

Sex Work and Infection: What's Law Enforcement Got to Do with it?*

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Abstract

A number of countries are pursuing the regulation of sex work in order to decrease the spread of sexually transmitted infections (STIs) and reduce the probability of a generalized HIV/AIDS epidemic. We study the effects of enforcing licensing regulation laws on sex worker STI rates using a nationally representative sex worker dataset from Ecuador. We find that increasing enforcement in the street sector significantly decreases STIs, yet increases the probability of a sex worker ever having had an STI in the brothel sector. We propose a conceptual framework suggesting that market forces rather than the standard epidemiological model explain these results. Enforcement increases the fixed cost of working in the street relative to the less risky brothel sector and raises the price of sex. Specifically, results indicate that increasing enforcement in the street sector significantly shifts sex workers from the risky street into the less risky brothels. In addition, enforcement increases street prices, reducing the overall number of street clients both protected and unprotected. Therefore, both the price and sectoral choice effect in the street sector unambiguously improves public health outcomes. We also show that increasing enforcement in the brothel sector seems to exacerbate public health problems as it induces unlicensed sex workers working in brothels into the riskier street sector. For enforcement in the brothel sector to work, it needs to be complemented with strong enforcement in the street.

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A large portion of the approximately 20,000 people who each day acquire the human immunodeficiency virus (HIV), are infected through unprotected sex with sex workers (UNAIDS, 2002). Indeed, sex workers play a central role in the spread of HIV and other sexually transmitted infections (STIs) as they have higher infection rates and more sexual partners relative to the general adult population in most countries (World Bank, 1999). A number of countries are trying to reduce the spread of sexually transmitted infections, especially the HIV virus, by regulating sex work.¹ These policies are especially interesting to countries with low HIV prevalence rates who are trying to lower the odds of a generalized pandemic through prevention efforts in key populations from which an HIV/AIDS pandemic could emanate such as sex workers.

Under regulation sex work is legal if the sex worker obtains a license certifying that she is healthy and clean of infection based on frequent STI tests as well as medical check-ups. The objective is to use universal testing to identify infected sex workers, remove them from the work force, and treat them before they return to work so as to prevent them from infecting others. This is consistent with the standard epidemiological model method of combating infectious disease epidemics such as an outbreak of influenza or TB, which is to identify those infected, isolate them from the general population, treat them if possible, and only return them to the general population when cured.

However, the standard epidemiological model is problematic in the case of combating STIs among sex workers because there are large costs to being tested as well as a large opportunity cost to being identified as infected and removed from the population. Typically, sex workers have to pay substantial fees for the tests both in terms of time and money, and they have substantial lost earnings from being isolated while being treated. In addition, if they are found to be HIV positive they cannot return to work as there is no cure. As a result, there is likely substantial non-compliance with the licensure regulations, thereby mitigating the effectiveness in reducing infection rates. Hence, in the case of sex work, the licensure regulation is typically accompanied by stiff penalties, both in terms of monetary fines and incarceration, for non-compliance.

In this paper, we study the effects of enforcing licensing regulation on sex worker STI rates using a nationally representative sex worker dataset from Ecuador that we collected in 2003. The dataset is unique in that it combines socio-economic information with labor supply to sex worker

¹Some countries where regulatory policies have been debated and/or implemented include Argentina, Australia, Belgium, Canada, Kenya, Mexico, New Zealand, and Thailand (Platt, 2001; Kohm and Selwood, 2004; Jordan, 2005). South Africa is contemplating legalizing and regulating its sex market in time for the 2010 World Football Cup.

biological markers of sexually transmitted infections. In Ecuador, sex work is legal in institutions such as brothels and nightclubs with a license, but the police often treat soliciting on the street as illegal. Local police enforce licensing and the rules against solicitation on the street through surprise raids. Sex workers are fined and sometimes jailed if they are found to be in violation. Despite this, close to 30 percent of workers in brothels, bars and nightclubs do not comply with the licensure laws and slightly more than one-quarter of all sex workers are on the street.

We exploit plausibly exogenous regional variation in enforcement and find that sex worker STI rates are lower in localities where local police conduct more surprise raids on the street. Specifically, we find that increasing enforcement by one standard deviation per month in the street is significantly associated with a 21 percent lower rate of sex workers being currently infected with syphilis, chlamydia, and/or gonorrhea and a 12 percent lower rate of ever having any STI. In contrast, we find increasing enforcement by one standard deviation in the brothel sector is not significantly associated with the rate sex workers are currently infected with syphilis, chlamydia, and/or gonorrhea, but surprisingly is significantly associated with a 10 percent higher probability of ever being infected with any STI.

We then examine the mechanisms by which enforcement affects infection rates and find that they are not necessarily the epidemiological identification of isolation and treatment of infected sex workers. We argue that enforcement changes market returns in two ways. First, increased enforcement raises the fixed costs of working on the street or in a brothel without a license relative to the less risky² setting of working in a brothel and complying with the licensure regulation. Second, increased enforcement causes sex workers to raise their prices for both protected and unprotected sex, and thereby reduces the number of both types of sexual transactions. We find strong empirical evidence that both pathways are operative in Ecuador.

Our examination of the pathways explains why increased enforcement on the street is associated with lower STI rates, but increased enforcement in the brothels is associated with higher STI rates. Increased enforcement on the street raises the fixed costs of working on the street relative to working in a brothel with or without compliance. The brothel is a less risky setting as clients demand less unprotected sex and there are lower STI rates. Indeed, we find in the empirical work that increased street enforcement is associated with higher participation in the brothel sector and lower

²The brothel sector is less risky because sex workers have a lower risk of acquiring an STI since STI rates are lower and condom use rates are higher in this sector.

participation in the street. On the other hand, increased enforcement in the brothel raises the fixed costs of working in a brothel without a license relative to both staying in the brothel with a license and relative to working on the street. In the empirical work we find increased brothel enforcement is associated with increased participation in the riskier street sector rather than increased compliance with the licensure regulations. This suggests that increased brothel enforcement causes brothel workers without licenses to move to the street where there is more risk rather than stay in the brothel and comply with the license.

Our paper not only contributes to the literature on the economics of epidemiology, especially HIV/AIDS, but also to the literature on regulation and enforcement. Research in the economics literature suggests that increased enforcement of regulation decreases various social ills such as crime (Becker, 1968; Levitt, 1997; Corman and Moci, 2000; Di Tella and Schargrotsky, 2004) and drug use (Farrelly, Bray, Zarkin, and Wendling, 2001). However, to our knowledge, there is no existing research that tests the potential benefits of sex worker regulation.

We begin the paper by describing the institutional setting in terms of how the sex work industry in Ecuador is organized and regulated. We then describe our survey and data and use those data to examine the reduced form effects of increased enforcement on sex worker STI rates. We establish the major finding of this paper that increasing police presence in the street sector is most effective in decreasing disease. We also establish that increasing police enforcement in the brothel sector has no significant effect on current disease outcomes and increases the probability of a sex worker ever having had an STI. The rest of the paper is dedicated to sorting out the mechanisms to explain these reduced form results.

1 Background

Ecuador, like most countries, does not have a generalized HIV/AIDS epidemic. In fact, the 2003 national Ecuadorian adult HIV/AIDS prevalence was only 0.3 percent (UNAIDS, 2004). In 2000, the HIV/AIDS prevalence of sex workers in Guayaquil was 1.7 percent, 0.5 percent in Quito, and 1.1 percent in Esmeraldas (Chiribofa, Alaba, Almeida, Acosta, and Orozco, 2001). However, while the risk of HIV infection is low, the risk of being infected with another STI is much higher. Twenty-three percent of sex workers in our sample self-reported experiencing some type of STI in the last year and 52 percent reported ever having an STI. At the time of the survey, 8 percent of sex workers

actually tested positive for chlamydia, syphilis, or gonorrhea. These STI rates are much higher than the general adult population in Ecuador.

The fact that the STI infection rate is so much higher than the HIV rate raises the concern of a likely rise in HIV infection in the near future (Centers for Disease Control & Prevention, 2004). This is because a high incidence of STIs means low condom use and untreated STIs facilitate easier transmission of the HIV virus. For example, Africa currently has very high HIV transmission rates and this is very likely due to high rates of untreated sexually transmitted infections (Oster, 2005). Policy interventions that focus on reducing and treating STIs will most likely decrease HIV transmission rates.

In Ecuador and much of Latin America, regulating the sex market through licensure has been a key policy response to decrease the spread of STIs. In Ecuador, there are thought to be about 30,000 female sex workers (IJCG/INSP, 2003). This number is obviously an underestimate as sex workers are a hard-to-reach population due to the clandestine nature of their work. The majority of sex workers typically work in one of three environments: (i) the brothel sector where they comply with licensing requirements, (ii) the brothel sector where they do not to comply with the licensing requirements and risk getting fined, or (iii) the street sector where sex workers are subject to substantial harassment by the police.

1.1 The Regulation

In Ecuador there is no law that criminalizes sex work. In fact, the only legal document in which sex work is mentioned is the national Health Code of Ecuador (Tamayo, 2004), which states that sex work inside of ‘closed establishments’ should be monitored by the Ministry of Health. In this paper we refer to these closed establishments such as brothels and nightclubs as the “brothel sector.” However, this law does not mention other more informal sex worker sites such as the street, bus stops, parks, etc. We refer to these informal sites as the “street sector.” While there is no formal law, the police often treat solicitation on the street and other informal sites as illegal.

Monitoring sex work in brothels has taken the form of a “carnet,” which is an occupational license certifying good health status of a sex worker. To obtain the license, sex workers must bring proper identification, two photographs, and negative test results for syphilis, chlamydia, and HIV/AIDS to the local Ministry of Health clinic. The initial cost of all this is approximately 25 dollars. To keep the license updated, sex workers are required to return to the clinic every 8-15

days for a gynecological check-up. Each visit costs approximately 2 dollars, not including medicine and potential treatment if the sex worker tests positive for disease. Sex workers are also required to take HIV tests every 6 months. The HIV test costs 3 dollars for an Elisa test.³ If the Elisa results are inconclusive, then they must pay 18 dollars for a Western Blot.⁴ In addition, they must take syphilis tests every 2 months (1 dollar), and chlamydia and herpes every 4 months (10 dollars). The license is revoked with a positive HIV test result and is suspended during STI outbreaks. The license has been designed in such a way that it is very difficult to forge. It looks like a passport which includes a photograph of the sex worker as well as official stamps with dates and signatures from doctors at the Ministry of Health each time the sex worker receives a health check-up.

In focus groups, sex workers report that the cost of obtaining and maintaining the license is very burdensome and there is a lot of aggravation and hassle associated with maintaining the license. Sex workers must pay the costs of lab fees associated with STI and HIV tests, medicine, transportation to the health clinic, and all other costs associated with acquiring and maintaining the license. Sex workers find it very costly to pay for the exams, tests, and medicine given an hourly wage of about US\$5 per hour. In addition, there is often only one health center in town that treats sex workers. Travel to that one clinic and waiting to be seen by the doctor can take the majority of an entire day. This is obviously time that could be spent working or doing other things. As a result, enforcement of health regulation could have the unintended consequence of encouraging sex workers to work in informal street areas where sexual practices are more risky. In other words, since regulation is costly to sex workers and clients are willing to pay a premium for non-condom sex (Gertler, Shah, and Bertozzi, 2005; Rao, Gupta, Lokshin, and Jana, 2003; Robinson and Yeh, 2008), enforcement could actually promote risky behavior.

1.2 Enforcement and fines

While the license is obtained and maintained through the local Ministry of Health office, local police are responsible for the enforcement of the licensing requirements in brothels and the ban on solicitation in the streets. Indeed, local Ministries of Health have neither the jurisdiction nor resources to enforce the license. Most cities in Ecuador are relatively small and have a concentrated

³A sensitive immunoassay that uses an enzyme linked to an antibody or antigen as a marker for the detection of a specific protein, especially an antigen or antibody. It is often used as a diagnostic test to determine exposure to a particular infectious agent, such as the AIDS virus, by identifying antibodies present in a blood sample.

⁴A more specific HIV test to confirm if someone is truly HIV positive, as there are other conditions which may give a false positive ELISA screening test.

red light district where brothels and street sex workers are located. Police conduct raids in these areas to check sex workers licenses and identify street workers. Raids are simply large-scale exercises to check as many sex worker licenses in brothels and street sites as possible. Both sex workers and police report that raids are always surprise visits. Importantly, Brothel owners are not fined for employing unlicensed sex workers.⁵

In this paper, “enforcement” is defined as the average frequency of police raids per month to check sex worker licenses and the average frequency of police raids per month to find workers soliciting on the street in each city. While this is a crude measure, it captures the variation in numbers of raids across cities.⁶ Information from administrative records indicates that on average, police raid brothels about 1.28 times per month compared to about once every 5 months in the street sector. Interviews with sex workers confirm that the amount of enforcement is much higher in the brothel sector than in the street sector.

Brothel sex workers who do not have a license or have an expired license and sex workers on the street found soliciting are fined and can be ejected from the location. Brothel sex workers report the first fine is generally around 20 US dollars, while street sex workers report paying substantially more and that they are many times jailed. Sex workers report that the fine increases for repeat offenders and in the extreme the police sometimes demand that sex workers to pay the fine in sexual services. Repeat offenders become known, which results in more aggravation and harassment from the police.

2 Survey and Data

We use data on approximately 3000 female sex workers collected in 2003 by the Juan Cesar Garcia Institute as part of The Frontiers Prevention Project (FPP), a national Ecuadorian HIV/AIDS and STI prevention project. Female sex workers were surveyed in the cities of Quito, Guayaquil, Machala, Esmeraldas, Santo Domingo, Quevedo, Milagro, and Daule. The survey was a random sample from the universe of sex workers. The universe of sex workers in each city was mapped to develop the sample frame. Potential sites were identified through interviews with key informants (i.e. taxi drivers, police, sex workers, pimps, madams, bar owners, workers at nongovernmental

⁵Sex workers have been suggesting that this rule be changed so that brothel owners instead of sex workers have to pay the fine for unlicensed sex workers. However, at the time of the survey, the rule was that sex workers be fined.

⁶The police were not able to give us information on how many sex workers are fined per raid.

organizations, medical personnel, etc.). Every attempt was made to ensure that the survey was representative of the sex worker population. However, this type of mapping will obviously miss some informal situations such as the case in which a woman occasionally sells sex.

A multidisciplinary team, including local researchers, developed the survey questionnaire. The survey includes detailed sex worker characteristics and retrospective information about recent transactions. In order to minimize misreporting and collect the highest quality data, former sex workers were trained and hired to be the enumerators and the interviews took place at sex worker work places and meeting points. Members of high risk groups often feel more comfortable responding to sensitive issues with members of their own peer group (Ozer, Weinstein, Maslach, and Siegel, 1997). In fact, survey response rates were over 95 percent.

Table 1 provides a description of sex workers from the street and brothel sectors in Ecuador. The sample sizes are 1629 licensed brothel workers, 666 unlicensed brothel workers, and 619 street sex workers. Licensed brothel sex workers earn slightly more per hour than unlicensed brothel sex workers (5.51 dollars vs. 5.19 dollars) and significantly more than street sex workers who earn 4.14 dollars per hour.⁷ In terms of client numbers, licensed brothel sex workers have more clients per week. They have 26 clients per week compared to 19 for unlicensed brothel and 13 for street sex workers. This implies that licensed sex workers perform significantly more sex acts per week and have substantially higher earnings.

A unique component of this survey was the collection of STI information. Urine and blood samples were collected from each sex worker that were tested for syphilis, chlamydia, gonorrhea, and HSV. We measure current STI as a positive test outcome for syphilis, chlamydia, and/or gonorrhea. These infections can be treated and cured by antibiotics. While this variable is measured very precisely, it is a measure of infection of only three of many types of STIs at a moment in time. Therefore, we also use the sex worker self-report of ever having one of the following STI symptoms: genital warts, ulcers, anal inflammation, abnormal vaginal discharge, pain or blood while urinating, and/or genital swelling. The measure, though a self-report, captures many more STIs over a longer time horizon. While the biological STI measure is more specific, it is less sensitive. In contrast, while lifetime the STI status is a less specific measure, it is much more sensitive and comprehensive. The two measures together provide a nice overview of infection rates in this market

⁷Ecuador's national currency has been the US dollar since 2000. For a comparison of sex worker and non-sex worker socio-demographics and earnings, see (Arunachalam and Shah, 2008).

In terms of current STI prevalence, 7 percent of sex workers with a license tested positive for syphilis, chlamydia, and/or gonorrhea compared to 9 percent in the street sector. Therefore, even sex workers who have a license can get STIs between testing periods (since they only get STI tests every 4-6 months) and condom use is not 100 percent. Fifty-one percent of sex workers in the brothel sector reported ever having an STI symptom, compared to 55 percent in the street. The higher infection rates on the street are consistent with condom use patterns. Eighty-nine percent of licensed sex workers used condoms in all of their last three transactions compared to 78 percent of unlicensed brothel sex workers and 63 percent in the street sector. These results suggest that street sex workers seem to engage in riskier behavior as they use condoms less often and have higher STI rates.

Sex workers in the brothel sector have an average of one more year of education and tend to be younger. In terms of demographics such as children and marital status, women in the street and brothel sectors appear to be fairly similar. At the end of each interview, the interviewers rate the sex workers personal characteristics such as their beauty and communication abilities. The beauty scores indicate that brothel sex workers are more attractive than street sex workers.

Client characteristics as reported by sex workers are also summarized in Table 1. Sex workers from the street sector report a higher percentage of regular clients relative to sex workers in the brothel sectors. Clients who frequent the brothel sector tend to be slightly richer and more handsome than street clients. Interestingly, sex worker perceptions of clients across sectors are fairly similar in terms of client cleanliness.

In each city, police officers were interviewed about the frequency of visits to the brothel and street sector to verify that sex workers were fulfilling their licensing requirements. The summary statistics of city enforcement levels, the explanatory variable of interest, are reported in Table 2. The values in Table 2 are the mean visits per month by the police to each sector. On average, police conduct 0.2 raids per month in the street sector and 1.3 raids per month in the brothel sector. In almost every city, police report that they visit the brothel sector more often than the street sector.

3 Reduced Form Effect of Regulation on STIs

In this section we investigate whether the enforcement of health regulation affects STI rates measured by whether a sex worker currently tests positive for one of the three STIs and whether the

sex workers reports ever having had STI symptoms. To do so, we regress these measures against the level of enforcement (number of raids per month) in the brothel and enforcement in the street plus various sets of controls. Since both of the dependent variables are dichotomous, we estimate probit regressions. We cluster all standard errors at the city sector level and report marginal effects. We include sex worker, city, and client characteristics as additional controls. The sex worker characteristics include a measure of risk preference and risk knowledge, age, marital status, children, education, and beauty. The city level characteristics that control for potential geographic heterogeneity are the male to female sex ratio and average male education. The client characteristics include indicators for whether the client is regular, clean, handsome, and/or rich.

3.1 Results

The results from these regressions are reported in Table 3. In column 1 of Table 3, we find that increasing enforcement in the street sector by .2 visits (which is one standard deviation) per month significantly reduces current infection rates by approximately 1.7 percentage points. This translates to a 21 percent decrease in current STIs. However, enforcement in the brothel sector does not significantly affect current STI outcomes. The results in column 1 also indicate that more educated and attractive sex workers are less likely to have an STI. This result may be due to bargaining power as more attractive and educated sex workers are more likely to be able to negotiate condom use and/or better work conditions for themselves. While individual client characteristics are included as controls for demand side heterogeneity, none are significantly different from zero.

In column 2 of Table 3 we regress whether a sex worker self-reports ever having an STI on the same set of covariates. We find that increasing enforcement in the street sector by .2 visits (one standard deviation) per month, significantly reduces the probability of a sex worker ever having an STI by 6 percentage points. This is approximately a 12 percent decrease in lifetime disease and is consistent with the results from column 1. Surprisingly, increasing enforcement in the brothel sector significantly increases the probability that a sex worker will have an STI by 5 percentage points, which translates into a 10 percent increase. This result suggests that increasing brothel enforcement may actually exacerbate public health outcomes.

3.2 Causality

Any unobserved sex worker or client characteristics correlated with levels of enforcement would bias our results. For example, if enforcement responds to conditions in the city such as high disease rates or moral attitudes against commercial sex, then our estimates of the effect of enforcement on STI outcomes would be biased.

Can we interpret the above results as evidence that an increase in enforcement on the street causes a reduction in sex worker STI? A major concern with this interpretation is that enforcement may be correlated with unobservable city, sex worker, or client characteristics that are determinants of the probability of a sex worker having an STI. Enforcement of health licensing has the potential to bias the estimation results in two important ways. First, governments could select enforcement levels based on population characteristics that are correlated with STI rates. For example, police might enforce more in richer cities with higher prices for sex and have lower STI rates to extract higher fines. They might also enforce more in areas where sex workers are more likely to take risks and thus have higher disease prevalence. Secondly, sex workers could migrate to cities with lower (or higher) levels of enforcement based on individual risk preferences. This would result in selection problems that would bias the estimates.

How are enforcement levels determined? Local governments have jurisdiction over enforcement of the licensing requirement. We conducted numerous in-depth interviews with police, health officials, sex workers and establishment owners in order to gain a better understanding of how local enforcement levels in each city are determined. In these interviews, the police and Ministry of Health officials stated that enforcement is simply a result of overall decisions made by the local police in each city. In one interview, a doctor at the Ministry of Health in Quito says “The Ministry of Health does not have the capacity, funding or legal mandate to go out and enforce licensing requirements. That is up to the local police. However, the police are not terribly motivated by health concerns and enforce whenever they feel like it, depending on who the current police director is” (Tamayo, 2004). While this situation is obviously not ideal for those motivated by health concerns, it does imply that local police enforcement decisions are not being driven by disease.

In interviews with local police, we asked them to report the number of hours spent enforcing various types of regulation such as food hygiene rules, panhandling laws, and the sex worker license as we wanted to gain an understanding of police priorities when enforcing various similar laws.

Figure 1 illustrates the results of these interviews. It appears that cities that spend more hours enforcing the sex worker license also tend to spend more hours enforcing all other regulations as well. Different cities have different attitudes toward overall governance and enforcement of regulation.

Certain types of governments are more active and have a tendency to enforce all types of regulation more. In Ecuador, the cities that enforce the sex worker license more (and all other regulations), tend to be led by left-leaning parties who believe in more active government involvement. Cities that enforce less tend to be led by right-leaning parties. Interestingly, these right-leaning cities are also cities where police report a higher share of church attendance. This implies we can rule out the possibility that police are enforcing primarily for reasons related to morality or church leaders' condemnation of sex work, since police who attend church more work in cities that enforce less.

The qualitative evidence suggests that police are not enforcing because of high rates of disease or moral sentiments regarding commercial sex. It seems that cities with higher enforcement have more active enforcement of all types of regulation and tend to be led by more left-leaning parties. This suggests that city enforcement levels are not likely to be correlated with unobservable sex worker or client characteristics.

Do police enforce more in areas where sex workers take more risks? This would result in biased estimates due to systematic correlation of enforcement decisions and sex worker risk preferences. In Table 5, column (1) we check whether enforcement is correlated with sex worker risk preferences. We use a measure of sex worker risk preferences as our dependent variable that we label "doesn't like risks."⁸ As the regression results indicate, enforcement has no significant effect on sex worker risk preferences. Therefore, we can conclude that local enforcement decisions are not driving sex worker risk preferences or responding to local disease rates.

One might expect enforcement to be greater in richer cities as local police could extract higher fines in richer cities. To investigate the relationship between enforcement and income levels, average non-sex worker earnings⁹ are compared to brothel and street enforcement levels by city. We construct a scatter plot with enforcement on the vertical axis and earnings on the horizontal axis.

⁸In the questionnaire we asked sex workers how important it is they not get infected with HIV. Those who responded that it is very important they not get infected with HIV are coded as a "1." All other responses are coded as "0."

⁹We use the 2003 National Employment Survey, the ENEMDU, (Encuesta de Empleo, Desempleo y Subempleo) to generate city level earnings data. This is data collected by the National Census and Statistics Institute (INEC) in Ecuador.

We fit predicted values to the scatter to check for trends in the data. The results of this exercise are given in Figure 2. As the figure indicates, there is no significant relationship between average city level earnings and enforcement.

Another concern may be that sex workers migrate to cities with lower (or higher) levels of enforcement based on personal risk preferences. If this were the case, then selection problems would bias the results. In Table 5, column (2) we test whether enforcement is driving the decision to migrate. We construct a variable that defines a sex worker as a migrant if she migrated within the past five years. Since city level elections occur every four years and the police director is usually re-appointed at that time, enforcement in the past 5 years is the relevant period for testing whether enforcement is driving the decision to migrate. The results indicate that there is no significant relationship between enforcement in either the brothel or street sector and the decision to migrate. These regression results reinforce findings from qualitative work. In focus groups, most sex workers respond they are most likely to migrate for financial opportunities, not because of enforcement of the license. In addition, because the license is enforced at the city level, it is non-transferable by law across cities. Sex workers who are already licensed find it difficult to migrate for work as the fixed cost of obtaining another license is quite high.

The evidence presented in Section 3.2 does not support any claim that cities are enforcing based on infection rates or risk preferences of sex workers or clients. In addition, enforcement is not significantly correlated with the individual decision to migrate. While it appears that the reduced form results in Table 3 are robust to systematic correlation between enforcement levels and unobservable city, client or sex worker characteristics, it is ultimately impossible to rule out the possibility of endogeneity. If for example we are still concerned that more disease results in more enforcement, then our results from Table 3 might be lower bounds, since we have found that more enforcement results in less disease.

4 Conceptual Framework

In this section, we discuss the pathways through which regulatory enforcement could affect the extent to which a sex worker is exposed to risk of infection. To do so, we lay out the elements of a behavioral model. Sex workers have to make a number of choices including (i) work location, either street or brothel sector, (2) whether to obtain the carnet, and (3) what prices to charge

for protected and unprotected sex. Prices affect the demand for her services and the number of unprotected transactions determines risk exposure. Increased enforcement is likely to affect all three decisions and consequently the degree to which she is exposed to an STI including the HIV virus.

Let's consider the work location and carnet compliance choices together. The sex worker compares her maximum returns working in a brothel with a carnet to working in a brothel without a carnet to working on the street and chooses the one with the highest return. As we discuss below, the costs of the carnet and enforcement of the carnet as well enforcement of the street enter the payoff functions as fixed costs.

Consistent with the descriptive statistics, the brothel sector is a less risky place to work due higher rates of condom use and lower STI prevalence. Clients of brothels are wealthier and willing to pay more for certain types of sex workers (i.e. younger and more attractive) than are clients on the street. The street sector on the other hand is a much more risky place to work as clients more frequently demand unprotected sex resulting in lower condom use and higher STI prevalence among sex workers.

First, if a sex worker chooses to work in a brothel, she is expected to have a carnet. In order to get a carnet, she must pay the costs of the STI/HIV tests, which are substantial in terms of time and money. Since testing is required every two weeks, the costs of the carnet must be continuously paid over time. Her payoff function, then, is the net revenue from selling protected and unprotected sex less the fixed cost of maintaining the carnet.

If the sex worker chooses to work in the brothel without a carnet, then she is subject to the possibility of being caught in a police raid. In this case, she would be fined. The expected fixed cost of being caught is the probability of being caught in a raid times the fine if caught. In this case, the return to working in a brothel without a carnet is the net revenues from supplying protected and unprotected sex less the expected fixed cost of being caught. Increased enforcement raises the fixed costs of being caught.

Analogously, if the sex worker chooses to work on the street she faces some probability of being caught in a police raid and having to pay a fine, which could take the form of a monetary payment, a payment in kind (e.g. sexual favors) and/or incarceration. The return to working on the street is the net revenues from supplying protected and unprotected sex less the expected fixed cost of

being caught. Increased enforcement raises the fixed costs of being caught.

The decision whether to work in the brothel or on the street is purely one of comparing the maximum returns in each setting and choosing the larger. Increased enforcement on the street raises the fixed costs and makes working on the street less attractive relative to working in a brothel. Hence increased enforcement on the street should cause sex workers to shift from the more risky street to the less risky brothel sector. Since there is less unprotected sex in the brothel sector, the effect should be to reduce infection rates.

The effect of increased enforcement of the carnet in the brothel sector is less obvious. The increase in enforcement raises the fixed costs of working in a brothel without a carnet and lowers the returns relative to working in a brothel with a carnet and relative to working on the street. This will cause some sex workers to obtain the carnet and continue to work in the brothel, but it will cause others to leave the brothel altogether for the street. Since the street is more risky, the effect could be to raise infection rates if enough sex workers choose the street as opposed to complying with carnet regulations.

Up to now we have argued that an increase in enforcement raises fixed costs, but it could also cause an increase in prices which lowers the demand for sex, both protected and unprotected. How might this work? Let's start with sex workers on the street. Increased enforcement raises the fixed costs to a worker. She assesses whether fixed costs still make it worthwhile to work on the street compared with working in a brothel either complying or not and chooses the option that gives her the maximum utility. An increase in fixed costs causes some sex workers to leave the street for the brothel. If the street and brothel markets are either separate markets or at least not close substitutes then sex workers leaving the street for the brothel constitutes a reduction in the supply of sex workers on the street. The reduction in the supply of sex workers could cause an increase in the price and a reduction in the equilibrium number of sexual transactions both protected and unprotected.

There are reasons to believe the brothel sex workers and street sex workers are not close substitutes. First, the characteristics of clients using street workers are different; they are poorer compared to clients who frequent brothels (Table 1). Second, the sex workers tend to be older, less educated, and less attractive than brothel sex workers (Table 1). Third, the transactions costs to the client in terms of time, money and fear of embarrassment from being recognized increase with

the number of locations that one searches.

In the case of brothel sex workers not complying with the carnet law, increased fixed costs from enforcement may cause them to switch to the street or stay in the brothel complying with the carnet law. In the first case where sex workers leave for street, the enforcement would lower the supply of sex workers and therefore could raise prices. However, in the second case where non-complying sex workers stay in the brothel but obtain the carnet, the supply of sex workers does not change. Indeed, clients and sex workers report that no one asks to see the carnet in the brothel and therefore having a carnet does not affect the demand for a particular sex worker. In this case, increased enforcement would not cause an increase in prices. The empirical work confirms that increased enforcement does not really cause sex workers to leave the brothel and therefore should not affect prices.

Another reason that we might expect an increase in price is the nature of search and asymmetric information in the market. Until now we have assumed perfect information. However, one could model the equilibrium in terms of a standard search model with asymmetric information. Suppose clients do not have perfect price and quality information about the available providers. Rather, they must search for an acceptable offer. A client goes to a location (possibly a physical location, a phone number or web site) and identifies a potential sex work provider based on physical characteristics. The client obtains information about prices, services and sex worker characteristics that may affect the value of transaction such as more physical attributes or personality attributes. If interested, the client then solicits (or makes) an offer. And, after some negotiation, the client either accepts the deal or moves on.

The decision to accept or reject and search again depends on whether the client thinks that trying again would likely yield an option better than the one in hand. Increased enforcement affects the distribution of prices. An increase in enforcement that raises fixed costs makes working on the street no longer profitable or worthwhile for low-priced sex workers. In this case, the expected price from searching again increases and will increase the probability that a client will accept the offer and not take another draw. However, if sex workers know this, then they will raise the initial price offered to clients thereby raising transaction prices and lowering the number of transactions both protected and unprotected.¹⁰ In the next two sections we test the predictions from our conceptual

¹⁰One concern is that sex workers sort based on their illness status. This might be the case if STI status was permanent like HIV status, but since these STIs are temporary and can be treated, we don't believe women are

framework. We first estimate whether enforcement affects the sectoral choice decision of sex workers as predicted by theory. We then test whether increased enforcement affects transaction prices and the number of clients.

4.1 Sectoral choice estimation

In this section we test the hypotheses that increased enforcement on the street causes sex workers to move off the street into the brothels and the hypothesis that increased enforcement in brothels causes sex workers to either comply with the licensure requirement and stay in the brothel or move to the street. We test these hypotheses by estimating a multinomial probit (MNP) model of sectoral choice.

We assume that sex workers choose the sector that has the highest expected return and that there are no barriers to entry. We specify the returns to sex worker i living in community j from working in the licensed brothel sector, the unlicensed brothel sector, and on the street are as follows:

$$U_{ijb} = R_{ijb} - C + \varepsilon_{ib}$$

$$U_{iju} = R_{iju} - \lambda_u E_{ju} + \varepsilon_{iu}$$

$$U_{ijs} = R_{ijs} - \lambda_s E_{js} + \varepsilon_{is}$$

where:

U_{ijp} = return to sex worker i living in community j from working in sector p , where $p \in \{b, u, s\}$,

R_{ip} = expected net revenues sex worker i living in community j earns from working in sector p ,

C = cost of complying with the license regulation and does not vary across community,

E_{jp} = number of enforcement visits per month in community j in sector p ,

λ_p = the probability that a sex worker is caught in a raid times the amount she is fined if caught during a police raid in sector p , and

ε_{ip} is an individual random error term that captures individual sector preferences (e.g. risk) and is normally distributed.

While we do not know the expected net revenues that each sex worker would realize from each of the three sectors, we can parameterize the net revenues as a function of sex worker characteristics,

 sorting based on STI status.

client characteristics and community characteristics as follows:

$$R_{ijp} = \alpha_p + \sum_l B_{lp} X_{il} + \sum_m \delta_{mp} S_{mj} + \tau_{ijp}$$

where the X_{il} are sex worker i 's characteristics and the S_{mj} are client characteristics who frequent sector p in community j , and τ_{ijp} is an individual error term. Note that the net return functions have coefficients that vary by sector. All other potential costs are subsumed in the alternative specific intercept.

The probability of sex worker i choosing the street is:

$$\Pi_{is} = \text{Prob}(U_{ijs} > U_{ijb} \quad \text{and} \quad U_{ijs} > U_{iju})$$

and the probabilities of sex worker i choosing the licensed and unlicensed sectors similarly defined. Then assuming that the error terms $\eta_{ip} = \varepsilon_{ip} + \tau_{ip}$ are distributed multivariate normal, we can estimate the probability of choosing each sector as a multinomial probit (MNP). In all choice models, only the coefficients of $n - 1$ options are identified. Therefore, we set the licensed brothel as the default option and the estimated coefficients are interpreted as the effect of choosing sector p over the default option.

The MNP allows us to simultaneously estimate how individual and community characteristics affect the sectoral decision without assuming that the errors are identically and independently distributed (Hausman and Wise, 1978). The MNP model is very flexible in that it allows for errors to be correlated across choices. For example, the error terms between the choice of brothel licensed and brothel unlicensed may be correlated. This does not impose any restrictions on the cross-partial effects of enforcement i.e. the effect of increased enforcement in the unlicensed sector on the probability of switching to the licensed brothel versus street sectors. This is in contrast to the multinomial logit and conditional logit models that do not allow for correlation between the error terms. This assumption is known as the independence of irrelevant alternatives and restricts the cross-partial effects to be proportional to the baseline choice probabilities (Hausman and Wise, 1978).

Table 6 reports the results from the sectoral choice multinomial probit. We find that enforcement is a strong predictor of the sectoral choice decision. In both the street and the unlicensed brothel sector, increasing enforcement reduces the probability of sex workers choosing these sectors. These empirical results are consistent with the predictions from the model and are significant at the .05

and .01 percent level. We find that a one standard deviation increase in enforcement per month in the street sector decreases the probability of sex workers choosing this sector by 6 percent, relative to the licensed brothel sector. While the coefficient on unlicensed brothel enforcement is negative, when we attempt the same transformation to generate the marginal effect, its value is close to zero.

The results on the individual characteristics are sensible. We find that better educated sex workers who have more knowledge about risk and who do not like to take risks are more likely to choose the licensed brothel sector relative to working either on the street or in a brothel without a license. In addition, older sex workers are more likely to choose the street sector and are less likely to work in a brothel without a license.

We include several client characteristics in the multinomial probit to control for potential demand-side client heterogeneity as client characteristics will be important in determining the prices paid. Regular clients increase the probability of the street sector being chosen and decrease the probability that the unlicensed brothel sector is chosen.

To better understand how increasing enforcement affects sectoral choice, we simulate changes in enforcement in each sector to see how the proportion of sex workers in each sector changes. The results of this exercise for the street sector are shown graphically in Figure 3. Increasing street enforcement from 0 to .2 police visits per month (one standard deviation) results in a 5 percent decrease in sex workers choosing the street sector. Increasing this amount to .6 visits per month (3 standard deviations) results in a 16 percent decrease in sex workers choosing the street. The majority of these sex workers shift to the unlicensed brothel sector and only a few shift to the licensed brothel sector. This is a substantial decrease in the share of women choosing the street sector, which should have positive implications for infection rates. By shifting women out of the high risk (high infection rate and low condom use) street sector into the lower risk brothel sector, increased street enforcement lowers overall STI rates should decrease. This corresponds exactly to the predictions of the model and the reduced form regression results in Table 3.

We conduct the same experiment for the unlicensed brothel sector and the results are illustrated graphically in Figure 4. At 1.7 brothel visits per month (1sd), 22.5 percent of women are in the unlicensed brothel sector, compared to 56 percent in the licensed brothel sector and 21.5 percent in the street sector. From 0 to 1.7 police visits per month in the brothel sector, there is a 4 percent decrease in sex workers choosing the unlicensed brothel sector. Increasing enforcement from 0 to 5.1

visits per month (3sd), there is a 15 percent decrease in sex workers choosing the unlicensed brothel sector. In theory this could be great for public health outcomes if these sex workers were shifting to the licensed brothel sector. However, Figure 4 indicates that the majority of these women are shifting to the street sector. This implies that increasing enforcement in the brothel sector could actually be shifting women to the riskier sector where disease rates are higher and condom use lower. These results explain the reduced form estimates in Table 3 which report that increasing enforcement in the brothel sector is significantly associated with higher ever STI rates.

5 Effect of Enforcement on Price and Quantity

In this section we test the prediction that increased enforcement raises prices and lowers the number of clients. We estimate regression models for the $\ln(\text{price})$ ¹¹ and number of clients last week separately for those working in the street sector and those working in the unlicensed brothel sector as a function of enforcement in the sector, sex worker characteristics, client characteristics and community characteristics. These regressions include the same set of controls as the STI reduced form estimates in Table 3 and the multinomial probit estimates in Table 6.

One concern with these models is that sex workers self-select into the sector and part of the reason the sex worker chooses that sector maybe correlated with unobservable characteristics that affect price and quantity. For example, risk taking sex workers may select into the street sector and charge lower prices.

We employ Heckman selection models to control for the sectoral choice decision and then estimate the effect of enforcement on the variable of interest. We use enforcement in the other sector as the exclusion restriction to predict the first stage sectoral choice decision. Specifically, enforcement in the street sector predicts entry into the unlicensed brothel sector but does not otherwise directly influence prices and quantities in the unlicensed brothel sector. Similarly, enforcement in unlicensed brothel sector affects entry into the street, but does not otherwise directly affect the price or quantity on the street. So enforcement in both sectors will influence the initial sectoral choice decision, but once a sex worker makes that decision and chooses a sector, only enforcement in her sector will affect the outcomes of interest such as price and the number of clients.

Tables 7 displays the second stage results of these regressions for the street and unlicensed

¹¹We generate “ $\ln(\text{price})$ ” as sex worker earnings last week divided by the total number of clients last week.

brothel sector, respectively.¹² The first two columns report the results for the unlicensed brothel sector where the dependent variable is $\ln(\text{price})$ in column (1) and the number of clients last week in column (2). We find no significant effect of enforcement on either price or quantity. The street sector estimation results in columns (3) and (4) confirm the predictions of the theoretical model. Street sector prices do significantly increase with enforcement and reduce the number of clients. Specifically, a one standard deviation increase in enforcement leads to a 12 percent increase in prices and a 23 percent reduction in the number clients on the street. These results are consistent with the reduced form results where street enforcement is negatively correlated with the STI rate, but brothel enforcement and STI rates are uncorrelated.

The results also suggest that more educated sex workers charge higher prices and have more clients per week. Not surprisingly, richer clients pay higher prices. Interestingly, none of the Mills ratios are significant; suggesting that selection on unobservables may not be a problem.

6 Conclusions

Increasing the use of condoms by sex workers is a priority for countries working to prevent the spread of HIV and other STIs. A number of countries believe that regulating the sex market will improve overall public health outcomes through increased condom use and lower disease. However, these claims were relatively unsubstantiated prior to this work. This paper offers both empirical and theoretical insights into the regulation of sex work. Specifically, we examine how increased police raids to enforce no solicitation rules on the street and enforce licensure laws in the brothels affect the transmission of STIs.

We find that additional police raids in the street are most effective in reducing disease. Specifically, we find that a one standard deviation increase in raids is associated with a 21 percent reduction in current syphilis, chlamydia, and/or gonorrhea and a 12 percent reduction in the probability of ever having an STI. These results are consistent with the hypothesis that enforcement increases the fixed cost of working in the street relative to the less risky brothel and by raising prices. Specifically, results indicate that increasing enforcement in the street sector significantly shifts sex workers from the risky street into the less risky brothels. In addition, enforcement increases street prices, reducing the overall number of street clients both protected and unprotected.

¹²The results from the estimation of the first stage selection equation are given in Table 8 in the Appendix.

Therefore, both the price and sectoral choice effect in the street sector unambiguously improves public health outcomes.

We also show that increasing enforcement in the brothel sector seems to exacerbate public health problems as it induces unlicensed sex workers working in brothels into the riskier street sector. Specifically, we find that increasing enforcement by one standard deviation in the brothel sector is significantly associated with a 10 percent higher probability of ever being infected with any STI.

Table 1 indicates that the street sector has the highest disease rate and the lowest levels of condom use. This implies that how sex workers shift sectors as a function of enforcement has serious implications for disease. These results indicate that the potential for public health gains from increasing enforcement in the street sector is tremendous. In terms of policy implications, increasing enforcement in the street has a much larger impact in decreasing disease than increasing brothel enforcement. In addition, only small increases in street enforcement are needed to improve health outcomes. For enforcement in the brothel sector to work, it needs to be complemented with strong enforcement in the street. This implies that more cost-effective interventions should target both the street and brothel sector, especially since increasing enforcement only in the brothel sector without commensurate enforcement on the street has the potential to exacerbate public health problems.

References

- ARUNACHALAM, R., AND M. SHAH (2008): "Prostitutes and Brides?," *American Economic Review: Papers & Proceedings*, 98(2), 516–522.
- BECKER, G. (1968): "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, 76, 169–172.
- CENTERS FOR DISEASE CONTROL & PREVENTION (2004): "Global AIDS Program: Strategies," <http://www.cdc.gov/nchstp/od/gap/strategies>.
- CHIRIBOFA, M., A. ALABA, G. ALMEIDA, M. E. ACOSTA, AND L. OROZCO (2001): "Estudios de seroprevalencia," Discussion paper, Ecuador Ministry of Health.
- CORMAN, H., AND N. H. MOCI (2000): "A Time- Series Analysis of Crime, Deterrence, and Drug Abuse in New York City," *American Economic Review*, 90(3), 584–604.
- DI TELLA, R., AND E. SCHARGRODSKY (2004): "Do Police Reduce Crime? Estimates Using the Allocation of Police Forces After a Terrorist Attack," *American Economic Review*, 94(1), 115–133.
- FARRELLY, M., J. BRAY, G. ZARKIN, AND B. WENDLING (2001): "The Joint Demand for Cigarettes and Marijuana: Evidence from the National Household Surveys on Drug Abuse," *Journal of Health Economics*, 20(1), 51–68.
- GERTLER, P., M. SHAH, AND S. BERTOZZI (2005): "Risky Business: The Market for Unprotected Commercial Sex," *Journal of Political Economy*, 113(3), 518–550.
- HAUSMAN, J. A., AND D. A. WISE (1978): "A Conditional Probit Model of Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preferences," *Econometrica*, 46(2), 403–426.
- IJCG/INSP (2003): *Frontier Prevention Project* Quito, Ecuador.
- JORDAN, J. (2005): "The Sex Industry in New Zealand: A Literature Review," Discussion paper, Ministry of Justice, New Zealand.

- KOHN, S. A., AND J. SELWOOD (2004): "Sex Work and City Planning: Winnipeg's Red Light District Committee and the Regulation of Prostitution," Institute of Urban Studies Research and Working Paper.
- LEVITT, S. D. (1997): "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review*, 87(3), 270–90.
- OSTER, E. (2005): "Sexually Transmitted Infection, Sexual Behavior and the HIV/AIDS Epidemic," *The Quarterly Journal of Economics*, 120(2), 467–515.
- OZER, E. J., R. S. WEINSTEIN, C. MASLACH, AND D. SIEGEL (1997): "Adolescent AIDS Prevention in Context: The Impact of Peer Educator Qualities and Classroom Environments on Intervention Efficacy," *American Journal of Community Psychology*, 25(3), 289 – 323.
- PLATT, L. (2001): "Regulating the Global Brothel," *The American Prospect*, (12).
- RAO, V., I. GUPTA, M. LOKSHIN, AND S. JANA (2003): "Sex Workers and The Cost of Safe Sex: The Compensating Differential for Condom Use in Calcutta," *Journal of Development Economics*, 71(2), 585–603.
- ROBINSON, J., AND E. YEH (2008): "Transactional Sex as a Response to Risk in Western Kenya," Working Paper.
- TAMAYO, S. (2004): "Director of Sanitary Control Clinic for Sex Workers," personal conversation.
- UNAIDS (2002): *Report on the Global HIV/AIDS Epidemic*. UNAIDS:Geneva.
- (2004): *Report on the Global HIV/AIDS Epidemic*. UNAIDS:Geneva.
- WORLD BANK (1999): *Confronting AIDS: Public Priorities in a Global Epidemic*. Oxford University Press.

Table 1: Sex Worker Summary Statistics

	Brothel	Brothel Licensed	Brothel Unlicensed	Street	Difference
Hourly earnings(\$)	5.43 (9.21)	5.51 (9.16)	5.19 (9.35)	4.14 (7.88)	1.29**
Price per transaction (\$)	7.06 (12.0)	7.06 (14.04)	7.04 (9.18)	8.44 (20.9)	1.38*
Clients per week	24.0 (30.2)	26.3 (30.6)	18.7 (28.6)	13.1 (19.7)	10.9***
STI(=1)	.08 (0.26)	0.07 (0.26)	0.08 (0.27)	0.09 (0.28)	0.01
Ever STI(=1)	0.51 (0.50)	0.51 (0.50)	0.51 (0.50)	0.55 (0.50)	0.04*
Condom always used(=1)	0.86 (0.35)	0.89 (0.31)	0.78 (0.42)	0.63 (0.49)	-0.23***
Doesn't like risk(=1)	0.96 (0.22)	0.97 (0.18)	0.94 (0.23)	0.91 (0.28)	-0.05***
Risk knowledge(=1)	0.72 (0.46)	0.74 (0.44)	0.66 (0.47)	0.61 (0.49)	-0.11***
Experience(years)	3.66 (4.19)	3.92 (4.17)	3.02 (4.20)	6.45 (6.82)	2.79***
Age(years)	26.9 (7.09)	27.4 (7.03)	25.9 (7.14)	31.5 (9.91)	4.6***
Education(years)	7.7 (3.3)	7.8 (3.27)	7.49 (3.34)	6.49 (3.64)	-1.21***
Married/Civil union(=1)	0.47 (0.49)	0.49 (0.5)	0.44 (0.5)	0.49 (0.5)	0.02
Children(=1)	.85 (0.36)	0.85 (0.36)	0.85 (0.36)	0.90 (0.30)	0.05***
Attractive sex worker(=1)	0.31 (0.46)	0.32 (0.47)	0.29 (0.46)	0.16 (0.37)	-0.15***
Regular client(=1)	0.46 (0.41)	0.48 (0.42)	0.41 (0.41)	0.62 (0.40)	0.16***
Clean client(=1)	0.88 (0.26)	0.89 (0.32)	0.87 (0.34)	0.89 (0.25)	0.01
Handsome client(=1)	0.13 (0.22)	0.12 (0.32)	0.15 (0.36)	0.10 (0.30)	-0.03**
Rich client(=1)	0.08 (0.21)	0.08 (0.27)	0.08 (0.28)	0.06 (0.24)	-0.02**
Sample Size	2295	1629	666	619	

Standard deviations are reported in parentheses. The variable "STI" includes sex workers who tested positive for chlamydia, gonorrhea, and/or syphilis. The variable "Ever STI" is a self-report of STI status. ***indicates difference between street and brothel sector is statistically significant at 1% level, ** at 5% level, * at 10% level.

Table 2: Enforcement: Police Visits (per month)

City	Enforcement, Brothel	Enforcement, Street	SW Sample Size
	(per month)	(per month)	
	Mean	Mean	
Machala	4.0	0.507	453
Quito	3.68	0.13	413
Milagro	0.4	0.4	294
Quevedo	0.4	0.38	414
Esmeraldas	0.2	0.05	300
Guayaquil	0.088	0.012	416
Daule	0.034	0.018	279
Santo Domingo	0.034	.034	345
All cities	1.28	0.203	2914
(std. dev)	(1.68)	(.194)	

Table 3: “STI Positive” Probit

Dependent variable:	Has STI	Ever STI
	(1)	(2)
Enforcement brothel	-0.00 (0.01)	0.05 (0.01)***
Enforcement street	-0.09 (0.04)**	-0.30 (0.06)***
Risk knowledge	0.01 (0.01)	0.02 (0.02)
Doesn't like risk	-0.02 (0.02)	0.05 (0.04)
Age	-0.00 (0.00)	-0.00 (0.00)
Children	0.03 (0.01)**	-0.01 (0.03)
Married/Civil union	0.00 (0.01)	0.03 (0.02)**
Education	-0.00 (0.00)*	-0.01 (0.00)*
Attractive	-0.02 (0.01)**	0.00 (0.02)
Sexratio	0.01 (0.00)***	-0.03 (0.01)***
Male education	0.02 (0.17)	-1.53 (0.34)***
Regular client	-0.01 (0.02)	-0.03 (0.02)
Clean client	0.01 (0.01)	-0.06 (0.04)
Handsome client	-0.00 (0.03)	-0.00 (0.04)
Rich client	0.00 (0.02)	0.06 (0.05)
Clustered	Y	Y
χ^2	119.2	274.8
Sample size	2914	2914

The reported coefficients are marginal effects from probit regressions where the dependent variable is the biological outcome of “has an STI(=1)” in column 1 and the self-report of “ever had an STI(=1)” in column 2.

*** indicates significance at 1% level, ** at 5% level, * at 10% level.

Table 4: Sex Worker Enforcement Validity Checks

Dependent variable:	Doesn't like	SW
	Risks (1)	Migrated (2)
Enforcement brothel	0.01 (0.01)	-0.01 (0.01)
Enforcement street	-0.05 (0.03)	0.04 (0.09)
Risk knowledge	0.07 (0.01)***	0.03 (0.02)*
Age	-0.00 (0.00)	-0.00 (0.00)*
Children	0.01 (0.01)	0.01 (0.01)
Married/Civil union	-0.01 (0.01)	-0.01 (0.02)
Education	0.01 (0.00)***	0.00 (0.00)**
Attractive	0.01 (0.01)*	0.02 (0.01)
Sex ratio	0.00 (0.00)*	0.01 (0.01)
Male education	0.03 (0.12)	-0.06 (0.40)
Regular client	0.01 (0.01)	0.02 (0.02)
Clean client	0.03 (0.01)***	0.02 (0.01)
Handsome client	-0.01 (0.01)	-0.03 (0.03)
Rich client	0.03 (0.02)	-0.01 (0.02)
Clustered	Y	Y
χ^2	251.1	160.7
Sample Size	2914	2914

The reported coefficients are marginal effects from probit regressions.

*** indicates significance at 1% level, ** at 5% level, * at 10% level.

Table 5: Sex Worker Enforcement Validity Checks

Dependent variable:	Doesn't like Risk			SW Migrated		
	All (1)	Unlicensed (2)	Licensed (3)	All (4)	Unlicensed (5)	Licensed (6)
Enforcement brothel	0.01 (0.01)	0.01 (0.01)*	-0.00 (0.00)	-0.01 (0.01)	0.00 (0.01)	-0.03 (0.02)
Enforcement street	-0.05 (0.03)	-0.12 (0.04)***	0.01 (0.01)*	0.04 (0.09)	0.02 (0.06)	0.09 (0.12)
Risk knowledge	0.07 (0.01)***	0.09 (0.02)***	0.04 (0.01)***	0.03 (0.02)*	0.00 (0.01)	0.04 (0.03)
Age	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)*	-0.00 (0.00)	-0.00 (0.00)***
Children	0.01 (0.01)	0.00 (0.02)	0.01 (0.00)	0.01 (0.01)	-0.01 (0.02)	0.02 (0.02)
Married/Civil union	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.02)	0.02 (0.02)	-0.04 (0.02)
Education	0.01 (0.00)***	0.00 (0.00)***	0.00 (0.00)***	0.00 (0.00)**	0.00 (0.00)*	0.00 (0.00)
Attractive	0.01 (0.01)*	0.03 (0.02)	0.00 (0.01)	0.02 (0.01)	0.02 (0.02)	0.01 (0.02)
Sex ratio	0.00 (0.00)*	-0.00 (0.00)	0.00 (0.00)***	0.01 (0.01)	0.00 (0.01)	0.01 (0.01)
Male education	0.03 (0.12)	-0.25 (0.22)	0.22 (0.05)***	-0.06 (0.40)	-0.14 (0.30)	0.18 (0.59)
Regular client	0.01 (0.01)	0.01 (0.02)	0.01 (0.01)	0.02 (0.02)	0.01 (0.02)	0.03 (0.03)
Clean client	0.03 (0.01)***	0.06 (0.02)***	0.01 (0.01)	0.02 (0.01)	0.01 (0.02)	0.02 (0.02)
Handsome client	-0.01 (0.01)	-0.01 (0.03)	-0.01 (0.01)	-0.03 (0.03)	-0.01 (0.03)	-0.03 (0.05)
Rich client	0.03 (0.02)	0.05 (0.04)	0.02 (0.02)	-0.01 (0.02)	-0.01 (0.03)	-0.00 (0.03)
χ^2	251.1	97.6	77.1	160.7	14.15	53.7
Sample Size	2914	1285	1629	2914	1285	1629

The reported coefficients are marginal effects from probit regressions. All specifications are clustered at the city sector level.

*** indicates significance at 1% level, ** at 5% level, * at 10% level.

Table 6: Multinomial Probit Results		
Sector choice	Brothel	Street
	Unlicensed	
Enforcement brothel	-.13 (.06)**	–
Enforcement street	–	-1.17 (.38)***
Risk knowledge	-.27 (.1)***	-.29 (.14)**
Doesn't like risks	-.34 (.28)	-.48 (.25)*
Age	-.02 (.009)**	.03 (.008)***
Children	.13 (.15)	.06 (.26)
Married/Civil union	-.1 (.11)	.04 (.14)
Attractive	-.16 (.15)	-.1 (.17)
Education	-.02 (.01)*	-.05 (.03)*
Sex ratio	.15 (.05)***	.04 (.12)
Male Education	5.96 (1.94)***	12.56 (6.37)**
Rich client	.09 (.31)	.46 (.29)
Handsome client	.52 (.35)	-.19 (.32)
Clean client	-.12 (.13)	.05 (.25)
Regular client	-.26 (.13)**	.36 (.22)
Constant	-14.93 (4.82)***	-6.64 (13.25)
Clustered	Y	Y
χ^2	577.8	577.8
Sample Size	2914	2914

The reported coefficients are from a multinomial probit regression where the omitted sector is the licensed brothel sector.

*** indicates significance at 1% level, ** at 5% level, * at 10% level.

Table 7: Price, Clients Last Week and Enforcement

Dependent Variable:	Unlicensed Brothel		Street Sector	
	In Price	# Clients	In Price	# Clients
	last week	last week	last week	last week
	(1)	(2)	(3)	(4)
Enforcement Brothel	0.05 (0.04)	2.01 (1.43)	-	-
Enforcement Street	-	-	0.61 (0.25)**	-14.73 (6.33)**
Risk knowledge	-0.14 (0.08)*	7.64 (2.67)***	-0.09 (0.10)	7.24 (3.45)**
Doesn't like risks	-0.11 (0.16)	1.42 (5.25)	-0.04 (0.16)	6.54 (4.84)
Age	-0.00 (0.01)	-0.01 (0.35)	-0.02 (0.01)	-0.57 (0.34)*
Children	0.11 (0.10)	-8.87 (3.62)**	-0.14 (0.14)	0.73 (3.24)
Married/Civil union	-0.02 (0.07)	7.13 (2.44)***	-0.15 (0.08)**	2.66 (1.97)
Education	0.02 (0.01)**	0.26 (0.36)	0.04 (0.02)**	1.42 (0.64)**
Attractive	-0.02 (0.08)	3.16 (2.76)	-0.05 (0.12)	7.77 (3.49)**
Sex ratio	-0.06 (0.04)	-1.83 (1.49)	-0.01 (0.04)	2.89 (1.18)**
Male education	-1.51 (1.56)	-104.07 (57.05)*	-0.80 (0.96)	35.04 (24.73)
Regular client	-0.17 (0.13)	4.66 (4.51)	-0.15 (0.17)	-9.92 (6.05)
Clean client	-0.03 (0.13)	-3.10 (4.58)	0.05 (0.15)	-1.89 (4.13)
Handsome client	0.12 (0.21)	5.75 (6.40)	-0.01 (0.22)	2.77 (5.97)
Rich client	0.73 (0.16)***	-10.29 (5.48)*	0.74 (0.20)***	10.04 (5.47)*
Constant	-0.85 (2.74)	125.36 (79.26)	6.51 (4.86)	-141.38 (26.85)***
Mills ratio	0.39 (0.39)	-13.23 (15.03)	-0.51 (0.46)	-24.72 (16.15)
χ^2	193.1	208.9	333.0	353.9
Sample size	2650	2875	2734	2879

These are heckman regressions for the street and unlicensed brothel sector.
*** indicates significance at 1% level, ** at 5% level, * at 10% level.

Figure 1: Police Enforcement Priorities

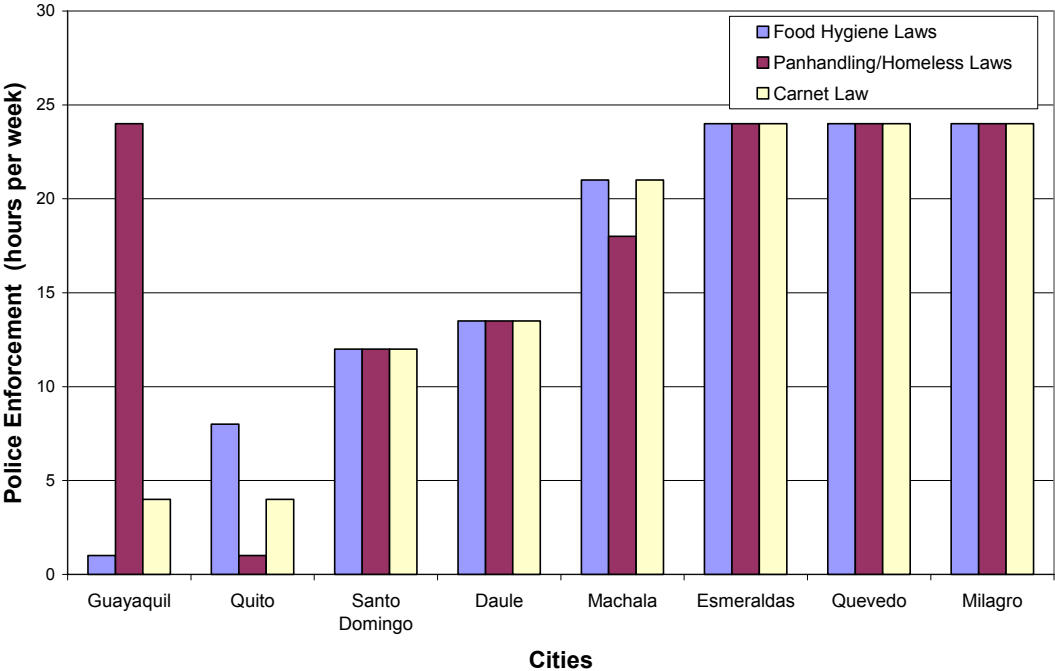




Figure 3: Sectoral Choice and Street Enforcement

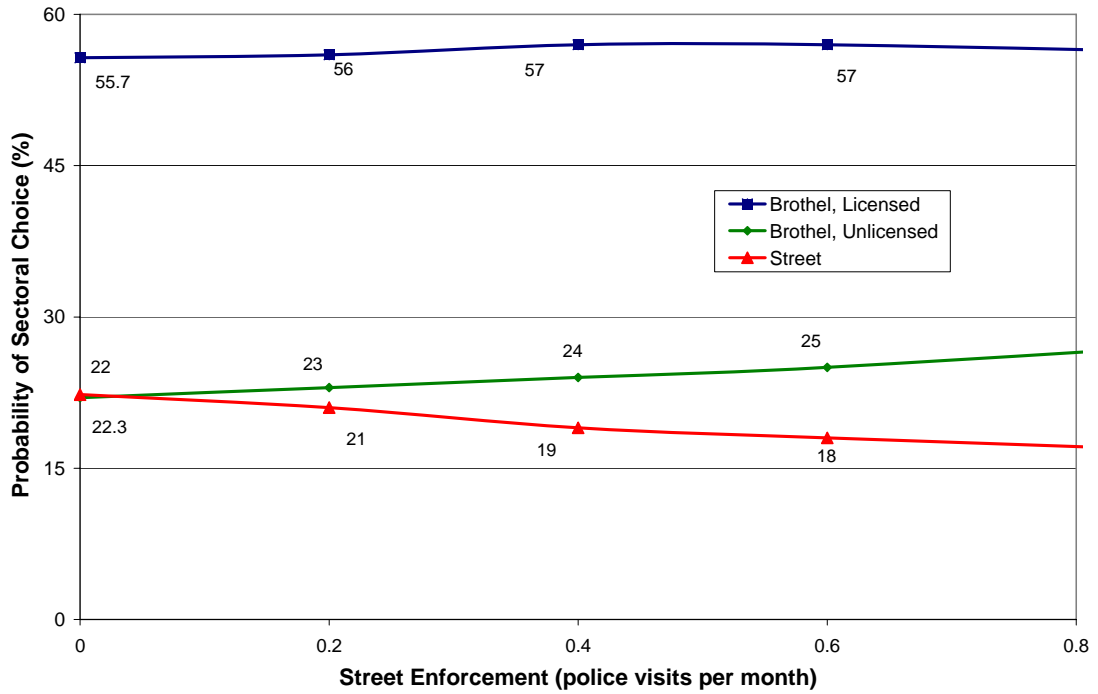
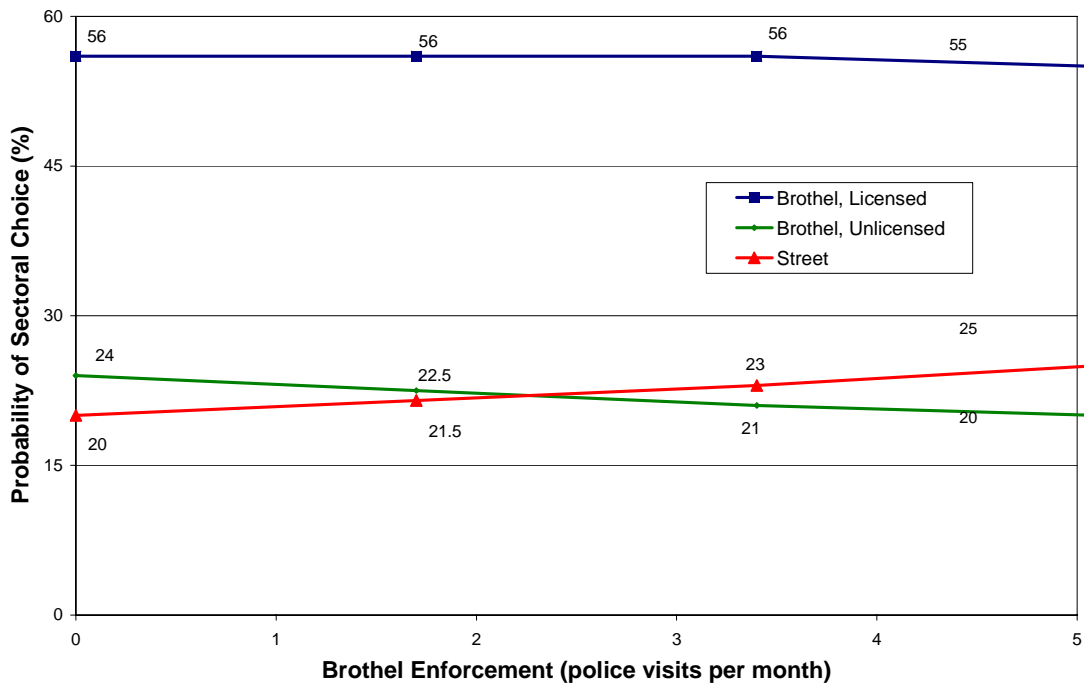


Figure 4: Sectoral Choice and Brothel Enforcement



7 Appendix

Table 8: Selection Equations for the Street and Unlicensed Brothel Sector

Dep Variable:	<u>Unlicensed Brothel</u>		<u>Street Sector</u>	
	(1)	(2)	(3)	(4)
Enforcement brothel	-0.11 (0.03) ^{***}	-0.15 (0.04) ^{***}	0.10 (0.04) ^{***}	0.07 (0.04) [*]
Enforcement street	0.58 (0.12) ^{***}	0.66 (0.20) ^{***}	-0.41 (0.26)	-0.40 (0.23) [*]
Risk knowledge	-0.03 (0.10)	-0.09 (0.08)	-0.23 (0.08) ^{***}	-0.25 (0.07) ^{***}
Doesn't like risks	-0.23 (0.14)	-0.08 (0.16)	-0.29 (0.18) [*]	-0.30 (0.16) [*]
Age	-0.03 (0.01) ^{***}	-0.03 (0.01) ^{***}	0.03 (0.00) ^{***}	0.03 (0.00) ^{***}
Children	0.06 (0.07)	0.13 (0.10)	0.14 (0.16)	0.02 (0.17)
Married/Civil union	-0.06 (0.09)	-0.09 (0.08)	0.07 (0.07)	0.04 (0.07)
Education	-0.01 (0.01)	-0.00 (0.01)	-0.05 (0.02) ^{***}	-0.05 (0.02) ^{***}
Attractive	-0.05 (0.10)	-0.07 (0.11)	-0.20 (0.10) [*]	-0.20 (0.08) ^{**}
Regular client	-0.32 (0.13) ^{**}	-0.30 (0.11) ^{***}	0.40 (0.15) ^{***}	0.47 (0.16) ^{***}
Clean client	-0.14 (0.14)	-0.13 (0.12)	0.08 (0.14)	0.11 (0.14)
Handsome client	0.53 (0.21) ^{**}	0.40 (0.20) [*]	-0.33 (0.19) [*]	-0.30 (0.19)
Rich client	0.09 (0.21)	0.09 (0.21)	0.03 (0.19)	-0.11 (0.19)
Sex ratio	0.09 (0.02) ^{***}	0.11 (0.01) ^{***}	-0.10 (0.03) ^{***}	-0.09 (0.03) ^{***}
Male education	3.86 (0.78) ^{***}	4.50 (0.95) ^{***}	-1.29 (1.26)	-0.48 (1.13)
Constant	-9.63 (1.81) ^{***}	-11.57 (1.37) ^{***}	9.02 (3.20) ^{***}	7.84 (2.82) ^{***}
Sample size	2650	2875	2734	2879

This is the output for the selection equation regressions for the street and unlicensed brothel sector regressions presented in Table 6.

*** indicates significance at 1% level, ** at 5% level, * at 10% level.