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The effect of becoming a legal sex worker in Senegal on health and wellbeing

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Abstract

Senegal is the only low-income country where prostitution is legal and regulated by a health policy. To solicit clients in public places, female sex workers need to register with a health facility and attend monthly routine health checks aiming at testing and treating sexually transmitted infections and distributing free condoms. While this policy was first introduced in 1969 to limit the spread of sexually transmitted infections, there is no evidence so far on its impact on sex workers' health. The paper aims to fill this gap by exploiting a unique data set of legal and illegal Senegalese sex workers. Using propensity score matching we find that becoming a registered sex worker leads to an improvement in health but has a detrimental effect on wellbeing. Precisely, registered sex workers are found to engage in riskier and more degrading sex acts and to have less social support from their co-workers. Our results are robust to the use of a super learner to improve the specification of the propensity score and the use of entropy balancing in order to achieve covariate balance. The results are also robust to the violation of the conditional independence assumption. The results suggest that psychological services should be offered to sex workers part of the registration policy in order to overcome its negative effect on wellbeing.

1 Introduction

The legal status of prostitution varies widely across countries worldwide but prostitution is illegal in most countries and when legal, soliciting, pimping or running brothels often remain illegal. The reason for prostitution prohibition lies on moral concerns and on the idea that legalisation could increase the spread of HIV and sexually transmitted infections (STI) by leading to a higher number of commercial sex acts. However, criminalising sex work can also lead to a reduction in HIV and STI acquisition considering that criminalisation is associated with greater isolation and stigma toward female sex workers (FSWs) and clients and a lower self-image of FSWs (Weitzer, 2005), which can translates into more risk-taking and a lower demand for HIV

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and STI prevention and treatment. The net effect of sex work decriminalisation on the spread of HIV and STI will then depend on the behavioural response of FSWs and clients to the policy change.

Empirically, recent evidence found that the net effect of criminalising sexual behaviours on the spread of STI and HIV/AIDS is rather negative. Cameron et al. (2016) found that while criminalising sex work in Indonesia decreased the number of FSWs and clients, criminalisation also decreased access to condoms and resulted in an increase in STI rate by 58 percent. Cunningham and Shah (2014) used a synthetic control method in order to assess the effect of the decriminalisation of prostitution in Rhode Island. They showed that decriminalising prostitution increased the size of the market but also led to fewer reported rape offences and fewer cases of gonorrhoea. Authors suggest that the reduction in sexual violence lies in the fact that violent males may consider rape and prostitution as substitutes and that decriminalisation would lead to more sex indoors and lower rapes. As for the public health pathways, authors highlighted two main reasons for the negative effect of decriminalisation on gonorrhea incidence. Firstly, they showed that the new entrants FSWs were lower risk FSWs. Secondly, they showed that decriminalisation led to lower risk taking in sex acts. Similarly, Gertler and Shah (2011) found that in Ecuador law enforcement in the street leads to lower risky sex acts and as a result to lower STI infection rate but law enforcement in brothel leads to higher risk-taking by shifting FSWs into the street sex market. Also in the US, Delavande et al. (2010) found that more aggressive prosecutions toward HIV-positive individuals were associated with an increased likelihood of having sex with FSWs and a reduced likelihood of disclosing HIV-positive status. While previous studies have focused on the effect of criminalising sex work on health outcomes, the evidence regarding the effect of decriminalisation associated to a public health component is scarce. The only evidence comes from Tijuana (Baja California), where since 2005, FSWs are compelled to obtain electronic registration cards, to monthly test for HIV and quaterly screen for other STIs. Quast and Gonzalez (2016) evaluated the effect of the introduction of this policy on trichomoniasis incidence. To do so, they created a synthetic Baja California based on other Mexican states and they found that sex work regulation led to a decrease in the incidence rate of trichomoniasis by 37 percent over 2005-2012. However, the pre-intervention trends in the real Baja California shows that incidence rates were on a decreasing trend before the introduction of the policy compared to the synthetic trend, which may suggest that the estimated effect might be overestimated.

While many studies investigated the market-level effect of (de)criminalisation on STI prevalence, hardly no study has yet assesses the impact of becoming a legal sex worker on her health in the context of legalisation. To fill this gap, we study the impact of the decision to register as a sex worker in Dakar on health and wellbeing. In addition to Tijuana in Mexico, a few

middle and high-income countries (Austria, Ecuador, Germany, Greece, Panama, Peru, Turkey or Uruguay) and states (Nevada state in the US) have opted for the registration of FSWs as a way to limit the spread of STI and HIV. Despite being a Muslim-dominated country, to date, Senegal is the only low-income country to have chosen this route. Since 1969, FSWs aged more than 21 years old are compelled to register with a health centre and to attend routine health visits in order to test (and treat) STI and to receive free condoms (Chersich et al., 2013). An official registration card is issued (called "*carte sanitaire*") with the FSW photography in order to keep a record of the visits made to the appointed health centre and this information is shared with the police. The card provides evidence regarding both their registration status and their negative STI status. If FSWs are tested positive for any STIs, with the exception of HIV, the card is kept at the health centre during the whole course of treatment, while HIV-positive FSWs are allowed to work if they adhere to antiretroviral treatment (ART), limiting the spread of the disease. Hence, an up-to-date health card gives FSWs the right to solicit clients and acts as an insurance against police arrests. FSWs who fail to present a valid registration card may incur a prison sentence of between two and six months (cf. Code pénal articles 323/ 325). Anecdotal evidence indicates that such sanctions are enforced despite widespread corruption in the country.

Although registration seems to be assorted with many benefits, there are some limits to this system according to Senegalese FSWs. Despite the legalisation of commercial sex, prostitution is strongly morally condemned by the society and forbidden by Islam and as a result, Senegalese FSWs hide their sex work activity to their relatives. Becoming a legal FSW means that FSWs need to hide their registration card from their relatives while at home. In fact, because this card is only issued to FSWs and pregnant women in the country, relatives who would find this card could become suspicious. Secondly, by soliciting clients in public places, FSWs can be identified by their relatives. Anecdotally, the story of a FSW who has been identified by her nephew in a nightclub was reported in focus group discussions taking place during field work. Finally, the personal information of registered FSWs will be stored on police records and will remain on the police records even if they decide to leave prostitution. FSWs fear that this information will be used by policemen to blackmail them and focus group discussions confirmed that this information was commonly used by the police to extort money from FSWs. There are also common wrong beliefs associated with registration, many FSWs think that once registered they will not be able to travel outside the country or that they will loose their civil and political rights. These elements explain why despite the penal and health benefits of registration, the majority of the population of FSWs is not registered with authorities in Dakar (APAPS, 2011-2012).

Given this context, the paper aims to evaluate the effect of becoming a registered FSW in Senegal on physical and wellbeing. To do so, we first develop a theoretical framework that models the main effects of registration on physical and wellbeing and points out the different

potential channels at play. We show that registration can affect health in two opposite directions since registration leads to a greater number of sex acts, which has a detrimental effect on health through greater infection risk, but at the same time, registration is associated with greater investment in health capital. The theoretical model also highlights that registration is expected to negatively affect wellbeing through increased stigma. We then test the model predictions empirically by using a unique data set collected from a sample of 630 FSW in Dakar, stratified by the registration status. Given the voluntary nature of registration, we use propensity score matching in order to construct a balanced sample of registered and non-registered sex workers. Our empirical results indicate that registration has a positive effect on health in the Senegalese context but a detrimental effect on wellbeing. Empirical analysis also sheds light on two unintended consequences of the policy that accentuate its negative effect on wellbeing: firstly, registered sex workers engage in riskier and more degrading sex acts and secondly, they have less social support from their co-workers. Our empirical results are robust to two additional methods to improve the performance of the propensity score matching; namely the use of a super learner to improve the specification of the propensity score and the use of entropy balancing in order to achieve covariate balance. Finally, we investigate the effect of the violation of the conditional independence assumption by simulating the effect of unobserved confounders affecting both the treatment and the outcomes. We show that the existence of such confounders is unlikely to affect the results.

To summarize, this paper contributes to the literature on the decriminalisation of sex work but, unlike previous studies, it adopts a unique angle by investigating the consequences of the decision to register of sex workers on their health and wellbeing. Indeed, previous studies investigated the impact of sex work decriminalisation and regulation on STI incidence at the market level.

The remainder of the paper is organized as follows. In section 2, we model the theoretical framework. Section 3 presents the data and descriptive statistics. Section 4 presents the method to overcome the selection bias associated with the decision to register. Results and a series of robustness checks are presented in section 5 and discussed in Section 6. Finally, section 7 concludes.

2   Theoretical framework

Let's consider a country where prostitution is regulated. Sex workers can, in such context, choose between two types of prostitution: either they choose to solicit clients in public places or they choose to remain discreet. If they choose to solicit clients in public places, they will access a larger pool of clients, but to do so, they need to register with authorities to avoid penal sanctions. Hence, one can consider that registration is a direct consequence of choosing

to solicit clients in public places. Therefore, the sex worker chooses both the number of sex acts a and her registration status $R = \{0, 1\}$ in order to maximise her utility. Let's denote a^0 and a^1 the number of sex acts performed by a clandestine FSW and a registered FSW respectively.

Despite the legalisation of prostitution by a government, prostitution is often morally condemned by the society. We assume that if identified by the relatives, the sex worker suffers from *external* stigma s. We assume that external stigma depends on the level of wealth of the family, $s(A)$. Indeed, poorer families may be less contemptuous when discovering the source of the revenues the sex worker brings to the household because they are strongly financially constrained and they need those sex work earnings. As a result, FSWs from poorer families are less likely to be excluded from the household although they may experience some external stigma within the household. We thus assume $s'(A) > 0$ for all A. Therefore, the main cost of registration is that it increases the risk of being identified as a sex worker by relatives, δ, and thus increases the probability of suffering from the external stigma $s(A)$. This is a direct consequence of multiple elements related to registration such as holding an identifying registration card, working in public places or being registered in police files. Thus, we assume that the probability of being identified as a sex worker by her relatives is larger for registered FSWs than for clandestine FSWs, $\delta^1 > \delta^0$. In addition, external stigma can be internalised and we denote *internal* stigma τ. Internal stigma relates to the self-image and self-esteem of the sex worker. We assume that the more intense the sex work activity is, the greater the internal stigma a FSW suffers from, i.e. $\tau'(a) > 0$ for all a.

But registration comes also with benefits. Indeed, if FSWs do not register with authorities and solicit clients in public places, they risk a prison sentence and a fine denoted P. The likelihood of this penalty increases with the number of sexual acts, but only for unregistered FSW, i.e. $P^1 = 0$ and $P^0 > 0$, with $P^{0'}(a) > 0$. Another benefit of registration is that registered FSWs receive a compulsory medical follow-up that aims to prevent (through condom use) and treat STIs, which is expected to have a positive effect on their health. We will introduce the health benefits of the registration program in a second step.

In such context, the utility of a FSW depends on her consumption, on the psychological distress (both external and internal stigma) and on police sanctions she may experience while being a sex worker. Her utility is given by:

$$U = u(c) - \delta^R(a^R)s(A) - \tau(a^R) - P^R(a^R) \tag{1}$$

We assume that the utility function is increasing and concave: $u'(c) > 0, u''(c) \leq 0, \forall c \in \mathbb{R}_{++}$.

Furthermore, let's assume that a FSW's revenues are composed of her sex work earnings W and of other revenues A (such as assets, other occupation revenues, transfers, etc.). Therefore, the FSW solves the following maximization program:

$$\max_a u(c) - \delta^R(a^R)s(A) - \tau(a^R) - P^R(a^R) \tag{2}$$

$$\text{s.t. } wa^R + A = c$$

The first order condition (FOC) is:

$$F \equiv u'(wa^{R*} + A)w - \delta^{R'}(a^{R*})s(A) - \tau'(a^{R*}) - P^{R'}(a^R) = 0$$

The FSW chooses a^{R*} to equate the marginal consumptive utility with the marginal expected cost of both external and internal stigma and the marginal cost of police sanction.

Assumptions 1.

1. $\delta^0(0) = \delta^1(0)$.

2. $\delta^{0'}(a) \geq \delta^{1'}(a), \forall a \in \mathbb{R}_+$.

Assumption 1.1. is a normalisation assumption which may be justified on the ground that whatever the legal status of the FSW, if she does not engage in any commercial sex act, her sex worker occupation will not be revealed. As for Assumption 1.2., this is a sufficient condition for the FSW to have a marginal increase in expected external stigma under the non-registered status at least as large as in the registered status.[1] We note that it suffices to assume a weaker condition $\delta^{0'}(a) = \delta^{1'}(a)$ for our purpose.

Based on the assumptions made, we can derive that for a given level of wealth (A), a registered sex worker will perform more acts than a clandestine sex worker $(a^{0*} \leq a^{1*})$, and will therefore have greater revenues from sex work. However, by performing more acts, a registered FSW will subsequently suffer from a higher internal stigma $(\tau(a^{1*}) \geq \tau(a^{0*}))$. In addition, the expected external stigma is larger for a registered FSW for a given A, $\delta^0 s < \delta^1 s$.

Therefore, the FSW will decide to register if her maximised utility under registration V^1 is greater than under illegality V^0:

$$V^1 > V^0$$

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[1]This may be justified with a smooth density, as there is a discrete jump from $\delta^0(a)$ to $\delta^1(a)$ depending on registration, it requires δ^0 to increase more rapidly than δ^1 at some point.

$$u(wa^{1*} + A) - \delta^1(a^{1*})s(A) - \tau(a^{1*}) > u(wa^{0*} + A) - \delta^0(a^{0*})s(A) - \tau(a^{0*}) - P^0(a)$$

$$u(wa^{1*} + A) - u(wa^{0*} + A) > s(A)[\delta^1(a^{1*}) - \delta^0(a^{0*})] + [\tau(a^{1*}) - \tau(a^{0*})] - P^0(a)$$

In other words, a FSW will register if the extra consumptive utility obtained thanks to the increased activity and the avoided penalty is greater than the increased probability of being discovered by her relatives and its associated external stigma and the increased internal stigma.

Given that we assumed that the stigma from which a FSW will suffer depends positively on her family's wealth, we can show that the decision to register R switches from 0 to 1 as A becomes smaller. That is, there exists $\underline{A}$ such that $V^1(A) > V^0(A)$ for $A \leq \underline{A}$. We also can note this by looking at the comparative static results:

$$\frac{da^{R*}}{dA} = -\frac{F_A}{F_a} = -\frac{u''(wa^{R*} + A)w - \delta^{R'}(a^{R*})s'(A)}{u''(w)^2 - \delta^{R''}s}.$$

We assume the second order condition for the maximum to hold strictly so $F_a < 0.$[2] Then, the above fraction has a negative sign: the poorer the FSW is, the more sex acts she will perform and the more likely she will decide to get registered.

In addition, we can show that the decision to register R also switches from 0 to 1 as P becomes higher. That is, there exists $\underline{P}$ such that $V^1(P) > V^0(P)$ for $P \geq \underline{P}$.

These results are summarised in the following proposition and corollary.

Proposition 1.

1. There exists $\underline{A}$ such that $V^1(A) > V^0(A)$ for $A \leq \underline{A}$: For a small enough level of wealth, the FSW will decide to register.

2. $a^{1*} \geq a^{0*}$: For a given level of wealth A, a registered FSW will perform more sex acts than a clandestine FSW.

3. a^{R*} decreases with the level of wealth A (for a small level of c^{R*} or a range of δ^R values that satisfy non-decreasing density).

4. There exists $\underline{P}$ such that $V^1(P) > V^0(P)$ for $P \geq \underline{P}$: For a high enough level of penalty, the FSW will decide to register.

Corollary 1. For a given level of wealth A,

1. $wa^{1*} \geq wa^{0*}$: A registered FSW will earn more.

2. $\delta(a^{1*})s(A) \geq \delta(a^{0*})s(A)$ and $\tau(a^{1*}) \geq \tau(a^{0*})$: A registered FSW will suffer from greater external and internal stigma.

Let's now introduce in the model the health dimension. We assume that a FSW is endowed with health capital, $h > 0$ and that her utility increases with her level of health. For the number of sex acts chosen, there is a probability π that the FSW will be infected with a STI. If infected, the health capital will be reduced by I, which is the cost of illness. For simplicity, we assume that a FSW first chooses a and finds out her infection status after completing these sex acts. This corresponds to the periodic timing of routine visits to the health center. We assume that a STI is a curable disease or a treatable disease as in the case of HIV/AIDS. We therefore let the health capital recovers to h if treated. For simplicity, we formulate that h enters directly as health utility, so the health inclusive utility is $V = u(c) - \delta s - \tau - P + h - \pi I$.

The probability of being infected is a function of the number of sex acts and the type of clients. Registered FSWs are assumed to have riskier clients than unregistered FSWs. In other words, for a given number of sex acts, the probability of being infected is superior or equal for a registered FSW than for a clandestine FSW, $\pi^0(a) \leq \pi^1(a)$. On the other hand, with the periodical medical follow-up provided to registered FSWs, STI symptoms are more likely to be noticed and treated by health providers. We therefore assume that the probability of having a STI cured $\beta^R \in [0, 1]$ is greater for registered FSWs than for clandestine FSWs, $\beta^0 < \beta^1$. The net effect of registering on health is ambiguous for a given a: $\pi^0(a)(1 - \beta^0) \gtrless \pi^1(a)(1 - \beta^1)$.

Her problem becomes:

$$\max_a u(c) - \delta^R(a^R)s(A) - \tau(a^R) - P^R(a^R) + h - \pi^R(a^R)(1 - \beta^R)I \qquad (3)$$

$$\text{s.t. } wa^R + A = c$$

The first order condition (FOC) becomes:

$$F = u'(wa^{R*} + A)w - \delta^{R'}(a^{R*})s(A) - \tau'(a^{R*}) - P^{R'} - \pi^{R'}(a)[(1 - \beta^R)I] = 0$$

FOC implies the marginal utility u' is equated to $\frac{\delta^{R'}(a^{R*})s(A) - \tau'(a^{R*}) - P^{R'} + \pi^{R'}(a)(1 - \beta^R)I}{w}$. We can also derive how the number of acts a^{R*} varies with wealth A, with the probability of being cured β^R and with the size of the cost of STI, if left untreated I. Under an assumption the second order condition (SOC) for the maximum $F_a < 0$ holds strictly,

$$\frac{da^{R*}}{dA} = -\frac{u''(wa^{R*} + A)w - \delta^{R'}(a^{R*})s'(A)}{F_a} \leq 0$$

$$\frac{da^{R*}}{d\beta^R} = -\frac{\pi^{R'}(a)I}{F_a} \geq 0$$

$$\frac{da^{R*}}{dI} = \frac{\pi^{R'}(a)(1 - \beta^R)}{F_a} \leq 0$$

Again, the FSW will decide to register if her maximised utility under registration V^1 is greater than under illegality V^0:

$$V^1 > V^0$$

$$
\begin{aligned}
u(wa^{1*} + A) - u(wa^{0*} + A) + \quad & I[\pi^1(a)(1 - \beta^1) - \pi^0(a)(1 - \beta^0)] > \\
& s(A)[\delta^1(a^{1*}) - \delta^0(a^{0*})] + [\tau(a^{1*}) - \tau(a^{0*})] - P^0(a)
\end{aligned}
$$

Now, when deciding to register the FSW will also consider the difference in expected loss caused by STIs.

These results are summarised in the below.

Proposition 2.

1. $a^{1*} \geq a^{0*}$ holds under the health risks.

2. The greater the probability of being cured, the greater a^R. The access to quality health services increases the number of sex acts.

3. The greater the damage I, the smaller a^R. The severity of a disease reduces the number of sex acts.

4. For a given a, if the relative probability of being cured for a registered FSW is greater than her relative probability of being infected, registration ensures a lower health damage probability: $\frac{\pi^0}{\pi^1} < \frac{(1 - \beta^1)}{(1 - \beta^0)}$.

5. For a given a, if the relative probability of being cured for a registered FSW is lower than her relative probability of being infected, registration may lead to a larger health damage probability: $\frac{\pi^0}{\pi^1} \geq \frac{(1 - \beta^1)}{(1 - \beta^0)}$.

Proposition 2.1. shows that the registered FSWs still supply more intensively than the clandestine FSWs even if this leads to accrued infection risks. Proposition 2.2 reflects the moral

hazard resulting from to a higher probability, β^1 of being cured. In fact, if the probability of being cured is equals 1, the supply of sex act will not longer be affected by infection risk and supply of sex acts will be reduced to its baseline level. Proposition 2.3. expresses that there is a negative relationship between the expected severity of STIs that FSWs could contract and the number of sex acts they will be willing to supply. As for proposition 2.4 and 2.5, they express the potential positive and negative effect of registration on health, respectively. The probability of infection will also be affected by the change in characteristics of the clients pool following registration. The increased probability of infection resulted from the fact that registered FSWs will have more and hence a more heterogeneous pool of clients in terms of their infection risk may or may not be compensated by the improved access to treatment. Put differently, for registered FSWs, if their probability of being infected resulting from having riskier clients is lower than their probability of being treated once infected then registration will lead to a net positive effect on health. If this is not the case, registration will result in a net negative effect on health.

3   Data and descriptive statistics

Data were collected from 320 registered and 310 clandestine over-21 years old FSWs living in Dakar suburbs in June and July 2015. Our sample represents 15% of the total estimated number of FSWs in the region of Dakar (APAPS, 2011-2012). Given that sexual health services are integrated to reproductive health in Senegal, registered FSWs were recruited by midwives while clandestine FSWs were recruited by NGOs staffs and peer FSWs. FSWs were asked to come to the health centre and were interviewed at the health facility in private dedicated rooms. All active registered FSWs from the four STI health centres located in Dakar suburb (Pikine, Rufisque, Mbao and Sebikotane) were contacted to participate in our study and were surveyed. However, due to the snowball design of the recruitment of non-registered FSWs and the impossibility to include under-18 FSWs for ethical reasons, our sample of clandestine FSWs probably excludes the most isolated and vulnerable girls.

Besides a large set of socio-economic information, interviewed FSWs were asked about their sex work environment. Information on the demand for prevention services and on their health and wellbeing was also gathered. Table 1 presents the descriptive statistics of registered and clandestine FSWs. On average, FSWs of the sample are 36 years old and have low level of education. Most of FSWs are divorced and hence do not receive any financial support from their partner, which is consistent with the fact that 92% of FSWs report to have entered the prostitution market because of financial reason. Regarding household composition, they live in households of six persons on average, 34% live with their parents, 62% with their children and

48% with their brother and they have two children on average. Regarding sex work activity, on average, FSWs have been in the prostitution business for 8 years. FSWs report a monthly earning of USD 229 (CFAF 133,492) and have monthly household expenditure of USD 607 (CFAF 353,881) and a monthly per capita expenditure of USD 165 (CFAF 96,520), which is 2.2 times higher than the level of per capita expenditure in Dakar reported in national statistics (CFAF 43,260) (ANSD, 2013). In the sample, the demand for HIV and STI prevention is high since 74% of FSWs are affiliated to a STD centre and 57% went to the STD centre less than a month ago. Self-reported condom use is also high since 98% report that they have used a condom with the last client, however when elicited indirectly (via a list randomisation) condom use rate is 77% (Treibich and Lépine, 2016). In general, FSWs self-report taking low risk in sexual behaviour : only 2% report anal sex and 9% had sex with more than one client at a time. Despite those reported non-risky behaviours, 6% of FSWs declare to have a probability of 100% of being infected with HIV today wich is consistent with the 6.6% of HIV prevalence estimated in 2015 in Dakar (APAPS and IRESSEF, 2015) and self-reported STI prevalence assessed through different symptoms is 22%. Finally, respondents were 58% to declare being not satisfied with their life and 15% to have a very low self-esteem.

Table 1: Descriptive statistics

Variables	All FSWs N	Mean	Clandestine FSWs N	Mean	Registered FSWs N	Mean	p-value
Socio-demographic characteristics							
Age (in years)	630	36.42	310	36.01	320	36.81	0.257
Divorced (%)	630	0.708	310	0.668	320	0.747	0.029
No education (%)	629	0.278	310	0.226	319	0.329	0.004
Has at least one child (%)	630	0.888	310	0.897	320	0.881	0.536
Father or mother lives in Dakar (%)	630	0.548	310	0.626	320	0.472	0.000
Preference towards the future (%)	630	0.210	310	0.181	320	0.238	0.080
Altruism (USD)	630	0.47	310	0.37	320	0.58	0.000
Risk aversion (CRRA based on Gneezy and Potters game)	630	0.714	310	0.723	320	0.705	0.765
Beauty (score out of 10)	630	5.78	310	5.85	320	5.71	0.308
Entered the sex business alone (%)	630	0.532	310	0.577	320	0.488	0.024
Fatality (%) †	628	0.635	309	0.702	319	0.571	0.001
Own house (%)	630	0.200	310	0.268	320	0.134	0.000
Intermediate outcomes							
Received free condoms (%)	621	0.680	303	0.472	318	0.877	0.000
Is affiliated to a STD centre (%)	627	0.740	308	0.542	319	0.931	0.000
Went to a health centre in the last month (%)	630	0.567	310	0.274	320	0.850	0.000
Number of clients per week	627	6.51	310	5.15	317	7.85	0.000
Alcohol before last sex act (%)	619	0.076	305	0.039	314	0.111	0.001
Used a condom in the last sex act (%)	630	0.762	310	0.742	320	0.781	0.247
Declared monthly sex revenues (CFAF)	628	133,492	310	100,461	318	165,692	0.000
Final outcomes							
Has been sick or injured in the past 4 weeks (%)	630	0.419	310	0.461	320	0.378	0.035
Had lower abdominal pain in the past month	629	0.116	310	0.145	319	0.088	0.025
Has at least one FSW to go to be reassured (%)	603	0.474	306	0.533	297	0.414	0.004
Strongly disagree with "Overall I am satisfied with myself" (%)	629	0.146	310	0.106	319	0.185	0.005

Notes: ⋄ the stigma index comes from a PCA based on three questions related to (i) the fear of being discriminated by her family
if they discover the sex activity, (ii) fear that a neighbour discover her sex activity, (iii) fear that a neighbour repeat that she is a SW.
† Fatality =0 if strongly disagree with if someone is meant to have a disease he will.
N stands for the number of observations.

4 Method

In order to evaluate the impact of the registration policy one would ideally need to compare the outcome Y_1 for a registered FSW ($R = 1$) with the outcome Y_0 that we would observe if the FSW was not registered ($R = 0$). Unfortunately, because FSWs are either official or clandestine, these two sets of outcomes are never observed for a same FSW. If the registration status was randomly assigned, a simple difference in outcome means between legal and illegal FSWs would provide accurate estimates of the impact of the policy. However, given that FSWs register to the policy on a voluntary basis, registered FSWs may not closely resemble to clandestine ones as shown in Table 1 - Panel Socio-demographic characteristics. In order to circumvent the selection bias, we use propensity score matching.

Following the notation of Blundell and Costa Dias (2000), we want to estimate the effect of being a registered FSW given by:

$$\alpha_t = E(Y_1 - Y_0 | X, R = 1) \tag{4}$$

This is the expected difference in the outcomes between the treated and the control after accounting for the observable characteristics (X).

Given that we evaluate the impacts on different outcome measures in response to the registration decision, the aim of matching is to pair every registered FSW with similar FSWs from the control group based on their observable characteristics (X). Our analysis relies on the conditional independence assumption (CIA) that the outcomes of the non-treated FSWs (Y_0) and treated FSWs (Y_1) are independent of the registration status R once one controls for the observable variables (X).

$$(Y_0, Y_1) \perp R | X \tag{5}$$

Given the high dimension of X, a more feasible option is to match on a function of X. It has been shown that the probability to register $P(X)$, or the propensity score, can serve as such a function under the overlap assumption, which states that FSWs who are similar along the selected set of observable characteristics (X) must have a strictly positive probability to be either treated or untreated:

$$0 < Pr(R = 1 | X) < 1 \tag{6}$$

Hence we matched on the propensity score to create a balanced sample. CIA and the overlap assumption are combined as the strong ignorability assumption (Rosenbaum and Rubin, 1983):

$$(Y_0, Y_1) \perp R | P(X) \tag{7}$$

In order to test if the balancing property is satisfied, we apply the procedure developed by Becker and Ichino (2002). More specifically, we split the sample into five equally spaced intervals of the propensity score and we ensure that within each interval, the average propensity score as well as the means of each characteristic of treated and control units does not differ.

Once the closest matches among the controls have been found for each treated unit based on the propensity score, they are different ways of weighting the selected set of non-treated observations with each participant one.

We use the Gaussian Kernel matching estimator that matches all treated units with a weighted average of all controls with weights that are inversely proportional to the distance between the propensity scores of treated and controls. Valid standard errors were obtained by bootstrapping.

$$\alpha_t = \frac{1}{N_t} \sum_{i \in T} \left\{ Y_i^T - \frac{\sum_{j \in C} Y_j^C G\left(\frac{p_j - p_i}{h_n}\right)}{\sum_{k \in C} G\left(\frac{p_k - p_i}{h_n}\right)} \right\} \tag{8}$$

where N_T is the number of units in the treated group i and N_C in the control group j, p is the propensity score, $G(.)$ is a kernel function and h_n is a bandwidth parameter.

Let $S^\star$ be the space of X that is simultaneously observed among registered and non-registered FSWs (common support of X).

The expected average effect of the registration policy among treated participants (ATT) for whom we can find a comparable non-treated match is given by:

$$\frac{\int_{S^\star} E(Y_1 - Y_0 | P(X), R = 1) dF(P(X) | R = 1)}{\int_{S^\star} dF(P(X) | R = 1)} \tag{9}$$

5   Results

In this section, we first model the decision to register with authorities and estimate the propensity score. In a second step, we present the average treatment effects on the treated (ATT) using Kernel matching. Finally, we investigate the robustness of the results by using multivariate reweighing method to produce balanced samples, by further improving the specification of the propensity score by using machine learning and by testing the effect of the violation of the CIA.

5.1   Determinants of registration

Determinants of registration

Table 2 presents the determinants of registration and includes observable characteristics that affect the decision to register with authorities but that are exogenous to registration. To do this, we rely on self-reported reasons given by clandestine FSWs for not registering and by official

FSWs for registering with authorities.

The main reason against registration was discretion (44%); followed by the fact that their sex work activity was occasional (18%), the poor knowledge of the legal system (10%), or procrastination (4%). Hence a key determinant of registration is associated with the fear of FSW stigmatised by relatives. To account for this, we include whether the FSW's parents live in Dakar as this would increase the risk of being discovered by relatives. In addition, we include whether the FSW was introduced by another FSW assuming that those FSWs would be more likely to be aware of the registration policy than those who entered prostitution alone. It is assumed that FSWs who have other opportunities outside sex work may decide to do this activity only occasionally. We thus control for a set of variables that may be correlated with the FSW's opportunity cost such as educational level to account for outside work opportunities, age to account for the fact that younger FSWs will be more willing to attract clients in bars and night clubs and hence will have greater benefits in becoming official FSWs, beauty since beautiful FSWs may see more benefits in becoming legal FSWs. We also control for divorce status and whether the FSW has children as this may be correlated with their economic vulnerability. On the other hand, health concerns (62%) and police threats (36%) were the main reasons provided by legal FSWs for registering. In order to account for these factors we control for the following individual intrinsic attributes: risk aversion, preference for the future, altruism and fatalism. Moreover, we control for whether the FSW household owns the house where she lives in. Contrary to the observed assets which are a mixed between the FSW wealth prior to her entry in the sex business and the earnings she has accumulated, we believe that house ownership is a good exogenous proxy for household wealth.

The selected set of covariates appears to significantly explain the registration status. Table 2 shows that 12% of the variance in registration status is explained by the model. In particular, and as expected from the theoretical predictions, FSWs who face more economic and social vulnerability are more likely to register.

In Table 3, we test the balancing assumption. We note that while registered and non-registered FSWs are very different along the set of covariates used for the propensity score (column 1), the differences between registered and non-registered FSWs with respect to these observables are no longer statistically significant in each block (columns 2 to 7). This is confirmed visually by Appendix 1.

Table 2: Determinants of registration

Variables	Coefficient	Robust SE
Age	0.000	0.002
Divorced	0.076*	0.044
No education	0.059	0.043
Has at least one child	-0.085	0.062
Father or mother live in Dakar	-0.118***	0.041
Preference towards the future	0.070	0.047
Altruism†	0.208***	0.042
Risk aversion	0.006	0.025
Beauty	-0.050	0.048
Enters the sex business alone	-0.085**	0.038
Fatality	-0.096**	0.041
Own house	-0.161***	0.049
Observations		*627*
R^2		0.119
VIF (max)/ (mean)		1.29/ 1.09

Notes: † Binary variable which equals 1 if the women gave more than gave more than
40% of the money received in a dictator game to a street children association.
VIF stands for variance inflation factors and is used to test multicollinearity
of independent variables. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Table 3: Significance of the differences between registered and nonregistered FSWs within blocks

| p-values	Total (1)	Block 1 (2)	Block 2 (3)	Block 3 (4)	Block 4 (5)	Block 5 (6)	Block 6 (7)
Observations	*627*	*21*	*51*	*104*	*255*	*167*	*29*
# treated	*318*	*2*	*13*	*44*	*118*	*116*	*25*
Age	0.288	0.887	0.422	0.189	0.619	0.221	0.116
Divorced	0.038	0.947	0.694	0.097	0.865	0.196	0.317
No education	0.004	0.755	0.474	0.374	0.571	0.771	0.788
Has at least one child	0.527	0.567	0.148	0.848	0.664	0.864	0.297
Father or mother live in Dakar	0.000	-	0.844	0.650	0.184	0.911	0.407
Preference towards the future	0.091	-	0.409	0.230	0.617	0.790	0.197
Altruism†	0.000	-	0.427	0.428	0.833	0.713	0.697
Risk aversion	0.800	0.318	0.116	0.256	0.762	0.052	0.869
Beauty	0.107	0.042	0.099	0.374	0.519	0.704	0.718
Enters the sex business alone	0.026	0.567	0.417	0.082	0.829	0.150	0.239
Fatality	0.001	0.650	0.443	0.249	0.517	0.791	0.065
Own house	0.000	-	0.268	0.544	0.943	0.016	-

Notes: 1 out of the 627 individuals are excluded for being below the lower bound of the common support.
† Binary variable which equals 1 if the women gave more than 40% of the money received in a dictator game
to a street children association.

Overlap

Figure 1 brings evidence that the overlap condition is fulfilled by representing the densities of the distribution of the estimated propensity score for registered and non-registered FSWs. In fact, less than one percent of observations in our sample are off support.

Figure 1: Common support
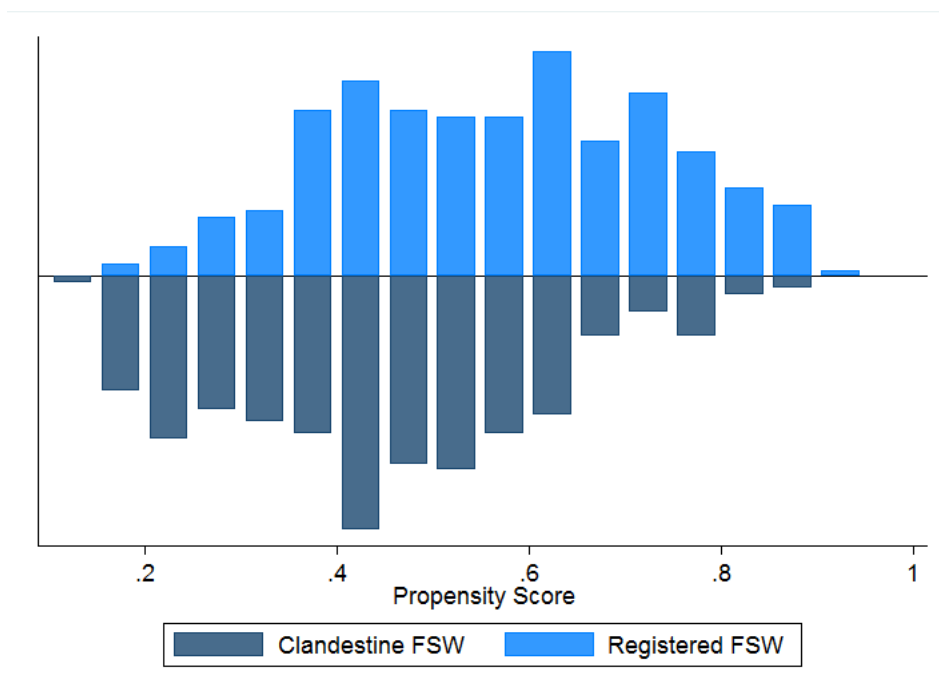
5.2   Effects of the policy

Table 4 and Table 9 (in the Appendix) report the average treatment effect on the treated (ATT).

5.2.1   Effects predicted by the model

Effect on the number of sex acts and earnings

Once registered, FSWs should no longer be molested by the police and are therefore less urged to hide their activity. We find that legal FSWs are 34 percentage points (133%) more likely to work in bars or nightclubs. As expected, regulation leads to an increase in activity: registered FSWs have on average 2.7 (51%) more clients a week and are 19 percentage points (44%) less likely to only have regular clients. When turning to the impact of registration on monthly earnings, we find that legal FSWs earn CFAF 62,879 (USD 107) more than clandestine FSWs, which corresponds to an increase in monthly earnings of 61%. This difference in earnings is explained by a greater intensity of their sex activity rather than by a higher price charged per sex act. Indeed, there is no difference in the price charged by registered and non-registered

FSWs during the last sex act with regular and occasional client.

Effect on HIV/STI prevention and health

We note that legal FSWs receive significantly more prevention than non-registered FSWs. In particular, they are 37 percentage points (72%) more likely to have received free condoms the last time they obtained condoms. However, they are also more likely to have experienced a condom breakage during the last 30 days, which could be due to the poor quality of the condoms received but also to a change in the type of sex act performed. Legal FSWs are 24 percentage points (34%) more likely to have had an HIV test in the past 12 months and 7 percentage points (8%) more likely to have collected their HIV test results. The greater the access to prevention, the stronger the links registered FSWs have with the health system. Indeed, legal FSWs are 36 percentage points (64%) more likely to be affiliated to a health centre and 56 percentage points (192%) more likely to have visited the health centre in the past month. This set of evidence indicates that the registration policy leads to a greater uptake of prevention services. Despite the greater link with the health system, no difference is found in terms of HIV and STI knowledge as a result of registration.

In addition to the positive effect of registration on HIV/STI prevention, registered FSWs appear to be in better health than their clandestine counterparts. More precisely, they are 14 percentage points (27%) less likely to have been sick or injured in the past four weeks. They also are 7 percentage points (45%) less likely to have suffered from lower abdominal pain (a common STI symptom) in the past 30 days. However, no difference in self-reported HIV status, elicited via subjective expectations, is found.

Effect on wellbeing

Registered FSWs are 8 and 7 percentage points (29% and 36%) more likely to declare that they are unhappy and unsatisfied with their life in general, respectively. Finally, registered FSWs appear to have a lower self-esteem since they are 9 percentage points (95%) more likely to strongly disagree with the statements *"Overall I am satisfied with myself"* compared to clandestine FSWs.

5.2.2 Unintended effects

Change in risk taking

Based on information gathered regarding the circumstances of the last paid sexual intercourse, it appears that these differences in work places and type of clients also translate into riskier sexual behaviours. More precisely, legal FSWs are 14 percentage points (36%) more likely to have had an occasional client as the last client, 7 percentage points (189%) more likely to have consumed alcohol prior the sex act and 12 percentage points (122%) more likely to have had an intoxicated client. No difference in condom use or anal sex is detected between registered

Table 4: Registration policy impacts

Outcomes	# treated	# controls	ATT	t	sign.	Mean of matched controls
Intermediary outcomes						
Received free condoms	316	301	0.367	9.246	◇◇◇	0.509
Is affiliated to a STD centre	317	306	0.364	9.374	◇◇◇	0.566
Went to a health centre in the last month	318	308	0.560	15.113	◇◇◇	0.289
Number of clients per week	315	308	2.668	5.261	◇◇◇	5.211
Had alcohol before last sex act	312	303	0.062	2.534	**	0.047
Used condom during last intercourse	318	308	-0.018	-0.559	NS	0.798
Monthly earnings from sex work (FCFA)	316	308	62,879	5.290	◇◇◇	103,466
Final outcomes						
Has been sick or injured in the past 4 weeks	318	308	-0.109	-2.431	**	0.484
Had lower abdominal pain in the past month	317	308	-0.055	-1.865	*	0.143
Has at least one FSW to go to be reassured	296	304	-0.146	-3.051	***	0.558
Strongly disagree with "Overall I am satisfied with myself"	318	308	0.090	3.153	***	0.095

Notes: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$; ◇◇◇ $p < 0.001$. NS stands for "not significant".
ATT stands for Average Treatment effect on the Treated. Results of the Gaussian Kernel matching on the common support with replacement and 1,000 replications are presented here.

FSWs and clandestine FSWs, maybe because of the poor variability in those variables (98% of FSWs declare having used a condom and not having performed anal sex during last sex act). However, official FSWs were 5 percentage points (165%) more likely to have had a sex act with several clients at the same time during last sex act.

Social support

Greater competition between registered FSWs translates into lower psychological support from peers. We find that while registered FSWs know on average 3 more girls working in the sex industry, they are 15 percentage points (26%) less likely to report to know a FSW who will reassure her when they need it. This unintended effect may provide another explanation for the negative effect of registration on wellbeing.

The effect of registration on other intermediary and final outcomes is provided in Appendix 2.

5.3 Robustness checks

Propensity score matching is widely used in the literature in order to assess the causal effect of a programme on a set of outcomes of interest, circumventing the existing biases induced by the voluntary selection into the programme. Yet, the consistency of the propensity score relies on correct specification and balancing property. We presented hereinafter, two alternative methods to preprocessing data to avoid these caveats namely entropy balancing to achieve balance in covariates beyond the mean and a super learner to improve specification of the estimation of propensity scores. Given that these alternative approaches do not tackle the unobserved confounder bias, we conduct sensitive analysis suggested by Ichino et al. (2008) to test whether the results obtained with the propensity score matching are robust to deviations from the conditional independence assumption.

5.3.1 Improving the propensity score matching

Improving covariates balance using entropy balancing

Matching techniques aim at reducing the imbalance between the treatment and the control groups with respect to some covariates related both to the probability of being treated and the outcomes of interest. Through trial and error, applied researchers attempt to find the set of covariates that reach the right balance. This procedure may take some time and may not rule out the possibility that the introduction of some variables may increase the imbalance regarding other observed confounders. Hainmueller (2012) introduced entropy balancing, a data preprocessing procedure that directly focuses on covariate balancing and is able to ensure balancing not only on the first moment of the distribution but also on any specified moment. One can then force the distribution of all covariates considered to look very similar in the treatment and in the reweighted control groups, simulating a randomised experiment.

We implement entropy balancing so that the three first moments of the distribution of each covariate used to estimate the propensity score is identical for registered and non-registered FSWs. Table 5 shows the differences between the two groups before and after implementing the entropy balancing procedure. Weights generated by this procedure are then used to estimate the causal effect of registration on the outcomes of interest, which lead to similar results as the ones obtained with propensity score matching (see Table 7).

Table 5: Balancing of covariates

	Means			Variances			Skewness		
	Controls			Controls			Controls		
Covariates	Pre	Post	Treated	Pre	Post	Treated	Pre	Post	Treated
Age	36.06	36.81	36.81	82.49	75.01	75.01	0.301	0.284	0.284
Divorced	0.670	0.745	0.745	0.222	0.191	0.190	-0.723	-1.126	-1.126
No education	0.227	0.330	0.330	0.176	0.222	0.222	1.307	0.722	0.722
Has at least one child	0.896	0.881	0.881	0.093	0.106	0.106	-2.602	-2.346	-2.346
Father/ mother live in Dakar	0.625	0.472	0.472	0.235	0.250	0.250	-0.515	0.113	0.113
Preference towards the future	0.178	0.233	0.233	0.147	0.179	0.179	1.684	1.265	1.265
Altruism (more than 400 FCFA)	0.197	0.387	0.387	0.159	0.238	0.238	1.520	0.465	0.465
Risk aversion	0.725	0.709	0.709	0.571	0.587	0.587	0.755	0.775	0.775
Beauty	0.799	0.745	0.745	0.161	0.190	0.190	-1.495	-1.126	-1.126
Enters the sex business alone	0.576	0.487	0.487	0.245	0.251	0.251	-0.308	0.050	0.050
Fatality	0.702	0.572	0.572	0.210	0.246	0.246	-0.885	-0.293	-0.292
Own house	0.269	0.135	0.135	0.197	0.117	0.117	1.044	2.132	2.133

Improving specification of the propensity score using a super learner

While it is common practice to use logistic regression to estimate propensity score, there is evidence that propensity score model misspecification may affect the balance of covariates and lead to biases in treatment estimation (Drake, 1993). Machine learning methods can be used for propensity score estimation in order to choose the optimal regression algorithm among a set of candidates (Pirracchio et al., 2014). We implement the method proposed by van der Laan et al. (2007) so that a weighted linear combination of the candidate learners associated with a low risk is used as a super learner estimator. To achieve this, we include 15 different algorithms in the super learner library (see Table 6). Analyses were performed using R statistical software. Table 6 displays the composition of the super learner estimator. Figure 2 shows the common support based on the super learner propensity score estimation. We can note that the overlap is reduced compared to previously. Despite having a lower number of units on support, ATTs based on the scores estimated with a super learner remains of comparable magnitude (see Table 7) than the ones obtained using a logistic regression.

Table 6: Composition of the Super Learner

Models	Risk	Coefficient
Stepwise regression with interactions	0.2363	0.2183
Logistic regression	0.2291	0.0000
Generalised additive model	0.2294	0.0000
Random forest	0.2307	0.1458
Polynomial spline regression	0.2401	0.0000
Neural network	0.2471	0.0000
Stepwise regression	0.2333	0.0000
Bayesian generalised linear model	0.2290	0.2013
Classification and regression routines	0.2297	0.0195
Classification and regression trees (CART): recursive partitioning	0.2450	0.0000
Bootstrapped aggregated CART	0.2294	0.0000
Gradient boosting	0.2268	0.0000
Support vector machine	0.2338	0.1570
Generalised linear model with penalised maximum likelihood	0.2295	0.0000
Multivariate adaptive regression splines	0.2299	0.2581

Notes: A low risk indicates a greater performance of the model.
The coefficients indicate how much weight the super learner puts
on each model in the weighted-average.

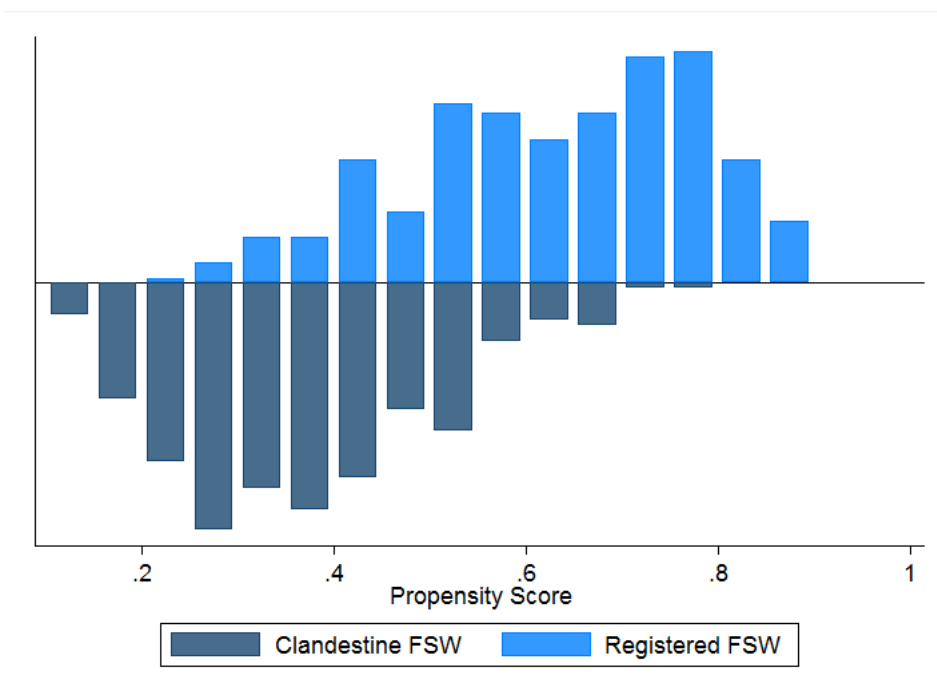Figure 2: Common support based on Super Learner weights

Table 7: Robustness checks

Outcomes	PSM		Entropy balancing		Super Learner	
	ATT	sign.	Coeff.	sign.	ATT	sign.
Observations	T=318	C=308			T= 274	C= 280
Intermediary outcomes						
Received free condoms	0.367	◇◇◇	0.369	◇◇◇	0.265	◇◇◇
Is affiliated to a STD centre	0.364	◇◇◇	0.353	◇◇◇	0.274	◇◇◇
Went to a health centre in the last month	0.560	◇◇◇	0.553	◇◇◇	0.499	◇◇◇
Number of clients per week	2.668	◇◇◇	2.616	◇◇◇	2.364	◇◇◇
Had alcohol before last sex act	0.062	★★	0.065	★★★	0.086	◇◇◇
Used condom during last intercourse (list experiment)	-0.018	NS	-0.015	NS	-0.134	◇◇◇
Monthly earnings from sex work (FCFA)	62,879	◇◇◇	57,149	◇◇◇	61,767	◇◇◇
Final outcomes						
Has been sick or injured in the past 4 weeks	-0.109	★★	-0.116	★★	-0.138	★
Had lower abdominal pain in the past month	-0.055	★	-0.059	★	-0.019	NS
Has at least one FSW to go to be reassured	-0.146	★★★	-0.143	★★★	-0.136	★
Strongly disagree with "Overall I am satisfied with myself"	0.090	★★★	0.094	◇◇◇	0.099	◇◇◇

Notes: ★ $p < 0.1$; ★★ $p < 0.05$; ★★★ $p < 0.01$; ◇◇◇ $p < 0.001$. NS stands for "not significant".

Results in italic come from Table 4. ATT stands for Average Treatment effect on the Treated.

Results of the Gaussian Kernel matching on the common support with replacement and 1,000 replications are presented for Super Learner.

T and C indicate the number of treated and control observations respectively.

Super Learner propensity score is a weighted linear combination of candidates presented in Table 6.

5.3.2 Testing the violation of the CIA

Ichino et al. (2008) propose a simulated sensitivity analysis to test whether the results obtained with the propensity score matching are robust to specific failures of the CIA. The idea is to assume that the selection on observables assumption is not satisfied given the observables considered (equation 10) but could be if one could observe an additional binary variable U (equation 11).

$$(Y_0, Y_1) \not\perp R|X \tag{10}$$

$$(Y_0, Y_1) \perp R|X, U \tag{11}$$

Ichino et al. (2008) define the selection effect Λ as the effect of U on the relative probability to be assigned to the treatment and the outcome effect Γ as the effect of U on the relative probability to have a positive outcome in the absence of treatment.

$$\Lambda = \frac{\dfrac{P(R=1|U=1,X)}{P(R=0|U=1,X)}}{\dfrac{P(R=1|U=0,X)}{P(R=0|U=0,X)}} \tag{12}$$

$$\Gamma = \frac{\dfrac{P(Y=1|R=0,U=1,X)}{P(Y=0|R=0,U=1,X)}}{\dfrac{P(Y=1|R=0,U=0,X)}{P(Y=0|R=0,U=0,X)}} \tag{13}$$

Put differently, an outcome effect of $\Gamma > 1$ means that the unobserved U positively affects the outcome variable.

In order to study the robustness of our results to the violation of the CIA assumption, Ichino et al. (2008) propose two alternatives. A first approach relies on the assumption that the unobserved variable U should have similar selection and outcome effect as important observed variables. To implement this test, we fix $p_{ij} = P(U = 1|R = i, Y = j)$ according to their values for the set of covariates used in the propensity score equation. A second approach is to search for the existence of parameters p_{ij} such that if U were observed the estimated ATT would be driven to zero. Then one can assess the plausibility of this particular configuration of parameters. In the case where the needed distribution of U can be considered as unlikely, the exercise would support the robustness of the estimates derived under CIA.

We first implement the sensitivity exercise for different outcomes of interest, namely health and wellbeing. We find that any unobserved variable with similar treatment and selection effect as the covariates already introduced in the propensity score matching will not confound our results (see Table 8). As for the potential confounders, firstly, we consider intra-familial sexual

abuse during childhood. On the one hand, this unobserved variable may explain the family breakdown and therefore can be positively correlated to the decision to register (selection effect, Λ). On the other hand, it may also explain the difficulties to socialise with peers and the low self-esteem (outcome effect, Λ), hence the omission of this variable would mean that the estimated effect of registration on wellbeing is overestimated. Secondly, we consider the preference for health of the FSW since this characteristic is likely to be positively correlated with registration ($\Lambda > 1$) and negatively correlated with the likelihood of being sick ($\Gamma < 1$) or having an STI, then its inclusion should reduce the size of the ATT.

As we can see from Table 8, accounting for the fact that sexual abuse and preference for health could be correlated with the treatment and outcome does reduce the size of the ATTs. However, ATTs do remain high and statistically significant.

Table 8: Sensitivity analysis

	outcome effect Γ	selection effect Λ	ATT	SE
Outcome: *Strongly disagree with "Overall I am satisfied with myself"*				
PSM result	-	-	*0.090*	*0.029*
Confounder-like				
Father or mother live in Dakar	0.767	0.530	0.086	0.006
Altruism[†]	0.387	2.675	0.104	0.007
Fatality	0.247	0.567	0.075	0.008
Killer confounder				
U = sexual abuse	4.371	2.055	0.075	0.008
Outcome: *Has been sick or injured in the past month*				
PSM result	-	-	*-0.109*	*0.045*
Confounder-like				
Preference towards the future	2.434	1.455	-0.117	0.009
Altruism[†]	1.252	2.689	-0.119	0.016
Fatality	0.887	0.562	-0.114	0.010
Killer confounder				
U= preference for health	0.243	2.818	-0.038	0.021
Outcome: *Had lower abdominal pain in the past month*				
PSM result	-	-	*-0.055*	*0.029*
Confounder-like				
Preference towards the future	0.688	1.447	-0.054	0.004
Altruism[†]	0.867	0.572	-0.059	0.007
Fatality	0.854	0.572	-0.060	0.008
Killer confounder				
U= preference for health	0.249	1.825	-0.040	0.007

Notes: All covariates are binary variables and [†] stands for above average in the sample.
500 replications have been performed for the sensitivity analysis.

6 Discussion

We analysed the effect of the registration policy for sex workers in Senegal. Our results show that this policy is effective in controlling the spread of STI and HIV by targeting high-risk populations with preventive services. However, our results also highlight that this policy has a detrimental effect on FSWs' wellbeing. The net positive effect of the policy on health is interesting considering that we found that registered sex workers have more and riskier sex acts than their non-registered counterparts. This result emphasises the effectiveness of the routine medical visits received by registered sex workers in Senegal. As predicted by our theoretical model, we empirically find that registration has a detrimental effect on wellbeing. We show that this result is attributable to greater internal and external stigma resulting from registration and to some unintended effects of registration, namely greater risk-taking in sex acts and lower social support from peers. Registered sex workers are therefore more exposed than non-registered sex workers to the violence of the sex business, which induces negative psychological effects due to the physical and emotional wearing sides of this activity.

Those conclusions are based on data collected from registered and non-registered FSWs in Dakar. While our results may not be generalisable to the whole population of clandestine FSWs, the selection of the clandestine that have strong links with NGOs to our sample is pertinent for the purpose of the study. First, it is probably a explanation for the good common support obtained using propensity score matching. Secondly, if one was implementing interventions to encourage registration, one could not reach out the most isolated clandestine girls. Hence, the effect of the registration policy presented in the study is likely to represent the one we could expect if we were encouraging registration of clandestine FSWs in Dakar.

While the matching approach ensured that the covariates were balanced in the samples of registered and non-registered sex workers, the propensity score matching results rely on the assumption that there is also no difference in their unobserved characteristics. We identified the existence of sexual abuse during childhood and the preference for health as potential confounders affecting both treatment and outcomes. However, results provided by the sensitivity analysis looking at the effect of the violation of CIA showed that our results were robust when considering these confounders.

The main limitation of the paper is that it only investigates the effect of registration on the current pool of sex workers and falls short to investigate the effect of the policy at the market level. In fact, the effect of registration on market size and on the type of sex workers entering the market is unknown. If regulation was attracting a lot more FSWs and riskier ones on the sex market, the policy could lead to more infections in the general population

even though the transmission of STI and HIV is contained in the current pool of sex workers. The effect of decriminalisation and registration hence relies strongly on context specificity (e.g quality of care, STI/HIV prevalence) and on the behavioural response of sex workers and clients.

Our results can be used to improve the design of the registration policy in Senegal. The result that the policy has a detrimental effect on wellbeing should be addressed. There is some weak but promising evidence in the sex work literature that providing psychological training is an effective way to boost self-esteem and translates into greater investment towards the future (Ghosal et al., 2016). More evidence is needed in the Senegalese context about effective interventions that could address the negative effects of registration on wellbeing.

7 Conclusion

Few countries worldwide have opted for the regulation of prostitution and mandatory medical screening in order to control the spread of STI and HIV. We show that in Senegal, the only country on the African continent that chose this route, the registration scheme of sex workers is associated with greater demand for HIV/STI prevention services and improved health. However, we show that this policy also has some detrimental effects on psychological and social well-being that would require further attention from policy-makers.

Figure 3: Appendix 1. Balance of covariates
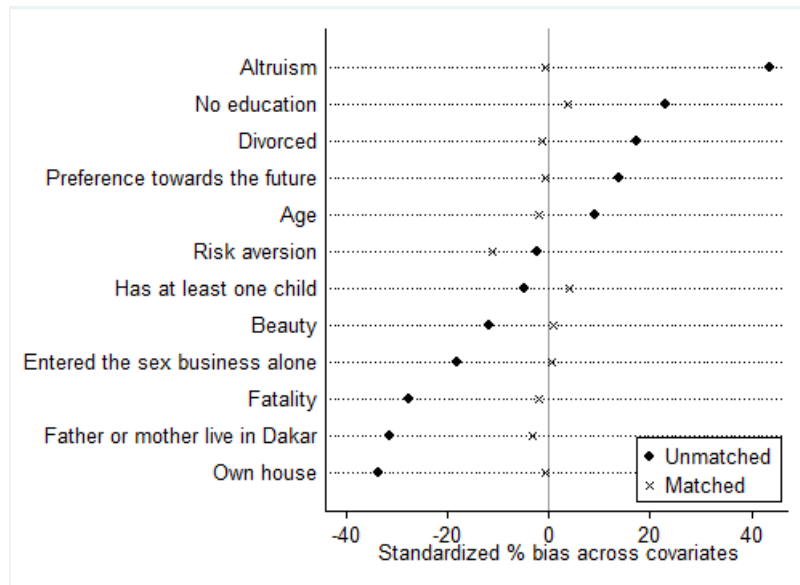
8 Appendices

Table 9: Appendix 2. Registration policy impacts on additional outcomes

Outcomes	# treated	# controls	ATT	t	sign.	Mean of matched controls
Other intermediary outcomes						
Condom breakage in the last 30 days	317	303	0.209	6.003	◇◇◇	0.129
Had a HIV screening in the past year	318	308	0.237	7.053	◇◇◇	0.707
Had collected her HIV results the last time she was screened	313	278	0.073	3.210	⋆⋆⋆	0.908
Last sexual act earnings with an occasional client (FCFA)	241	170	-994	-0.788	NS	15,494
Attracts usually clients in bars or night clubs	318	308	0.337	8.135	◇◇◇	0.254
Has only regular clients	318	307	-0.188	-4.497	◇◇◇	0.418
Last client was an occasional client	315	305	0.153	3.525	◇◇◇	0.368
Last client consumed alcohol	310	304	0.125	3.885	◇◇◇	0.091
Multiple clients relationship during last sex act	285	295	0.051	2.229	⋆⋆	0.036
Anal intercourse during last sex act	315	305	0.019	1.523	NS	0.013
Fellatio during last sex act	315	305	0.015	0.730	NS	0.055
Other final outcomes						
Is not happy	318	308	0.076	1.921	⋆	0.266
Is not satisfied at all in general	317	308	0.074	1.941	⋆	0.207
Number of known FSWs	296	303	2.957	2.427	⋆⋆	8.350

Notes: ⋆ p < 0.1; ⋆⋆ p < 0.05; ⋆⋆⋆ p < 0.01; ◇◇◇ p < 0.001. NS stands for "not significant".
ATT stands for Average Treatment effect on the Treated. Results of the Gaussian Kernel matching on the common support with replacement and 1,000 replications are presented here.

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