Yes	No	No
Observations	2577	2588	2583	2583	2588	2588

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses, clustered at individual level. Analysis is conducted at the transaction level using data collected at baseline and endline. The sample is restricted to transactions in the month prior to the survey. At baseline and endline, sex workers reported up to three recent STI episodes. *Any STI* is an indicator for reporting an episode of STI symptoms in the past month. STI episodes are classified as either visible or invisible. *Visible STI* is an indicator for an episode with visible symptoms, and *Invisible STI* is an indicator for an episode with no visible symtpoms. *Actively registered* is an indicator for the sex worker having a valid registration when the transaction was completed. Individual and round fixed effects and controls for treatment group are included in all regressions.

prices. Their inclusion substantially increases the standard errors; however, the point estimate on invisible episodes is actually positive. In Column 5, I compare the effect of a visible STI episode to the effect of registration. When controlling for visible STI, the estimate on registration falls even further relative to Column 3 of Table 7, suggesting a roughly 5 percent discount for certified FSWs. The coefficient on visible STI episodes remains significant, and is nearly 4 times the magnitude of the coefficient on registration.

The result that prices respond to episodes that are observable by the client, but do not respond to episodes that are observable only to the sex worker, strongly suggests a demand-driven explanation for the association between prices and STI symptoms.[22] The results are most consistent with the hypothesis that client willingness-to-pay responds to the presence of STIs, implying that STIs are partially observable.

Returning to our model, these results indicate that visible STI symptoms reveal the health status to be θ_S. This suggests that, in fact, we should not expect any impact of registration on prices for those who have visible symptoms. However, there may be an effect among those who do not. In Column 6 of Table 8, I explore this implication by studying the interaction of registration status and visible STIs, with minimal controls to maximize power. The coefficient of interest is the uninteracted term for registration status, which represents the within-individual effect of registration when FSWs did not have visible STIs. The coefficient on registration status remains insignificant, and is smaller in magnitude than the coefficient in Column 1. The coefficient on the interaction term is also not significant, suggesting that registration has no impact on the price response to visible STI symptoms.

The results in Table 8 suggest that health status is at least partially observable. In Table 9, I perform an additional test to explore whether there is important asymmetric information remaining in the market. That is, what are clients beliefs about the value of s, the probability that visible symptoms will appear conditional on STI infection? Using a probit model, I predict STI status based on observable characteristics of the sex worker, such as age, area of residence, or where the transaction was arranged.[23] Clients may use these characteristics as signals of STI risk. Column 1 shows that this prediction is highly correlated with actual STI status.

If clients are concerned about invisible STIs, we would expected the predicted risk to matter even when controlling for visible STI symptoms. In Columns 2-4, I study correlations between predicted STI risk and prices in the pooled sample, without individual fixed effects. Column 2 shows that, although the coefficient is not significant, predicted STI risk is associated with a large reduction in prices. However, when I control for visible STI episodes (Column 3), the residual effect

[22]The most obvious alternate story for an association between STI and reduced prices is that an STI is a health shock, and sex workers respond by expanding their labor supply. This is known as the "income smoothing" hypothesis, and empirical support for this has been found in other African contexts (Robinson and Yeh, 2011). In Appendix C, I show that total quantity exchanged in a month is lower when sex workers have STI symptoms, which suggests a limited labor supply response. More importantly, in the case of income smoothing, prices should respond to any STI episode, not just visible episodes as we see here.

[23]The full list of variables used in the prediction is: age, area of residence, region of birth, ethnic group, education, religion, whether the FSW has a manager or pimp, where the transaction was arranged, where the transaction took place, sex worker alcohol use, and sex worker drug use.

Table 9: Prices and predicted STI risk (Senegal)

	(1) Any STI	(2) Price	(3) Price	(4) Price
Predicted STI risk	0.962***	-2624.0	-674.4	-806.0
	(0.118)	(1746.2)	(2147.5)	(2138.7)
Visible STI			-2455.7***	-2393.2**
			(941.1)	(933.3)
Invisible STI				688.9
				(3940.4)
Constant	0.000534	10676.3***	10772.2***	10760.0***
	(0.0240)	(1195.0)	(1065.4)	(1133.5)
Month fixed effects	No	Yes	Yes	Yes
Observations	2580	2588	2588	2588

Bootstrapped standard errors in parentheses, clustered at individual level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Round fixed effects included in all regressions.

Sample restricted to transactions in the month prior to survey.

of predicted risk is much smaller in magnitude. Column 4 controls for both visible and invisible STI episodes, which does not change the results.

The results in this section suggest that from the client's perspective, the most important information about health status is observable, and as a result, certification is not valued in the market. There is no evidence for a statistically or economically significant price premium for certified sex workers, and there is no evidence that clients use other signals to make inferences about unobservable health status.

5.4 Prices and STI symptoms: Ecuador

Table 10 describes the association between transaction price and sex workers' STI status in Ecuador, and determines whether STI visibility moderates this association. Column 1 shows that, in general, there is no association between STI status and price: the coefficient of interest is both statistically and economically insignificant, representing just 0.05 standard deviations. However, Column 2 shows that when I disaggregate by visible versus invisible STIs, sex workers with visible STIs earn lower prices, while there is no such association for sex workers with invisible STIs. Column 3 represents the preferred approach, comparing sex workers with visible STIs to those with invisible STIs. Conditional on having an STI, visibility predicts a decrease in prices of nearly $2.00, representing 0.27 standard deviations.

Table 11 explores robustness of the preferred specification to various types of controls. Column 1 controls for demographic characteristics that are strongly correlated with prices, such as age, marital status and education. Column 2 includes controls for work location, an important control

Table 10: Price and recent STI (Ecuador)

Dependent Variable:	Transaction Price		
	(1)	(2)	(3)
Any STI	-0.371		0.321
	(0.458)		(0.620)
Invisible STI		0.260	
		(0.710)	
Visible STI		-1.693***	
		(0.005)	
Any STI × Visible			-1.995**
			(0.015)
Observations	7807	7807	7807

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Wild cluster bootstrapped p-values in parentheses, clustered at city level. Analysis is conducted at the transaction level. The sample is restricted to transactions in the month prior to survey. Syphilis is classified as a visible STI, while gonorrhea and chlamydia are classified as invisible STIs. City fixed effects and controls for registration status included in all regressions.

given previous work showing that STI prevalence in a given work location predicts prices in the same dataset (Arunachalam and Shah, 2013). Reassuringly, the effect of visibility remains statistically significant and similar in magnitude as both types of controls are introduced. Finally, Column 3 controls for type of sex act exchanged. Given that there is a price premium for unprotected sex in this setting (Arunachalam and Shah, 2013), one possible explanation for the visibility result is that observable STI symptoms lead clients to substitute toward lower-priced sex with a condom. However, the stability of the coefficient from Columns 2 to 3 suggests that this is not the mechanism for the effect.

These results are consistent with partial observability of STIs in Ecuador. However, because this is a cross-sectional analysis, a leading alternate explanation for the results is a supply-side effect, rather than a demand-side effect. I hypothesize that visible STIs affect prices because client willingness-to-pay is lower for sex workers with STIs. However, it may instead be the case that sex workers with lower willingness-to-accept, and thus lower prices, are also more likely to acquire visible STIs. Notably, my classification of visible and invisible STIs also applies to men: 84 percent and 58 percent of chlamydia and gonorrhea cases, respectively, are entirely asymptomatic in men (Farley et al., 2003), while early syphilis infection is characterized by genital sores (Chandrasekar, 2016). Sex workers with lower willingness-to-accept may be more likely to transact with clients who have visible symptoms. If this is the case, we would expect the association between visible STIs and prices to be stronger (more negative) among sex workers who report recent transactions with clients who have visible STIs. In contrast, if demand-side effects drive the association, we would expect a weaker (less negative or positive) effect for clients who already have STIs.

While I do not have biological data for clients, the survey included the sex worker's assessment of

Table 11: Robustness: Price and recent STI (Ecuador)

Dependent Variable:	Transaction Price		
	(1)	(2)	(3)
Any STI × Visible	-1.596*	-1.706*	-1.754*
	(0.080)	(0.055)	(0.090)
Any STI	0.190	0.191	0.190
	(0.755)	(0.790)	(0.780)
Demographic controls	Yes	Yes	Yes
Work Location controls	No	Yes	Yes
Sex act controls	No	No	Yes
Observations	7807	7807	7807

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Wild cluster bootstrapped p-values in parentheses, clustered at city level. Analysis is conducted at the transaction level. The sample is restricted to transactions in the month prior to survey. Syphilis is classified as a visible STI, while gonorrhea and chlamydia are classified as invisible STIs. City fixed effects and controls for registration status included in all regressions.

the likelihood that each client had an STI, as well as other client characteristics. Table 12 explores how the association between STI visibility and prices varies with these client characteristics. Since there are a large number of missing observations for client characteristics, Column 1 verifies that the main result holds on the subsample with no missing data for all client characteristics studied. While the effect is no longer statistically significant due to the smaller sample, the point estimate for the coefficient on STI visibility remains negative and of similar magnitude to the comparable result in Table 11. Column 2 shows that the association between visible STIs and prices becomes weaker as the likelihood that a client had an STI increases: the interaction of visibility and client STI likelihood is positive and statistically significant. This is contrary to the prediction of a supply-side effect, and consistent with a demand-side effect. Columns 3 and 4 demonstrate that there is no similar effect for client marital status or client wealth, and Column 5 shows that the interaction of visibility and client STI likelihood remains positive with the inclusion of additional client controls, and is just marginally insignificant with a p-value of .105.

The results in Senegal and Ecuador are remarkably similar despite very different approaches to sampling and measuring STI visibility. In both cases, prices are robustly associated with visible STIs but not invisible STIs, and evidence is more consistent with a demand-side response than a supply-side response. The results of this section strengthen the evidence that STIs are partially observable and priced into the sex market.

5.5 Discussion: HIV and asymmetric information

A key result of this paper is that while client willingness-to-pay responds to visible STI symptoms, clients do not appear to value information about unobservable STIs. This may seem surprising,

Table 12: STI Visibility and Client Characteristics (Ecuador)

Dependent Variable:	Transaction Price				
	(1)	(2)	(3)	(4)	(5)
Any STI × Vis.	-1.475	-1.747	-0.753	-1.297*	-1.570
	(0.190)	(0.170)	(0.505)	(0.055)	(0.220)
Any STI	0.0606	0.206	-0.00520	0.198	0.235
	(0.905)	(0.775)	(1.000)	(0.260)	(0.755)
Any STI × Vis. × Cl. STI prob.		1.130*			1.032
		(0.090)			(0.105)
Any STI × Cl. STI prob.		-0.654**			-0.560
		(0.040)			(0.120)
Cl. STI prob.		-0.165			-0.283
		(0.520)			(0.225)
Any STI × Vis. × Cl. married			-1.285		
			(0.165)		
Any STI × Cl. married			0.105		
			(0.905)		
Client married			0.216*		0.103
			(0.095)		(0.515)
Any STI × Vis. × Mid. class				0.0476	
				(0.955)	
Any STI × Vis. × Wealthy				-1.420	
				(0.830)	
Any STI × Mid. class				-0.156	
				(0.945)	
Any STI × Wealthy				-0.121	
				(1.000)	
Middle class				1.182***	1.177***
				(0.000)	(0.000)
Wealthy				6.567***	6.558***
				(0.000)	(0.000)
Sex act controls	Yes	Yes	Yes	Yes	Yes
Demographic controls	Yes	Yes	Yes	Yes	Yes
Work location controls	Yes	Yes	Yes	Yes	Yes
Observations	5814	5814	5814	5814	5814

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Wild cluster bootstrapped p-values in parentheses, clustered at city level. Analysis is conducted at the transaction level. The sample is restricted to transactions in the month prior to survey. Syphilis is classified as a visible STI, while gonorrhea and chlamydia are classified as invisible STIs. City fixed effects and controls for registration status included in all regressions.

given that the most well-known unobservable STI is HIV. This section gives an overview of the HIV epidemics in Senegal and Ecuador, considers several possible explanations for why the results are reasonable even in the context of HIV, and evaluates the plausibility of these different explanations.

It is important to note that neither Senegal nor Ecuador has a generalized HIV epidemic. General population prevalence is 0.5 percent in Senegal and 0.3 percent in Ecuador, and has been stable or declining in both countries for over a decade (UNAIDS, 2015).[24] New HIV infections among young people are also declining (UNAIDS, 2012). Senegal was the first African country to provide free access to antiretroviral therapy (ART), beginning in 2001 (Desclaux et al., 2003). Nevertheless, female sex workers are a high risk population. In Ecuador, HIV prevalence among female sex workers is estimated between 1 and 2 percent Arunachalam and Shah (2013). In Senegal, however, HIV prevalence estimates among female sex workers range from 3.3 percent to as high as 19.9 percent (Lyons et al., 2017; Baral et al., 2012).[25] While there are no good estimates of prevalence among clients, in one convenience sample of 1,083 clients in Dakar, 4 percent of participants tested positive for HIV. Thus, while overall prevalence is low, it may be difficult to argue that HIV is an insignificant concern for female sex workers and their clients, particularly in Senegal.

Even so, there are several reasons that clients may not value health certification. First, it is possible that clients do not know that HIV is often unobservable; they may even believe that symptoms of curable STIs are, in fact, symptoms of HIV. While I do not have data to directly measure client beliefs, we might expect some correlation between client beliefs and sex worker beliefs. In my sample in Senegal, at baseline, 91 percent of sex workers knew that HIV can be asymptomatic.[26] Moreover, sex workers correctly answered this question more often than any of six other HIV knowledge questions asked. Since sex workers are targeted for HIV-related education in Senegal, this is likely an upper bound on client HIV knowledge; nevertheless, given these results, it seems unlikely that clients have massively misunderstood the extent to which HIV is observable.

Another possibility is that because of longstanding ART access in Senegal, clients perceive the cost of HIV infection to be relatively small. de Walque et al. (2012) show that beliefs about the effectiveness of ART predict risky sexual behavior in Mozambique, and studies have documented increases in risky sexual behavior in response to ART access among men who have sex with men in San Francisco and adolescent girls in Kenya (Mechoulan, Mechoulan; Friedman, 2015). These results strongly suggests that ART availability has reduced the perceived cost of HIV infection in several contexts. On the other hand, even in the presence of ART, HIV remains a chronic illness requiring active management. Moreover, the costs of HIV infection are not limited to its health

[24]UNAIDS defines an HIV epidemic as "generalized" if 1-5 percent of pregnant women attending antenatal clinics are HIV positive. In generalized epidemics, the majority of new infections occur in the general population, rather than specific high-risk groups, such as sex workers or men who have sex with men(UNAIDS, 2016). HIV prevalence levels in Senegal contrast starkly with those of hyperendemic countries in Eastern and Southern Africa, where HIV prevalence is 7 percent on average, and exceeds 20 percent in some countries.

[25]It is useful to compare these numbers with estimates in hyperendemic countries: for example, HIV prevalence among female sex workers is 45.1 percent in Kenya, 70.7 percent in Malawi, 59.6 percent in South Africa, and 60.1 percent in Zimbabwe (Baral et al., 2012).

[26]In particular, they agreed with the statement, "A person may have HIV even if they seem to be in good health."

effects; HIV remains a highly stigmatized illness. In Senegal in 2014, 51.7 percent of adults reported discriminatory attitudes towards people living with HIV (UNAIDS, 2015).

Finally, clients may believe that the risk of HIV infection from sex transactions is low. Again, this belief could be related to the longstanding program providing free access to ART. With sufficient adherence, ART reduces the probability that a person with HIV will transmit the virus by 96 percent (Cohen et al., 2011). Despite the fact that the preventive value of ART was shown in the medical literature only recently, 75.5 percent of the sex workers in my sample knew that HIV treatment can reduce the probability of transmitting the virus.[27] These beliefs may actually predate the confirmation from the medical literature: using data from 2008 and 2010, Baranov et al. (2013) find that, among HIV-negative individuals in Malawi, ART availability reduced the subjective probability of HIV infection. The combination of low general population prevalence and longstanding ART access may create the perception that the risk of HIV infection in the sex market in Dakar is quite low, and the most salient risk is a curable STI.[28]

6 Non-monetary costs of certification

The analysis up to this point provides a clear explanation for low take-up of Senegal's sex worker registration program: both the stated advantage of legalization and the theoretical price premium to certified sex workers are limited in practice. Given limited benefits of registration from the sex worker's perspective, it is reasonable to expect that time, travel, and hassle costs would generate low take-up.

However, in my experiment, I offered a financial incentive that should more than cover minor costs associated with certification. Thus, with the incentive, the costs of registration should be zero or even negative. Even if benefits of registration are low, we should expect high take-up of the incentive. Yet, a strikingly large number of women refused registration even when offered this incentive. This suggests that although the monetary costs associated with certification are low, there may be other costs that my model did not account for. Referring back to the model in Section 2, I hypothesized that the treatment made the cost of registration γ zero or negative. However, low take-up in the experiment suggests that γ is higher than hypothesized. This section further explores the costs of registration, documents substantial resistance to registration in my sample, and provides evidence contrary to the hypothesis of low certification costs.

First, one potential reason for low take-up of the incentive to register is mismanagement: perhaps the participants did not understand the incentive offer. I rule this out as the primary explanation using two pieces of evidence: stated willingness-to-accept (WTA), and study comprehension questions included in the endline survey.[29] Table 13 presents summary statistics for these questions.

[27] This is measured by agreement with the statement, "A woman with HIV can take medicine that reduces the risk of transmittng the virus."

[28] It is also worth noting that the reported rate of condom use is quite high: unprotected vaginal or anal sex is reported in only 14.9 percent of transactions, and I observe only one unprotected sex act with a certified sex worker. It may be the case that clients who are most concerned about HIV infection use condoms consistently.

[29] The questions were included only in version 2 of the endline survey, as explained in Section 4. Stated willingness-

Table 13: Study comprehension

	Mean	S.D.	Min	Max	Obs
Inf. WTA	0.44	0.50	0	1	228
WTA $\mid < \infty$, FCFA ($)	34,525	82,530	0	500,000	121
	(58.72)	(140.36)	(0.00)	(850.34)	
Understood incentive offer	0.98	0.13	0	1	119
Stated incentive amount	0.53	0.50	0	1	118

The WTA data indicate very significant resistance to registration in the sample. Nearly half (44 percent) of the sample said there was no incentive amount that would convince them to register (i.e., their WTA is infinite). While the question was not incentivized, there is no clear reason that subjects would have an incentive to falsely state an infinite WTA. In addition to this, mean WTA among those with a finite WTA was 34,566 FCFA, which is nearly seven times the incentive I offered, and represents 31 percent of mean monthly income in the sample with WTA data.

The study comprehension questions provide further evidence that the incentive offer was successfully communicated. Nearly all of the treatment participants understood that the study offered them an incentive for registration (Table 13, Panel 2). Approximately 52 percent were able to correctly state the incentive amount when asked (Table 13, Panel 3). This is a bit lower than anticipated; however, this response is highly correlated with having an infinite WTA (last row of Table 13). This result is more consistent with bounded attention than mismanagement: individuals who would never register did not pay attention to the details of the incentive offer.

Therefore, I explore substantive reasons for the resistance to registration in the sample. First, I present summary statistics on participants' stated reasons for remaining uncertified, disaggregated by finite or infinite WTA (Table 14).[30] Column 1 shows means and the number of participants stating the reason for finite WTA, while Column 2 shows the same for infinite WTA. The most commonly stated reasons, by far, are related to stigma and fear that their status as a sex worker will be revealed. Regardless of WTA, the top two reasons are fear that someone will find the registration card; and fear of being seen at the clinic, which is known to serve vulnerable populations such as sex workers. The third most commonly cited reason in both groups is related to self-stigma: not wanting to assume a "sex worker" identity. Column 3 shows the difference between Columns 1 and 2, along with p-values from a simple t-test of the difference. Both fear that someone will find the card and self stigma are significantly more common among participants who state an infinite WTA.

It is clear from the summary statistics that concerns related to stigma and confidentiality are paramount, but it is also useful to understand the relative importance of different aspects of stigma. I divide stigma concerns into three categories: community stigma, self stigma, and direct

to-accept is the answer to the question, "What is the minimum incentive you would accept to register?" The comprehension questions were included only for members of the treatment group. In total, 118 subjects were asked this question; 3 members of the treatment group were not asked because their treatment assignment was mismarked on the survey.

[30]The responses were not mutually exclusive: participants could give more than one reason

Table 14: Reasons for remaining uncertified at follow-up

	(1) WTA$< \infty$ mean(n)	(2) WTA$= \infty$ mean(n)	(3) Difference (1)-(2)	p-val.
Clinic visits are too expensive	0.055	0.040	0.014	0.62
	(7)	(4)		
STI treatment is too expensive	0.0078	0	0.0078	0.38
	(1)	(0)		
Clinic is too far away	0.031	0.010	0.021	0.28
	(4)	(1)		
Clinic visits take too long	0.016	0.010	0.0055	0.72
	(2)	(1)		
Clinic hours are not convenient	0.047	0.010	0.037	0.11
	(6)	(1)		
Afraid of HIV test	0.016	0.020	-0.0046	0.79
	(2)	(2)		
Afraid someone will see me at the clinic	0.45	0.48	-0.040	0.55
	(57)	(48)		
Afraid someone will find the health card	0.55	0.74	-0.19	0.00***
	(70)	(73)		
Afraid of police harassment	0.047	0.081	-0.034	0.29
	(6)	(8)		
Clinic personnel do not treat me with respect	0.062	0.10	-0.039	0.29
	(8)	(10)		
Do not know how to register	0.11	0.010	0.099	0.00***
	(14)	(1)		
Do not want to assume "sex worker" identity	0.11	0.39	-0.28	0.00***
	(14)	(39)		

Table 15: Stigma and refusal to register

	(1) Inf. WTA	(2) Inf. WTA	(3) Inf. WTA	(4) Inf. WTA
Confidentiality index	-0.01000			-0.0610
	(0.0581)			(0.0540)
Community stigma index		0.103		0.0746
		(0.0777)		(0.0723)
Self stigma index			0.250***	0.254***
			(0.0301)	(0.0297)
Constant	0.435***	0.425***	0.424***	0.416***
	(0.0477)	(0.0486)	(0.0450)	(0.0458)
Observations	228	228	228	228

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Controls for treatment and registration status included in all regressions.

confidentiality. Community stigma refers to the cost of community members learning the subject's status as a sex worker. Self stigma, in contrast, refers to the cost of the subject admitting to herself that she has a stigmatized identity. Finally, direct confidentiality concerns are related to the confidentiality of the information provided during registration and the registration list. It may be that FSWs do not trust the government clinic to safeguard registration records.

I find that self stigma is the most important predictor of certification refusal. I construct summary indices of variables related to each type of stigma cost, following Anderson (2008a), and evaluate associations between each index and infinite WTA.[31] Table 15 shows regressions of infinite WTA on these indices. Neither confidentiality concerns nor community stigma costs are significantly associated with infinite WTA (Columns 1-2). In contrast, self stigma is strongly and significantly associated with infinite WTA (Column 3). A one-σ increase in the self stigma index increase the probability of reporting infinite WTA by 24.1 percentage points.

It is worth noting that the requirement to self-identify as a sex worker is fundamental to the concept of a registration program. Reducing this cost on a large scale would require dramatic changes in social norms. This is distinct from community stigma and confidentiality costs, which could in principle be reduced by improved program design (e.g., expanding registration sites beyond STI clinics, or redesigning the registration card). This result suggests that in order to achieve universal health coverage of women who exchange sex for money, legalization and regulations regimes require

[31]The confidentiality index includes a direct measure of whether the subject believes information provided during registration is confidential, and two questions about who can access the registration list. The community stigma index includes two reasons for remaining uncertified: "Afraid someone will see me at the clinic" and "Afraid someone will find the health card"; whether the participant has ever been to the registration clinic for gynecological care (so the cost of going to the clinic to register would be low); and whether the participants solicits or completes transactions in public (so registration increases risk of community stigma by a relatively smaller amount). The self stigma index includes "Do not want to assume 'sex worker' identity" and agreement with the statement "Some women exchange sex for money but are not sex workers."

Table 16: Targeting: STI infection and Take-up

	(1) Registered	(2) Registered	(3) Registered
Treatment	0.0498*	0.0541**	0.0535**
	(0.0265)	(0.0269)	(0.0268)
STI symptoms, past month	0.0958**	0.0909**	0.119**
	(0.0403)	(0.0396)	(0.0516)
Well visit, past month		-0.0686***	-0.0423**
		(0.0180)	(0.0165)
STI symptoms, past month × Well visit, past month			-0.118**
			(0.0519)
Constant	0.00230	0.0213	0.0135
	(0.0149)	(0.0162)	(0.0172)
Baseline controls	Yes	Yes	Yes
Observations	288	287	287

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

All observations weighted by w_{ij} in 4

complementary services to reach underground and occasional sex workers.

7 Discussion and policy implications

The preceding sections establish a clear explanation for low take-up of health certification among sex workers in Senegal: the benefits of certification are limited, and stigma costs of certification are high. Moreover, both low benefits and high costs follow from fundamental features of this market and certification mechanism. The evidence is consistent with a model where the certification premium is low because STI status is partially observable, through visible STI symptoms; and the stigma costs of certification stem from the fact that it requires self-identification as a sex worker. These results thus suggest that we should continue to expect low take-up of certification programs in Senegal, and in other contexts where sex work is highly stigmatized.

This section therefore considers policy implications of low take-up, through the lens of targeting. If take-up is low, but the registration program reaches those at highest risk of acquiring and transmitting STIs, it may still be effective in controlling STIs, and, thus limiting the infectious disease externality inherent in sex markets. To study targeting, I evaluate baseline predictors of opting in to registration in my sample. Overall, there is some evidence that registration improves attachment to the health system, but the results are inconsistent with effective targeting of high risk FSWs.

First, I show that recent STI episodes predict selection into the program (Table 16, Column 1). Those who had STI symptoms in the past month were 9.83 percentage points more likely to register, and this association is significant at the 5% level. Column 2 explores registration among

those who had a "well visit" in the past month: they saw a doctor for gynecological care even when they did not have STI symptoms. Those who completed a well visit in the past month were less likely to register, and recent STI symptoms predict take-up only among those who did not complete a well visit (Column 3). Among those who completed a well visit in the past month, the association between recent STI symptoms and registration is statistically indistinguishable from zero. Registration is more likely among participants who had a recent STI and were not already participating in regular medical check-ups at baseline.

Why are women with recent STIs more likely to register? The registration program is described and marketed as a health program, both in my persuasive intervention and in wider messaging. The program is run by the Ministry of Health (not by the police), and the registration card is called a "health book." Thus, participants likely view registering as a health-promoting action, even if they did not register to get treatment for a specific STI episode (77 percent of those who got certified and had STI symptoms had already seen a doctor for those symptoms). Consistent with this hypothesis, I show that women who register are more likely to be "health-seeking types" (Table 17). I construct a summary index (Anderson, 2008b) of baseline health-seeking behavior using 10 different variables, including 3 measures of condom use with clients, number of casual partners, condom use with casual partners, contraceptive use, time since last HIV test, alcohol and drug use, and a question on willingness to take health risks "in general".[32] It is worth noting that many of these measures are unrelated to sex work: they are intended to capture a preference for health.

Health seeking types are more likely to register (Column 1). In fact, recent STIs are most predictive of registration take-up among health-seeking types, and it is this interaction that drives the effect of STIs on take-up (Column 2). The interaction of health-seeker index and recent STIs is large and significant at the 1 percent level, while the coefficient on STIs alone, which corresponds to the effect of STIs at the mean of the health seeker index, is no longer significant. Appendix D shows that these results are not driven by any single component of the index. Additionally, I elicited subjects' subjective probability of getting an STI in the next month. This measure is not associated with take-up of registration in the full sample (Column 3); however, the health seeker index is more predictive in interaction with subjective probability of STI (Column 4). Taken together, these results suggest that registration take-up is driven by STI shocks among health-seeking types.

These results are not consistent with effective targeting of high risk FSWs. While the components of the health seeker index are self-reported, the results are similar across a wide range of outcomes. The women who got certified report a high rate of condom use, suggesting that they were at low risk of acquiring and transmitting STIs, but were simply unlucky.[33] Those at the highest risk of acquiring and transmitting STIs remain outside the system.

[32]The question on willingness to take health risks is drawn from Dohmen et al. (2011), and is the only variable that is measured at endline. Results are robust to excluding it from the index.

[33]While condom use significantly reduces the risk of acquiring an STI, it does not eliminate it. WIth typical use, condoms reduce the risk of HIV transmission by about 80 percent, and are believed to have similar effectiveness rates for STIs (Weller and Davis-Beaty, 2002).

Table 17: Registration take-up among "health-seeking types"

	(1) Registered	(2) Registered	(3) Registered	(4) Registered
Any STI, past month	0.0902**	0.0738**	0.0954**	0.0916**
	(0.0376)	(0.0325)	(0.0394)	(0.0390)
Health seeker index	0.103***	0.0261	0.127***	-0.0288
	(0.0378)	(0.0265)	(0.0452)	(0.0772)
Any STI, past month × Health seeker index		0.302***		
		(0.114)		
Subj. prob. of STI, next month			0.000534	-0.000195
			(0.0135)	(0.0137)
Subj. prob. of STI, next month × Health seeker index				0.0812
				(0.0508)
Constant	-0.000325	0.00113	-0.00312	0.00275
	(0.0148)	(0.0143)	(0.0248)	(0.0236)
Observations	288	288	275	275

Standard errors in parentheses

Health seeker index is a summary index (Anderson 2008) of 10 health protective behaviors and attitudes: three measures of condom use with clients, contraceptive use, number of casual partners, condom use with casual partners, time since last HIV test, alcohol use, substance use, and willingness to take health risks. Treatment status controls included in all regressions.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

8 Conclusion

This paper presents empirical evidence on the theoretical underpinnings of sex work legalization and regulation programs. Even after receiving information about the registration program and a moderate incentive to register, take-up for registration is extremely low. This can be explained, in part, by the fact that there is no evidence that sex workers who register earn a price premium. The absence of a price premium is consistent with a lack of an asymmetric information problem in sex markets, at least from the perspective of clients. Sex workers who experienced recent visible STI symptoms earn lower prices. Invisible STI symptoms, in contrast, have no effect on prices, suggesting that this effect is driven by client demand.

The result that client willingness-to-pay responds to STI risk may help inform new client side interventions. One explanation for the lack of a certification premium is that clients interpret the absence of visible STI symptoms as a clean bill of health. In reality, however, most STIs are asymptomatic (Farley et al., 2003). Among the FSWs who reported an invisible STI episode in this study, none reported visible symptoms in the same month. Educating clients about this fact could have impacts on demand for certified sex workers or condom use.

I also show that certification is costly for a large proportion of sex workers. The most significant cost is self stigma: in a context where sex work is highly stigmatized, it is costly for a woman to admit, even confidentially, that she is a sex worker. This cost is fundamental to the structure of registration programs. Thus, this result suggests that while registration programs may be valuable for a subset of sex workers who participate, they are unlikely to achieve full health coverage of female sex workers. In most settings, complementary services to reach uncertified sex workers are necessary to achieve STI control.

Finally, I present evidence that FSWs who self select into the program are at low risk for acquiring and transmitting STIs. While experiencing recent STI symptoms at baseline predicts take-up, it is only predictive among health-seeking types: women who were already engaged in numerous health-protective behaviors, such as condom use and transacting with fewer clients, that reduce their risk of both acquiring and transmitting STIs. The registration program is marketed as a health program, and a recent STI shock increases demand for health care, but it does so differentially among low risk types. This result reinforces the need for complementary services to uncertified populations. Mechanisms for targeting FSWs at the highest risk of STI acquisition and transmission would be a fruitful area for further research.

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A Attrition

Table A1 presents a regression of attrition status on treatment assignment. There is no differential attrition across experimental groups.

Table A1: Attrition

	(1) Attrited
Treatment	0.0140
	(0.0294)
Constant	0.0658***
	(0.0212)
Observations	315

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

B Balance

To account for the randomization sessions discussed in section 3.3, I test balance using separate, weighted regressions of the following form for each variable x_i:

$$x_i = \beta_0 + \beta_1 T_i + \epsilon_i \tag{9}$$

where T_i is the treatment assignment and each observation is weighted by w_i defined in equation (4).

I show balance in Tables A2 and A3. Each row represents a separate regression.

Table A2: Randomization Balance (I)

	Treatment	Constant	N
Transaction Price	133.90	9840.81	1453
	(803.69)	(673.63)	
Total income, past month	2.64	107.42	289
	(10.95)	(7.11)	
Registration knowledge index	-0.01	3.06	291
	(0.26)	(0.18)	
Age	-0.62	37.84	290
	(1.05)	(0.72)	
No. of arrests, past month	0.08	0.03	289
	(0.05)	(0.03)	
Time in jail, past month	0.31	-0.00	290
	(0.24)	(0.00)	
Any clients met in a public place	-0.04	0.27	291
	(0.05)	(0.04)	
No. of clients met in a public place	-0.07	0.62	291
	(0.14)	(0.10)	
Any transactions completed in a public place	0.03*	0.01	291
	(0.02)	(0.01)	
No. of transactions completed in a public place	0.09	0.03	291
	(0.07)	(0.03)	
No. of recent STI episodes	0.05	0.29	288
	(0.08)	(0.04)	
Severity of recent STI episodes	-0.10	0.53	291
	(0.11)	(0.09)	
No. of clients	-3.14	14.90	290
	(1.98)	(1.49)	
No. of unprotected sex acts, past month	-0.65	3.40	290
	(1.05)	(0.68)	

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A3: Randomization Balance (II)

	Treatment	Constant	N
Frequency of condom use with clients	0.14	3.36	291
	(0.13)	(0.10)	
Exchanged unprot. sex, any of last 5 trans.	-0.08	0.38	291
	(0.06)	(0.04)	
Exchanged unprot. sex, no. of last 5 trans.	-0.25	0.98	291
	(0.17)	(0.13)	
HIV knowledge index	-0.01	1.98	291
	(0.11)	(0.08)	
Saw a doctor for recent STI symptoms	0.06	1.65	291
	(0.07)	(0.05)	
No. of preventive medical visits, past month	0.06	0.36	290
	(0.08)	(0.06)	
Ever had an HIV test	0.01	0.90	291
	(0.04)	(0.03)	
Time since last HIV test	-0.04	5.29	287
	(0.38)	(0.28)	
Can charge more if registered	0.07	0.61	291
	(0.06)	(0.04)	
Any of last 5 clients asked if registered	0.00	0.24	291
	(0.05)	(0.04)	
No. of last 5 clients who asked if registered	0.04	0.52	291
	(0.15)	(0.10)	
Any of last 5 clients asked to see reg. card	-0.01	0.11	291
	(0.04)	(0.03)	
No. of last 5 clients asked to see reg. card	-0.00	0.28	291
	(0.12)	(0.08)	

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Extensive margin effects of STIs

Table A4: Extensive margin effects of STIs

	(1)	(2)	(3)
	Quant. Exch.	Quant. Exch.	Quant. Exch.
STI_any	-8.700*		
	(4.878)		
Visible STI, past month		-7.721	-8.576
		(5.632)	(5.809)
Invisible STI, past month			-7.939*
			(4.697)
Constant	29.14***	28.30***	28.99***
	(2.524)	(2.345)	(2.533)
Observations	577	580	580

Standard errors in parentheses, clustered at individual level

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Individual and round fixed effects, treatment controls included in all regressions.

D Robustness: health-seeking types

Table A5: Registration take-up, STIs and health seeker index components (I)

	(1)	(2)	(3)
Treatment	0.0438*	0.0462*	0.0429*
	(0.0255)	(0.0259)	(0.0258)
N. recent STIs	0.0120	0.0998**	0.112**
	(0.0172)	(0.0464)	(0.0537)
Always used condoms with clients	0.0258		
	(0.0179)		
Always used condoms with clients × N. recent STIs	0.1000*		
	(0.0585)		
N. unprot. trans., past month		-0.000539	
		(0.000442)	
N. recent STIs × N. unprot. trans., past month		-0.00816**	
		(0.00377)	
N. unprot. trans., of last 5			-0.00743
			(0.00552)
N. recent STIs × N. unprot. trans., of last 5			-0.0259**
			(0.0129)
Constant	-0.0120	0.00687	0.0118
	(0.0114)	(0.0172)	(0.0196)
Observations	288	287	288

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.

Table A6: Registration take-up, STIs and health seeker index components (II)

	(1)	(2)	(3)	(4)
Treatment	0.0372	0.0464*	0.0576**	0.0262
	(0.0266)	(0.0265)	(0.0255)	(0.0272)
N. recent STIs	0.0794**	0.0742**	0.209**	0.162*
	(0.0369)	(0.0356)	(0.0890)	(0.0824)
Ever used alcohol	0.103			
	(0.0711)			
Ever used alcohol × N. recent STIs	-0.0871			
	(0.128)			
Ever used drugs		-0.0463**		
		(0.0191)		
Ever used drugs × N. recent STIs		-0.0812**		
		(0.0370)		
Time since last HIV test			0.00225	
			(0.00382)	
N. recent STIs × Time since last HIV test			-0.0230*	
			(0.0117)	
Health risk tolerance				-0.00917
				(0.00947)
N. recent STIs × Health risk tolerance				-0.0445
				(0.0305)
Constant	-0.000800	0.00690	-0.0159	0.0207
	(0.0155)	(0.0156)	(0.0301)	(0.0277)
Observations	288	288	284	232

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Robust standard errors in parentheses.