Prostitution and Violence

Evidence from Sweden

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April 29, 2019

Abstract

This paper analyzes the effects of the "Nordic Model" of prostitution legislation adopted in Sweden in 1999, according to which buyers only are prosecuted. We focus on various measures of violence, distinguishing between known and unknown perpetrator, indoor and outdoor crimes, and on health outcomes such as hospitalizations. This allows us to assess whether violence occurs within the prostitution market, or outside of it, namely as domestic violence. The empirical analysis shows an increase in violence as a consequence of the criminalization of buyers, but mostly ascribable to domestic violence rather than violence towards sex workers. We propose a model that rationalizes our conclusions on the source of the increase in violence and to simulate the effects of other policies.

JEL: L51, I18, O17, H21

Keywords: Prostitution, Regulation, Prohibition, Laissez-faire, Violence.

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In 1999 Sweden introduced an innovative asymmetric legislation against prostitution that criminalizes sex buyers but not sex sellers. The Swedish example was followed by Norway and Iceland in 2009, which gave it the catchy nickname "the Nordic Model". This model has been increasingly seen as a palatable third way between bilateral criminalization, and legalization with regulation. The first is often criticized on the ground that sex workers are typically victims rather than perpetrators, and should therefore not be criminalized; the second because it may have the effect of increasing demand and erode social norms against paid sex. Although some recent policy reports express concerns about the overall effects of the policy (e.g. Amnesty International 2016; Vanwesenbeeck 2017), the Nordic Model proved very popular with politicians: it has been adopted by Canada in 2014, Finland and Northern Ireland in 2015, France in 2016, Ireland in 2017, Israel in 2018, and many other countries are currently discussing its possible introduction. A lively debate is taking place on the overall effects of this legislation, mostly between enthusiastic politicians and skeptical social workers and NGOs. To better inform this debate, and connected policy choices, this paper provides more rigorous evidence on the effects of the 1999 Swedish prostitution law, in particular on violence and related health outcomes in Sweden. It also models the Swedish prostitution market simulating different law enforcement regimes, to perform counterfactual policy analysis.

The debate shares similarities with the standard arguments put forward for or against alcohol prohibition or drug liberalization. The criminalization of an activity is most likely shrinking the corresponding market, because it increases the cost of participation, but also functions as a signal of what a society deems acceptable or not, and coordinates behavior to potentially change social norms. At the same time, however, it pushes the remaining market in the darkness, where criminal activity and violence are likely to increase, and health education and controls to prevent unsafe sex and related diseases become hard. The policy reports informing this debate, however, are typically based on scattered and tentative suggestive evidence, as identifying the causal effects of these policies on the prostitution market is difficult. Moreover, recent economic studies, reviewed below, suggest that intervening on a market (be it for drugs or prostitution) may have complex spillover effects on society that go well beyond the targeted market.

To isolate the effects of this law on our outcomes of interest we focus on the comparison, within Sweden, between counties that are above or below average in terms of representation of women among police force and elected officials (we refer to them as treated and control counties, respectively). Both these indicators have been found in

previous studies to drive greater reporting and lower incidence of crimes against women (Iyer et al., 2012; Miller and Segal, 2018). Looking at population-wide changes in rates of violence against women in Sweden before and after the 1999 prostitution law, we observe an increase in *assaults* against women committed by *acquaintances indoor* by about 10% and an increase in *rapes indoor* by more than 20% in treated as compared to control counties.

The effects of the Nordic Model on violence that we identify are consistent both with the negative assessments of the policy reports mentioned above, and with a simultaneous and independent study focusing on rapes and using a different methodology (Ciacci, 2019). However, the reports are typically concerned with an increase in violence against prostitutes remaining in the market. Our findings do not support these concerns. The increase in violence we measure in connection to the 1999 prostitution law is taking place indoor and perpetrated by acquaintances. At the same time, in treated counties, where we observe more convictions for violent crimes against women, we observe fewer men convicted for buying sex. Therefore, the increase in violence we observe is likely not to take place in the context of the sex market; instead it indicates increased violence against non-prositutes from frustrated former customers, a possible negative externality of criminalizing prostitution. All in all, our evidence from Sweden suggests therefore that intimate partner violence and violence on women in general has increased as a consequence of the Nordic Model.

We then proceed with building an equilibrium model of the Swedish prostitution market and customer violent behavior in and outside the market under various law enforcement regimes, to lend more formal support to our interpretation. The model is calibrated using all information available to us on the Swedish population in order to perform comparative statics and counterfactual analysis. Specifically, we evaluate numerically the effects of alternative policies on equilibrium quantity, violence and violence risk inside and outside the market, denounce risk, and total harm. A key assumption of our model is that some individuals are "intrinsically" violent, meaning that they do not really have the choice between being violent or not. Therefore, as an effect of policy, they change their demand for prostitution services, that is they choose between being violent in the prostitution market or outside of it. As a result public intervention changes the relative proportion of violent individuals inside and outside the prostitution market, without decreasing the overall number of violent individuals in society. Moreover, the possibility of being violent outside the prostitution market implies that violent individuals' demand is more elastic with respect to enforcement for

prostitution and to enforcement for violence than non-violent individuals' demand.

We first look at the effect of an increase of fines for sex buyers from zero to the level prescribed by the new prostitution law. We find that the final outcome is a smaller and less violent prostitution market, where also the individual violence risk for the sex workers is smaller. This is in contrast with most recent policy reports that are concerned with an increase in violence within the prostitution market linked to asymmetric criminalization, but consistent with our empirical results. We also find that the violent individuals who are displaced from the prostitution market increase the violence risk outside it, leading to more total violence in society, an effect consistent with our interpretation of the reduced form estimates described earlier. We then use the model to study the comparative statics with respect to the strength of sanctions and effectiveness of prosecution against violence occurring in the prostitution market. Increasing the enforcement against violence on prostitutes decreases the demand from violent customers only, thereby significantly decreasing the individual violence risk for the sex workers. However, violence increases again outside of the prostitution market, leading to an overall increase in total violence. We then look at an increase in the stigma for the sex workers, an effect typically accompanying all forms of criminalization (Kotsadam, 2011). We find that bigger stigma translates into a lower supply and higher price. The higher price decreases demand both from violent and nonviolent customers, but the demand from violent customers decreases more [because they are subject to the extra enforcement for violence], thereby reducing the violence risk in the prostitution market. Again, the final outcome is a smaller and less violent prostitution market, accompanied by an increase in total violence in society linked to the behavior of violent individuals displaced from the prostitution market.

The rest of the paper is organized as follows. After a review of related studies in Section I, Section II clarifies the background of the reform, and Section III describes the data we use. The reduced form results are presented and discussed in Section IV. In Section V we set up the model and present our main analytical results, including a number of policy exercises. Finally, Section VI concludes.

I Related literature and contribution

Our paper contributes to a recent and growing literature on the effects of legal regimes for prostitution. Gertler and Shah (2011), Immordino and Russo (2015 and 2016), Lee and Persson (2018), Cameron et al. (2016) are examples of theoretical contributions in

this direction, while empirical studies are still relatively limited. Ours is the first study of the effects of the increasingly popular Nordic Model of asymmetric criminalization on violence, together with the simultaneous and independent study by Ciacci (2019) that focuses on rapes and uses a different methodology[1]. The risk of violence, both for the participants and within the neighboring geographic areas, is a natural area of concern for policy in relation to the sex market, and to criminal activities in general. To improve on cross-country comparisons and draw causal links from policies to outcomes, the most robust contributions in this area focus on natural experiments. Bisschop et al. (2017) exploit time and geographic variation in the opening and closing of *tippelzones*, designated areas for legal street prostitution within strictly defined opening hours, and estimate a decrease in registered sexual abuse and rape by about 30-40%, as well as drug-related crimes. Cunningham and Shah (2018) study an unintentional (and therefore unexpected and temporary) decriminalization of indoor prostitution in Rhode Island, and find that reported rape offences fall by 30%. Cunningham et al. (2019) also look at the geographic expansion of the erotic services section of Craigslist, a popular advertisements website, before online solicitation was banned in 2018. The possibility to use online platforms for their work, by allowing prostitutes to keep mostly indoors, and screen their potential clients to a larger extent, appears to have been very beneficial: the study finds a connected reduction in female homicide rates by 10-17%. Ciacci and Sviatschi (2018) find that the opening in a neighborhood of indoor prostitution establishments decreases sex crime by 7-13%, with no effect on other types of crime, arguing that the reduction is mostly driven by potential sex offenders resorting to the establishments to satisfy their needs. What is common to these studies is the finding that allowing the sex market to exist in some form is beneficial for outsiders, and that indoor prostitution is safer for the sex workers themselves. Our findings are consistent with these insights. As mentioned earlier, in a closely related simultaneous research, Ciacci (2019) studies the effect of fines against buying sex on rapes in Sweden. He uses the availability and distance of flights to well known sex tourism destination as an instrument to break the endogeneity problem that affects OLS estimates, and finds that an increase in fines has a sizable and significant effect on rapes. These results, obtained with a very different methodology, are reassuringly in line with our first set of

[1] Jakobsson and Kotsadam (2011, 2013) provide descriptive evidence on changes in attitudes towards prostitution and the prevalence of trafficking, respectively, in connection with the reform, however cannot draw robust causal links. Kotsadam and Jakobsson (2011) rely on a stronger identification to study the impact on attitudes of the Norwegian reform, using Sweden as a counterfactual.

results. Differently from Ciacci, who focuses exclusively on rapes, we focus on a variety of measures of violence, distinguishing between occurrence indoor and outdoor and between known and unknown perpetrator; and on health outcomes, like hospitalizations. This wider focus allows us to go beyond the measurement of a general effect, and shed light on whether the increase in violence is occurring within the residual prostitution market, as suggested by most policy report, or outside of it, e.g. in the form of increased violence from intimate partners. Also, our approach allows us to control at least in part whether the observed changes are affected by simultaneous changes in reporting behavior linked to the new law. Finally, our theoretical model allows us to confirm our conclusions on the source of increase in violence in a structured environment and to simulate the effects of other policies that could have analogous, negative spillover effects outside the prostitution market.

Other recent theoretical and empirical papers on prostitution have investigated the determinants of prices, demand and supply. In their seminal paper Edlund and Korn (2002) argue that prostitution is a low-skilled, labor-intensive, female and well-paid occupation. An important opportunity cost of prostitution is forgone marriage, and this cost explains the high wages. However, Arunachalam and Shah (2008) show that the premium to sex work is not due to the marriage market but is compensation for risk. Cameron (2002) provides an explanation for the high wages in terms of compensation for social exclusion, risk, boredom and physical effort, distaste and loss of recreational sex pleasure. Rao et al. (2003) and Gertler et al. (2005) use microdata to quantify the risk compensation required by sex workers for not using condoms.[2] Moffatt and Peters (2004) identify the factors affecting price in a regression framework for a subsector of the prostitution market in the United Kingdom and estimate the earnings, both aggregate and individual. Cameron and Collins (2003), Della Giusta et al. (2009) and Della Giusta et al. (2016) focus on the demand side, using UK microdata to identify the characteristics of the male clients that influence their demand for prostitution. Cameron et al. (1999) use data drawn from British advertisements to identify the characteristics of male escorts that make them more likely to offer particular services.

II Background

Prostitution was not regulated in Sweden before 1999. Procuring sexual services and human trafficking were though already illegal. A ban on buying sexual services was first

[2]On the relation between commercial sex and health see also Immordino and Russo (2017).

proposed to the Parliament on February 5, 1998, in a bundle with several "measures to combat violence against women, prostitution, and sexual harassment at work." (*Kvinnofrid*, or *Women's integrity* Proposition). The purchase of sexual services became then the object of a separate law, the so called *Sexköpslagen*, approved on April 4, 1998 and into force since January 1st, 1999. The new crime is punished with fines or prison up to 6 months.

There have been many policy evaluations, by government agencies and the police, various feminist groups, national and international NGOs, but no rigourous study, as mentioned in the previous section. Nevertheless, the reports provide useful descriptive information on the prevalence of prostitution in general, on the enforcement effort, and on potential changes in clients' and sex workers' behavior, in particular reporting behavior.

All in all, the authorities were satisfied with the reform, stating for example, in the evaluation for the 10th jubilee of the law, that "the ban on the purchase of sexual services has had the intended effect and is an important instrument for preventing and combating prostitution and human trafficking for sexual purposes" (SOU, 2010). The prostitution groups of the Social Services estimated at the time that street prostitution in Sweden had been halved since the introduction of the law, while street prostitutes in 2008 were estimated to be three times as many in the capitals of Denmark and Norway as compared to Stockholm. Police officers in the field as well as social workers' opinion was that the number of foreign women in street prostitution increased less in Sweden compared to the other Nordic countries, as did internet prostitution. Moreover, when it comes to hidden indoor prostitution, their perception was that "nothing indicates that the scope of indoor prostitution not marketed through advertisements in newspapers and on the Internet, e.g. prostitution on massage parlors, sex clubs and hotels as well as in restaurant and nightclub environments, would have increased in recent years" (SOU, 2010). According to surveys conducted in Sweden in the period after the criminalization, the proportion of men who state that at some point they bought sex decreased, and fewer men seem to buy sex in Sweden than in the other Nordic countries (Priebe and Svedin, 2012).

All of these claims are based, as mentioned, on perceptions.

One police report raised the concern that sex crimes were not given the right priority because of the low punishment, and suggested to increase it to one year prison (SOU, 2010). The opinion that the low level of punishment did not affect clients' behavior was also shared by some interviewed sex workers. Police also reported that prositutes felt

safer because of the increased police presence in the streets.

Nothing in the reports indicates any change in the conditions or modus operandi of organizations and institutions that work with prostitutes in connection with the reform. The dedicated Social Services' units have been operating in the three big cities since the 70s (there is however nothing comparable in the smaller cities)[3]. These same organisations and institutions report no change, in connection with the reform, in the volumes of requests of contact and help they receive (possibly a slight increase in Stockholm). Unfortunately, without data on the size of the market, this tells us little about a potential relative change. All in all, the reports seem to conclude that nothing indicates that opportunities and conditions for sex workers to come in contact and get help from the institutions have worsened after the reform (SOU 2010). Consistently, a large survey (5000 respondents, Svedin et al. 2012) finds that very few among those who stopped selling or buying sex report having received formal or informal help, and that the law did not affect their behavior.

III Data and Empirical Strategy

We use outcome data from two sources. The official statistics of convictions for violent crimes for the period 1985-2017 are provided by the police, and disaggregated along various dimension: by gender and age group of the victim, by county, by whether the perpetrator was known or unknown to the victim, and by whether the crime happened indoors or outdoors. We use the counts of assault and aggravated assault combined, and the counts of rape and attempted rape combined[4].

The National Board of Health and Welfare (*Socialstyrelsen*) maintains a database of hospitalizations, disaggregated by cause, or diagnosis, gender, age group and county[5]. We use the category of hospitalizations "due to external violence", which includes accidents, falls, burns, and other less well specified causes. We also focus on the category "effects of an external object entering the body through an orifice", which we use as a proxy for injuries more closely related to sexual activities.

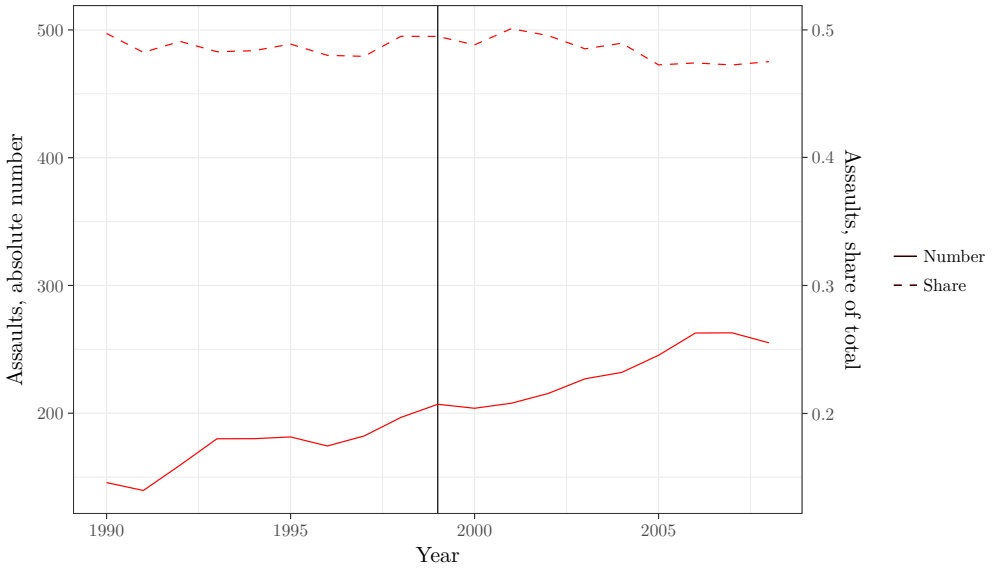
We use the most recent administrative division in 21 counties, and exclude the years

[3]One exception is the KAST program (adressed to buyers) to complement the previously existing FAST (adressed only to sellers), started by the Social Services after the reform. We are collecting information on it.

[4]Rape statistics are only disaggregated by where they happen, not by gender of the victim nor by whether the perpetrator is known or unknown to the victim

[5]This data exist since 1987, but only the period 1998-2017 is available online. We are currently trying to obtain the longer time series.

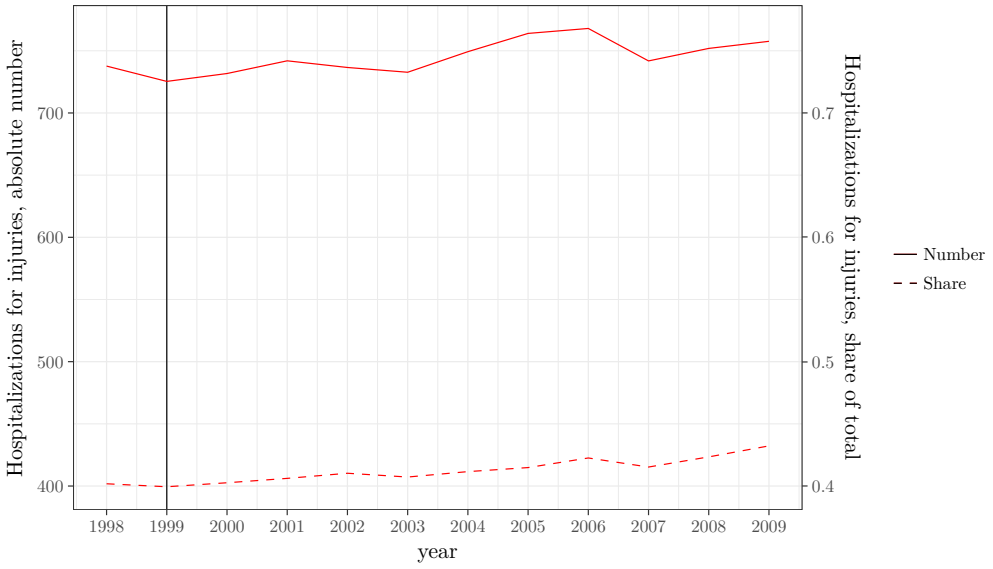
FIGURE 1: Assaults against women over time (in 10,000), county-level average



after 2009, when a similar reform was introduced in neighboring Norway. We want in this way to avoid the risk of capturing potential spill overs in Sweden from the norwegian reform.

Figures 1 and 2 plot the time series of the county-level average of the two variables, both in absolute numbers and as a share of the population total (i.e. relative to men). They reveal moderately increasing trends in violence over this period, even as assaults against women become a smaller share of the total in the most recent years.

FIGURE 2: Hospitalizations of women over time (in 10,000), county-level average



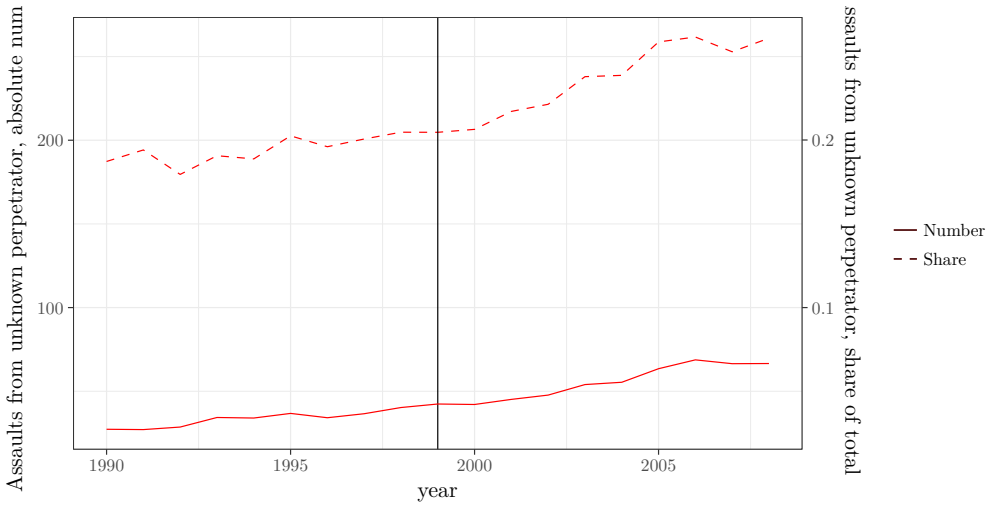
These data have several limitations. First of all, as any type of crime statistics, these numbers do not capture the total population of violent crimes committed, but only the ones reported or otherwise discovered. Moreover, these data do not distinguish victims by anything else than gender and age group, and in particular this does not allow to single out sex workers.

In order to infer, from what we observe, indications about the changes we are interested in, we need to identify appropriate counterfactuals.

As a first step to separate the impact of the reform on prostitutes, we follow Cunningham et al., (2017) and look at violence from a perpetrator unknown to the victim, which is more likely to comprise a larger share of violence against sex workers. Figure 3 plots this time series, again in absolute numbers and as a share of the total population. Assaults from perpetrators unknown increased more for women than for men.

The next necessary step is to separate the impact of the reform from secular trends. Although the law is national, we argue that its implementation and translation into specific policy priorities varied significantly at the county level. We look therefore at difference-in-differences with respect to two county-level indicators, inspired by the literature: the share of women among elected politicians (Iyer et al., 2012); and the share of women among police officers (Miller and Segal, 2018). Both of these variables have been found to drive a significant rise in reporting of crimes against women and

FIGURE 3: Assaults on women from perpetrator unknown (in 10,000), county-level average



at the same time significant declines in such crimes, in the context of India and the US, respectively. The hypothesized mechanism is that female politicians might drive an agenda that is to some extent closer to women's priorities and in particular more responsive to the issue of violence against women. Larger shares of female police officers could be a part in the implementation of this agenda, by making the police force also more responsive to these crimes, and lowering the cost of reporting for victimized women. We split the sample at the median along the two dimensions. Figure 4 shows a map of Sweden highlighting the treatment status of counties thus defined.

Table 1 reports the distribution of these two variables across Swedish counties. Ideally we would like to define treatment status based on information that pre-dates the reform, to ensure that it is exogenous to the impact of the reform. We could imagine that, if the reform affects perceptions, norms and values in the population, these might

FIGURE 4: Treatment indicators by county

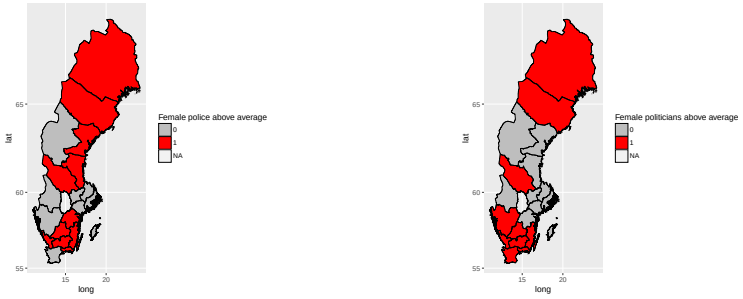
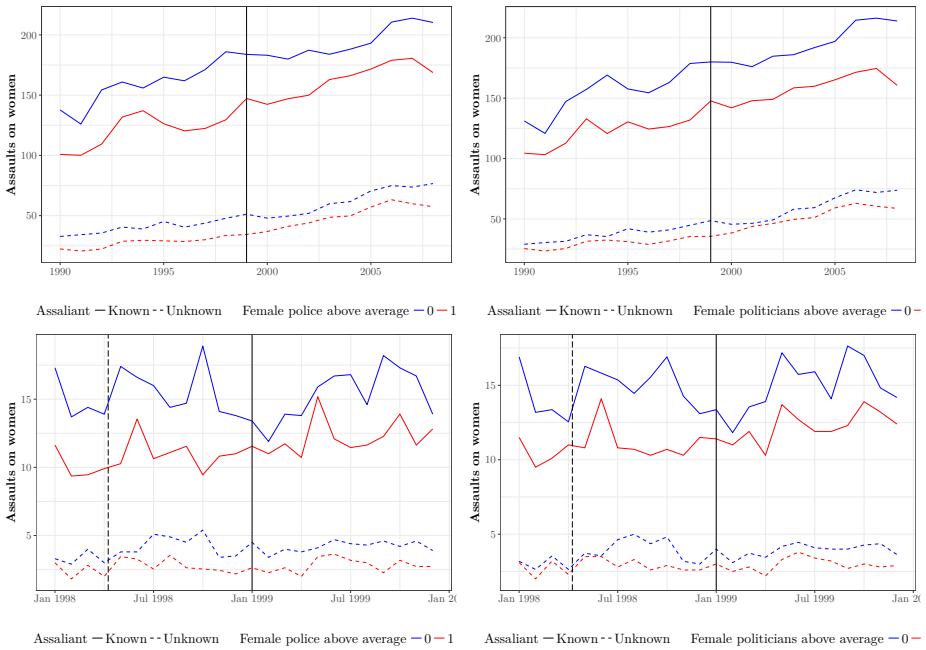


FIGURE 5: Parallel trends in assaults on women



in turn affect the share of women elected, while the share of female police officers might reflect policy priorities that go hand in hand with the reform. We observe the share of elected politicians at election times, which in this case is just before the reform, in 1998, and three years after the reform, in 2002. Although the distribution is very stable accross these two subsequent elections, we use the measure in 1998 to avoid endogeneity. The share of women in the police force is however first reported in 2000, the year after the reform, so this is the closest we can come to an exogenous measure. As we see the share of policewomen increases substantially during our period of observation.

The variation in both measures is non-negligible, in particular when it comes to the police force. However it is not so big as to make us suspect that these counties are dramatically different in other respects. Table 2 reports the balance of covariates accross treatment status. There are a few significant differences, in particular the share of single mother households and divorced couples are larger in control counties, while the share of foreign born and the share with higher education are smaller in the police-treated counties only. None of these are particular worrisome as potential confounders of the impact we are looking for.

Tables 3 and 4 report the pre-treatment summary statistics for violent crimes, disaggregated along the dimensions allowed by the data, at the yearly and monthly frequency respectively. The baseline levels are accross the board lower in treated

TABLE 1: Summary statistics, treatment variables

Share of female politicians, 1998	
min	0.38125
median	0.4368729
max	0.4693878
mean (sd)	0.43 ± 0.03
Share of female politicians, 2002	
min	0.3797101
median	0.4361262
max	0.4813499
mean (sd)	0.43 ± 0.03
Share of female police, 2000	
min	0.07488987
median	0.1385042
max	0.2433274
mean (sd)	0.14 ± 0.04
Share of female police, 2009	
min	0.1846154
median	0.2481618
max	0.3105023
mean (sd)	0.25 ± 0.03

Notes: This table reports summary statistics of the treatment variables at the county level, for different years before and after the reform in 1999. **Share of female politicians** is the share of women elected in office at all administrative levels lower and including county level, in the corresponding year. **Share of female police** is the share of women in the police force in the county and the given year.

TABLE 2: Pre-treatment summary statistics, covariates

	Police W: Low	:High	P-value		Elected W: Low	:High	P-value
Population Density				**Population Density**			
mean (sd)	63.32 ± 79.85	23.40 ± 17.20	$P = 0.1214$	mean (sd)	48.64 ± 76.89	35.56 ± 31.06	$P = 0.6221$
Fem Labor Force Part				**Fem Labor Force Part**			
mean (sd)	0.74 ± 0.03	0.74 ± 0.02	$P = 0.9296$	mean (sd)	0.74 ± 0.03	0.74 ± 0.02	$P = 0.6240$
Share Foreign Born				**Share Foreign Born**			
mean (sd)	0.12 ± 0.05	0.08 ± 0.02	$P = 0.0327$	mean (sd)	0.10 ± 0.05	0.09 ± 0.03	$P = 0.7301$
Unemployment				**Unemployment**			
mean (sd)	0.06 ± 0.01	0.06 ± 0.02	$P = 0.5103$	mean (sd)	0.06 ± 0.01	0.06 ± 0.02	$P = 0.7882$
Alcohol Consumption				**Alcohol Consumption**			
mean (sd)	1.13 ± 0.38	1.07 ± 0.16	$P = 0.5970$	mean (sd)	1.17 ± 0.35	1.02 ± 0.18	$P = 0.2329$
Sh. Single Mother Fam				**Sh. Single Mother Fam**			
mean (sd)	0.21 ± 0.01	0.18 ± 0.02	$P = 0.0038$	mean (sd)	0.21 ± 0.01	0.18 ± 0.02	$P = 0.0037$
Sh. w < 9 Years Ed.				**Sh. w < 9 Years Ed.**			
mean (sd)	0.14 ± 0.03	0.16 ± 0.02	$P = 0.0642$	mean (sd)	0.15 ± 0.03	0.16 ± 0.02	$P = 0.2679$
Divorced				**Divorced**			
mean (sd)	467.17 ± 49.29	405.55 ± 36.72	$P = 0.0040$	mean (sd)	455.10 ± 49.20	412.66 ± 48.98	$P = 0.0625$

Notes: This table reports the balance of covariates variables between treated and control counties, for the years before the reform in 1999. In the left panel, **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In the right panel, **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average.

counties. Looking at Figure 5 we see however that trends over time are reasonably parallel in the two sets of counties, which is reassuring for our identification.

Table 5 reports baseline summary statistics for the hospitalization data. With these data, starting the year before the reform, we cannot look at pre-treatment trends. However the baseline averages are not significantly different in this case.

As a last ingredient in our empirical strategy, we exploit a nuance difference among our two treatments. We argue that the share of women in the police force is more directly observable by prostitutes (and in general by the population) compared to the composition of local governments. Therefore, whatever the channel of impact, this is expected to be more likely to affect behavior. Moreover, all else equal, the cost of reporting should be lower with a larger share of women in the police force. The already cited Miller and Segal (2018) report for example anecdotal evidence from crime victims recalling in negative terms the experience of being surrounded by male police officers after being subjected to violence by male perpetrators. Therefore we expect the impact on reporting rates, if any, to be relatively stronger with the police treatment as compared to the politicians treatment. [6]

[6]Notice that the correlation between the two treatments is .4, implying that they are positively correlated but not equivalent. In particular, there is variation in the politicians treatment that is not explained by the police treatment, and the other way around.

TABLE 3: Pre-treatment summary statistics, crime outcomes, yearly

	Police W: Low	:High	P-value		Elected W: Low	:High	P-value
Assaults unknown				**Assaults unknown**			
mean (sd)	39.90 ± 15.15	27.18 ± 7.08	$P < 0.0001$	mean (sd)	36.64 ± 15.50	29.50 ± 8.88	$P = 0.0002$
Assaults known				**Assaults known**			
mean (sd)	157.64 ± 45.71	119.75 ± 33.19	$P < 0.0001$	mean (sd)	153.25 ± 49.08	120.79 ± 29.20	$P < 0.0001$
Assaults indoor				**Assaults indoor**			
mean (sd)	146.56 ± 44.69	112.32 ± 32.37	$P < 0.0001$	mean (sd)	142.87 ± 47.94	112.96 ± 27.69	$P < 0.0001$
Assaults outdoor				**Assaults outdoor**			
mean (sd)	50.99 ± 15.00	34.61 ± 8.71	$P < 0.0001$	mean (sd)	47.02 ± 16.09	37.33 ± 10.78	$P < 0.0001$
Rape indoor				**Rape indoor**			
mean (sd)	12.28 ± 5.87	9.04 ± 4.74	$P < 0.0001$	mean (sd)	11.73 ± 6.27	9.32 ± 4.28	$P = 0.0026$
Rape outdoor				**Rape outdoor**			
mean (sd)	4.24 ± 1.69	3.03 ± 1.67	$P < 0.0001$	mean (sd)	3.94 ± 1.76	3.24 ± 1.74	$P = 0.0071$

Notes: This table reports the pre-treatment summary statistics of the outcome variables, in treated and control counties, for the years before the reform in 1999. In the left panel, **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In the right panel, **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average.

TABLE 4: Pre-treatment summary statistics, crime outcomes, monthly

	Police W: Low	:High	P-value		Elected W: Low	:High	P-value
Assaults unknown				**Assaults unknown**			
mean (sd)	3.97 ± 2.62	2.69 ± 1.30	$P < 0.0001$	mean (sd)	3.69 ± 2.64	2.87 ± 1.24	$P = 0.0021$
Assaults known				**Assaults known**			
mean (sd)	15.43 ± 6.21	10.73 ± 3.24	$P < 0.0001$	mean (sd)	14.81 ± 6.25	10.94 ± 3.29	$P < 0.0001$
Assaults indoor				**Assaults indoor**			
mean (sd)	14.31 ± 6.06	9.87 ± 3.14	$P < 0.0001$	mean (sd)	13.70 ± 6.09	10.10 ± 3.20	$P < 0.0001$
Assaults outdoor				**Assaults outdoor**			
mean (sd)	5.09 ± 3.31	3.55 ± 1.66	$P < 0.0001$	mean (sd)	4.80 ± 3.33	3.71 ± 1.56	$P = 0.0011$
Rape indoor				**Rape indoor**			
mean (sd)	8.20 ± 12.08	2.20 ± 3.13	$P < 0.0001$	mean (sd)	5.72 ± 10.29	4.33 ± 7.62	$P = 0.2293$
Rape outdoor				**Rape outdoor**			
mean (sd)	2.73 ± 3.65	0.70 ± 0.91	$P < 0.0001$	mean (sd)	1.70 ± 3.06	1.63 ± 2.47	$P = 0.8400$

Notes: This table reports the pre-treatment summary statistics of the outcome variables, in treated and control counties, for the months before the reform in 1999. In the left panel, **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In the right panel, **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average.

TABLE 5: Pre-treatment summary statistics, hospitalizations

	Police W: Low	:High	P-value		Elected W: Low	:High	P-value
All injuries				**All injuries**			
mean (sd)	704.84 ± 121.35	767.55 ± 115.62	$P = 0.2402$	mean (sd)	730.98 ± 126.38	745.07 ± 118.34	$P = 0.7954$
Sex-related injuries				**Sex-related injuries**			
mean (sd)	8.09 ± 3.34	6.33 ± 2.79	$P = 0.2027$	mean (sd)	6.82 ± 3.52	7.54 ± 2.74	$P = 0.6103$

Notes: This table reports the pre-treatment summary statistics of hospitalizations, in treated and control counties, for the year before the reform in 1999. In the left panel, **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In the right panel, **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average.

IV Results

Tables 6 to 8 report the coefficients, standard errors and p-values from difference-in-differences regressions of the natural logarithm of assaults against women in different categories, including year-month and county fixed effects. We observe a positive significant impact of the police treatment, in Column (3) of Table 6, and a smaller impact (only significant at 10% level) of the politician treatment in Column (4) of Table 6, on the known-perpetrator crimes. Disaggregating this further, we see that this impact, close to a 10% increase, is driven by crimes perpetrated indoors (Column (3) of Table 7, and Columns (3) and (4) of Table 8). We also observe an increase larger than 20% and significant in rapes perpetrated indoors, in Columns (3) and (4) of Table 9.

These results present two issues of interpretation. First of all, we would like to disentangle violence against prostitutes from violence against women in general. Moreover we would like to understand whether the changes happen in the (unobserved) levels of crimes committed or only in reporting rates.

TABLE 6: DID regressions - Assaults on women

	(1)	(2)	(3)	(4)
	Unknown	Unknown	Known	Known
	b/se/p	b/se/p	b/se/p	b/se/p
Police	-.035271		.1163005	
	.0797922		.0463911	
	.6586772		.0125221	
Politicians		-.1093609		.0854815
		.0796241		.0465369
		.1702967		.0668779
N	492	492	504	504

Notes: This table reports the difference-in-differences coefficients, standard errors and p-values from regressions of the natural logarithm of the dependent variables on the interaction of a treatment indicator with a post-reform indicator. In columns (1) and (3), **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In columns (2) and (4), **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average. The dependent variable **Unknown** (respectively, **Known**) is the (natural logarithm of) the number of assaults and aggravated assaults against women perpetrated by an assaliant unknown (respectively, known) to the victim. All regressions include a complete set of county and year fixed effects.

TABLE 7: DID regressions - Assaults on women

	(1) Outdoor b/se/p	(2) Outdoor b/se/p	(3) Indoor b/se/p	(4) Indoor b/se/p
Police	-.0068689		.0998197	
	.0729068		.047851	
	.92498		.0375255	
Politicians		-.082653		.0722847
		.0727425		.0479588
		.2564608		.1324406
N	495	495	504	504

Notes: This table reports the difference-in-differences coefficients, standard errors and p-values from regressions of the natural logarithm of the dependent variables on the interaction of a treatment indicator with a post-reform indicator. In columns (1) and (3), **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In columns (2) and (4), **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average. The dependent variable **Outdoor** (respectively, **Indoor**) is the (natural logarithm of) the number of assaults and aggravated assaults against women perpetrated outdoor (respectively, indoor). All regressions include a complete set of county and year fixed effects.

TABLE 8: DID regressions - Assaults on women

	(1) Outdoor Known	(2) Outdoor Known	(3) Indoor Known	(4) Indoor Known	(5) Outdoor Unknown	(6) Outdoor Unknown	(7) Indoor Unknown	(8) Indoor Unknown
	b/se/p	b/se/p	b/se/p	b/se/p	b/se/p	b/se/p	b/se/p	b/se/p
Police	.0740335		.1223192		-.090182		-.0792725	
	.080308		.0521875		.0805203		.0778634	
	.3571029		.0195119		.2634017		.309263	
Politicians		-.002442		.0912116		-.0538905		-.1038757
		.0803254		.0523259		.0805372		.078057
		.9757606		.0819781		.5038002		.1840431
N	484	484	504	504	438	438	435	435

Notes: This table reports the difference-in-differences coefficients, standard errors and p-values from regressions of the natural logarithm of the dependent variables on the interaction of a treatment indicator with a post-reform indicator. In columns (1), (3), (5) and (7), **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In columns (2), (4), (6) and (8), **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average. The dependent variable **OutdoorKnown** (respectively, **IndoorKnown**) is the (natural logarithm of) the number of assaults and aggravated assaults against women perpetrated outdoor (respectively, indoor) by assaliants known to the victim. The dependent variable **OutdoorUnknown** (respectively, **IndoorUnknown**) is the (natural logarithm of) the number of assaults and aggravated assaults against women perpetrated outdoor (respectively, indoor) by assaliants unknown to the victim. All regressions include a complete set of county and year fixed effects.

TABLE 9: DID regressions - Rapes

	(1)	(2)	(3)	(4)
	Rape Outdoor	Rape Outdoor	Rape Indoor	Rape Indoor
	b/se/p	b/se/p	b/se/p	b/se/p
Police	.0184217		.2001164	
	.1143765		.116035	
	.8721802		.0854638	
Politicians		-.0393142		.2464101
		.1144846		.1166288
		.7315967		.0353159
N	285	285	401	401

Notes: This table reports the difference-in-differences coefficients, standard errors and p-values from regressions of the natural logarithm of the dependent variables on the interaction of a treatment indicator with a post-reform indicator. In columns (1) and (3), **treated** counties are those where the share of women elected in the police force in the county in 2000 was higher than average. In columns (2) and (4), **treated** counties are those where the share of women elected in office at all administrative levels lower and including county level in 1998 was higher than average. The dependent variable **Outdoor** (respectively, **Indoor**) is the (natural logarithm of) the number of rapes perpetrated outdoor (respectively, indoor). All regressions include a complete set of county and year fixed effects.

Since the reform is argued to have eliminated street prostitution, and pushed the remaining sex trade indoors, violence against prostitutes will be classified in the indoor assaults statistic. The increase we observe is for crimes committed by perpetrators known to the victim, which could be interpreted, in accordance which previous literature, as violence against women in general rather than prostitutes in particular. However, we cannot exclude the possibility that prostitute patrons, in a smaller, indoor, and perhaps more controlled market, are increasingly considered acquaintances and classified in the statistics as known perpetrators. In order to make progress in this respect, we argue that, if these statistics reflect assaults committed within the sex market, these perpetrators will at the same time be convicted for buying sex (at least to some extent). It is not possible to do difference-in-difference analysis on this outcome, though, since the crime exists only after the refomr. Figure 6 shows, however, that, although numbers are generally small, convictions for buying sex are not more frequent in treated counties, where more are convicted of violent crimes against women. We think therefore unlikely that the increase in assaults we observe happens in the context of the sex market. We are instead observing a possible negative externality of deterring prostitution, namely increased violence against non-prositutes (and probably to some extent intimate partner violence) from frustrated former customers. This is in line with the results in the literature cited above, and the specular finding that liberalizations or otherwise expanded access to the prostitution market reduce violence against women in general (Cunningham and Shah, 2018); Cunningham et al., 2019; Ciacci and Sviatschi, 2018).

We argued above that, to the extent that the reform affected reporting rates, this impact can be expected to be relatively stronger with the police treatment. We observe indeed a stronger effect of the police treatment on assaults (*but not* on rapes). Can we exclude that the impact we see is simply reflecting a higher reporting? It is difficult to conceptualize why a legal reform affecting the prostitution market should encourage other women to report crimes such as domestic violence. Additional suggestive evidence on this point is reported in Figures 7 to 8. If we think that seeking hospital care is less sensitive than reporting to the police, the series of hospitalizations should be closer to the true violence than the convictions. Although numbers are small and differences not significant, Figure 7 shows that hospitalizations of women for injuries that are related to sexual interactions spike up in treated counties directly after the reform. Hospitalizations of women for other injuries, however, increase less in treated counties than untreated ones.

Discovered homicides are another statistic which is often used in the literature,

FIGURE 6: Convictions for byuing sex by treatment status

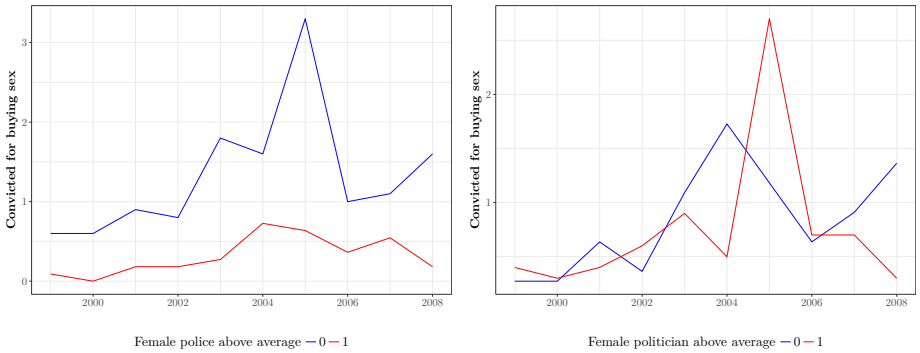


FIGURE 7: Hospitalizations for injuries related to sex by treatment status

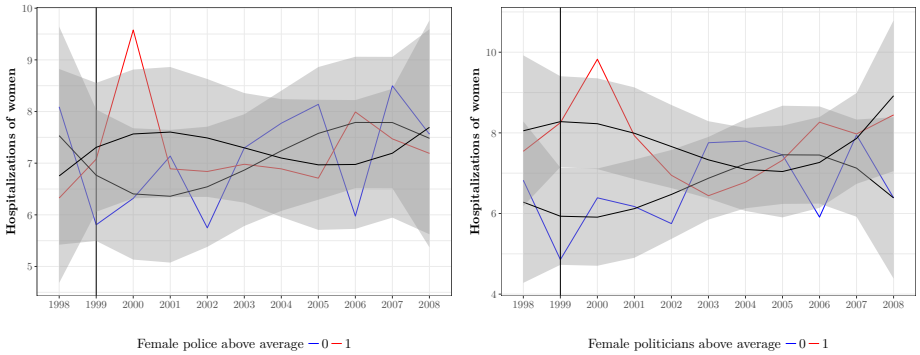
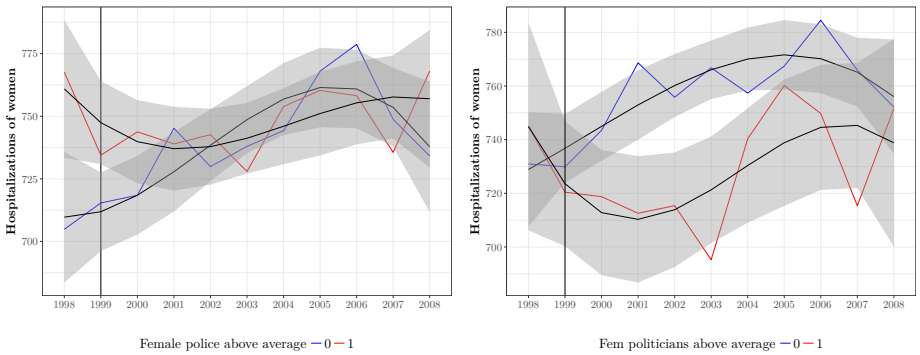


FIGURE 8: Hospitalizations for injuries of women by treatment status



because it is not affected by reporting. Numbers are however too small to draw reliable inference.

The model in the next section reproduces the same results, starting from a standard characterization of the behavior of sex workers and their customers, and parameter values calibrated to Sweden. It then simulates alternative policy experiments with the aim to compare equilibrium total harm in the economy.

V Theoretical model

A country is populated by a unit mass of risk-neutral individuals who choose to participate in the prostitution market according to subjective costs and benefits. The benefits are a monetary revenue for the sex workers and a "gratification" for the clients. Customers are heterogeneous along two dimensions: the value of lifetime earnings and the propensity to violence. Sex workers instead differ in terms of their the present discounted value of the outside earning opportunity (from now on lifetime earnings) and in terms of their individual cost of denouncing violent customers. The costs for the sex workers are the stigma associated with being identified as a sex worker and the risk of facing violent behavior which entails a loss in the value of lifetime earnings.[7] The costs for the clients are the price, the risk of being sentenced for buying prostitution services and only for violent individuals the risk of being sanctioned for violent behavior. The greater the value of the lifetime earnings of potential clients and potential sex workers the lower demand and supply. Although we model prostitution as a voluntary choice, we acknowledge the important distinction between forced prostitution – in particular the prostitution of trafficked women – and voluntary prostitution. Moreover, to simplify the analysis we consider a single standardized transaction, a specific sex "act", abstracting from the choice between different acts.

In section A. we describe our model for the Swedish prohibition regime characterized by an endogenous risk of violence for the sex workers and by an endogenous legal risk for the customers. In section B. we consider a numerical solution for our model. Finally, in section C. we evaluate numerically the effects of alternative policies on equilibrium quantity, violence risk, denounce risk, and total harm.

A. Scandinavian Prohibition Regime

The Scandinavian prohibition regime consists of a law criminalising the buying but not the selling of sex. Public intervention consist in the enforcement of sanctions against those clients who engage in the market.

The utility of an individual who engages in the market for sex services is

[7] In other words what the individual could gain in the labor market excluding the earnings from prostitution. For simplicity we do not consider other costs like health related ones (see Immordino and Russo, 2015).

$$U(d,u) = \begin{cases} (1-\pi^{sw})[q+u(1-s)] + \pi^{sw}[q+u(1-s-\alpha^{sw}+\gamma b-\delta)] & \text{if } d=1 \\ (1-\pi^{sw})[q+u(1-s)] + \pi^{sw}[q+u(1-s-\alpha^{sw})] & \text{if } d=0, \end{cases} \tag{1}$$

where $d = \{0,1\}$ indicates the decision to denounce violent behaviors (not denounce $d=0$, denounce $d=1$); s is the stigma of being a sex worker; π^{sw} is the probability of being victim of violence, which leads to a loss of a fraction $\alpha^{sw} < 1$ of lifetime earnings $u \in [0, \bar{u}]$ distributed according to the cdf G_u, whose pdf is g_u; δ is the proportional cost of denouncing violent behaviors, which is distributed, independently from income, in $[0, \bar{\delta}]$ according to the distribution $h(\delta)$ whose cdf is $H(\delta)$. The expected benefit of denouncing is γb, where γ is the probability that a denounce leads to a conviction and b the proportional benefit in such a case, that is reparation damages; q is the equilibrium prostitution price. Individuals who do not sell prostitution services simply have utility

$$U(u) = (1-\pi_h^{sw})u + \pi_h^{sw}u(1-\alpha^{sw}+\gamma b-\delta), \tag{2}$$

where π_h^{sw} is the risk of violence outside the prostitution market. If $\delta < \gamma b$, i.e. if the individual cost of denouncing is smaller than the expected benefit of a sentence, there will be a denounce, both inside and outside the market. Total supply of prostitution is

$$S = \int_0^{\gamma b} G_u\left(\frac{q}{s+(\pi^{sw}-\pi_h^{sw})(\alpha^{sw}+\delta-\gamma b)}\right) h(\delta)\, d(\delta) + [1-H(\gamma b)]\, G_u\left(\frac{q}{s+(\pi^{sw}-\pi_h^{sw})\alpha^{sw}}\right), \tag{3}$$

where the first integral refers to the supply of the individuals who denounce ($\delta \leq \gamma b$), the second to the supply of the individuals who do not denounce ($\delta > \gamma b$).

The utility of a client is instead

$$V(\theta,\omega) = \begin{cases} (1-f)[\omega(1+k)-q] + f[\omega(1+k-F)-q] & \text{if } \theta=0 \\ (1-f)(1-\pi^c)[\omega(1+k)-q] + (1-f)\pi^c[\omega(1+k-\alpha^c)-q] + & \\ +f(1-\pi^c)[\omega(1+k-F)-q] + f\pi^c[\omega(1+k-\alpha^c-F)-q] & \text{if } \theta=1, \end{cases} \tag{4}$$

where $\theta = \{0,1\}$ indicates if the client is a violent individual or not (non-violent $\theta=0$, violent $\theta=1$). We assume a fixed proportion of violent individuals equal to v. We let k denote the gratification for sex net of all non-monetary costs including the stigma and $\omega \in [0, \bar{\omega}]$ the client's lifetime earnings, distributed according to the cdf G_ω, whose pdf is g_ω. We assume that ω is distributed independently from θ. There

are two enforcement risks for customers, respectively for buying prostitution and for violent crimes. We let π^c denote the probability of being sentenced for violent crimes and α^c the legal sanction in such a case. Conversely, f is the probability of being sentenced for buying prostitution and F is the associated sanction. We assume that the two enforcements are separate for simplicity.[8] Individuals who do not buy prostitution services simply have utility

$$V_h(\theta,\omega) = \begin{cases} \omega & \text{if } \theta = 0 \\ (1-\pi_h^c)\omega + \pi_h^c\omega(1-\alpha^c) & \text{if } \theta = 1, \end{cases} \tag{5}$$

where π_h^c is the risk of being denounced for violence outside the prostitution market. Total demand for prostitution is

$$D = v\left[1 - G_\omega\left(\frac{q}{k - fF - \alpha^c(\pi^c - \pi_h^c)}\right)\right] + (1-v)\left[1 - G_\omega\left(\frac{q}{k-fF}\right)\right], \tag{6}$$

where $q/(k - fF - \alpha^c(\pi^c - \pi_h^c))$ and $q/(k - fF)$ are the threshold income level above which violent and non violent individuals respectively choose to demand prostitution services.

The key features of the model are the endogenous risks of being a victim of violence for the sex workers and the endogenous conviction risk facing the violent customers in the prostitution market. The violence risk in the prostitution market π^{sw} is equal to the probability of being matched with a violent client, which is equal to the ratio of violent to total clients. We have then

$$\bar{\pi}^{sw} = \frac{v\left[1 - G_\omega\left(\frac{q}{k - fF - \alpha^c(\pi^c - \pi_h^c)}\right)\right]}{D}. \tag{7}$$

We assume that violent individuals who do not buy prostitution services express their violence outside the prostitution market with a frequency x — possibly different from the one observed in the market — which will be calibrated to match some features of the Swidish prostitution market. Thus, violence risk outside the market for individuals who do not sell prostitution services is equal to the relative proportion of violent individuals who do not buy prostitution multiplied by the frequency factor x

$$\bar{\pi}_h^{sw} = x\frac{vG_\omega\left(\frac{q}{k - fF - \alpha^c(\pi^c - \pi_h^c)}\right)}{1 - D}. \tag{8}$$

[8] In case of enforcement for violence, it is also likely that the customer will be fined for prostitution. We considered this alternative model obtaining very similar results.

The conviction risk for violent customers is instead equal to the ratio of sex workers who denounce to total supply, multiplied by the probability γ that a denounce leads to a conviction sentence

$$\bar{\pi}^c = \gamma \frac{\int_0^{\gamma b} G_u \left(\frac{q}{s+(\pi^{sw}-\pi_h^{sw})(\alpha^{sw}+\delta-\gamma b)} \right) h(\delta)\, d(\delta)}{S}. \tag{9}$$

We define the harm associated with the market equilibrium as the mass of individuals who experience violence in equilibrium. Denoting the equilibrium quantity $Q = D = S$, we have

$$H = \bar{\pi}^{sw} Q. \tag{10}$$

Finally, total harm, obtained by adding violence inside (Q) and outside ($1 - Q$) the market, is equal to

$$H^{tot} = \bar{\pi}^{sw} Q + \bar{\pi}_h^{sw} (1 - Q). \tag{11}$$

B. Numerical Solution

In order to proceed to a solution, we have to pick a specific distribution for δ, u and ω. For δ we simply consider a uniform in the support $[0, \bar{\delta}]$. For u and ω we choose instead the Gamma family, since this allows for several possible shapes on a positive support. More formally, we assume $u \sim \Gamma[\theta^u, \beta^u]$ and $\omega \sim \Gamma[\theta^\omega, \beta^\omega]$, where the pdf of the gamma distribution is

$$f(x; \theta, \beta) = \frac{1}{\beta^\theta\, (\theta - 1)!}\, x^{\theta-1}\, e^{-\frac{x}{\beta}} \qquad\qquad x > 0. \tag{12}$$

Consistently with the empirical analysis, we target our numerical solution to Sweden. We use data from the "Prostitution i Sverige" report (Priebe and Svedin, 2012) to gather information on sex workers and their clients. The report includes both a survey of the general population and a survey administered by the prostitution units that routinely contact sex workers. The general population survey covers a total of roughly 5 thousand individuals between 18 and 65 years of age, and asks about sexual behavior, including the episodes in which the respondents paid or received money in exchange for sex. One potential limitation of the survey is that, since buying prostitution is illegal, there might be under-reporting of demand. The prostitution unit survey, instead, reports information for 326 sex workers.

Overall 5% of the respondents reported to have purchased sex during their lifetime. However only 0.2% of the women respondents and 10.2% of the men reported a purchase. This justifies a focus on male clients. 58% of the male customers are between 50 and 65 years old, 31.5% between 35 and 49, 8.9% between 25 and 34 and only 1.6% between 15 and 24. The average age is therefore 49.5 years. Considering a life expectancy of roughly 80 years for Swedish males (Statistics Sweden), we have a residual life expectancy of slightly more than 30 years for clients. We will use this number to compute the expected loss in case of sentences. The average age of the sex workers is instead 31 years, which, considering a life expectancy of 84 years for women in Sweden, implies 53 years of residual life expectancy. Notice that, for this computation, we are assuming that sex workers have the same life expectancy of other individuals, which might be a strong assumption given that they are exposed to mental and physical hazards. As for the age profile, 3% of the sex workers are unfortunately less than 18 years old, 33% between 18 and 25, 34% between 26 and 35 and 30% older than 36. We will use these numbers to compute the expected loss in case of violence.

Using income data for customers and sex workers, we pin down the parameters of the distributions of u and ω with a simulation procedure. Looking at the empirical distributions of income, we have that 6.7% of the customers reported an income below 15(k) SEK, 22.1% between 15(k) and 25(k) SEK, 37.9% between 25(k) and 35(k) SEK and 33.2% above 35(k) SEK. Conversely, 25% of the women that reported selling sex have an income below 15(k) SEK, 50% between 15(k) and 25(k) SEK, 12.5% between 25(k) and 35(k) SEK and 12.5% above 35(k) SEK. We draw artificial random samples of 1000 individuals from these empirical distributions of income and then estimate, on each sample, the parameters of a gamma distribution by maximum likelihood. We repeat the procedure 1000 times for each distribution and then parametrize the model according to the average MLE estimates. The resulting estimated parameter values are (in thousands of SEK) $\theta^u = 3.35$, $\beta^u = 9.66$ for sex workers and $\theta^\omega = 3.64$ and $\beta^\omega = 16.84$ for customers.

We also use judiciary data from Statistics Sweden on denounces and convictions for violent crimes and for prostitution. In 2016 there were 603 individuals prosecuted for purchase of sexual services. For 270 of those, or 44.8% of the total, there was a conviction. We set the enforcement probability for sex workers' clients dividing the number of convictions by the total number of purchases of sex services in a year. Out of the 10.2% adult males that declared to have purchased sex over their lifetime, only 11.4% declared to have purchased it in the past year, which accounts for 1.12% of the

total male population, or 56000 individuals considering roughly 5 millions male residents in Sweden. We take this number as representative of the total number of males that typically buys sex in any given year. Dividing the number of convictions by the number of individuals that typically buys sex, we end up with $f = 270/56000 = 0.48\%$. The conviction in roughly 85% of the cases is a fine corresponding to 50 days of wage. The remaining cases are jail sentences of up to six months. Considering a residual life expectancy of 30 years for clients, the expected fine is roughly 0.63% of the income capacity.[9] Thus we set $F = 0.0063$ accordingly.

In 2016 there were 5597 convictions for assault, of which 1101 where imprisonments, mostly for aggravated assault. There were also 171 convictions for rape. Total reported assaults and rapes in 2016 are, respectively, 88576 and 6715. Therefore there is a $(5597+171)/(88576+6715) = 6.05\%$ probability of sentence when denounced, assuming that all trials are completed in the same year of the denounce. We therefore set $\gamma = 0.0605$.

The minimum sentence for rape and aggravated assault is 10 years. Given that the average life time expectancy of the clients is 30 years, the minimum sentence entails a loss at least equal to 1/3 of the expected lifetime income. The relative proportion of imprisonments is however 20% (1101/5597). In the remaining 80% of the cases, the sentence is a fine. We assume that, on average, the fine entails a loss equal to half of what the minimum sentence for assault entails. We end up with an average loss in case of sentence of $0.2(33\%) + 0.8(16.5\%) = 19.8\%$ of the residual lifetime income. We set $\alpha^c = 0.198$ accordingly.

Assault victims are typically granted a 115(k) SEK compensation for rape (Statistics Sweden). Considering a residual life expectancy of 53 years for sex workers and an average income of 31(k) SEK per year, the compensation is actually 7% of the lifetime income. Therefore we set $b = 0.07$.

Unfortunately we don't have data on the damages from violent behavior. In the baseline parametrization we assume that the damage is equal to the compensation, $\alpha^{sw} = b$, but we consider robustness to different values.

The remaining parameters k, v, s, $\bar{\delta}$, x and π_h^c are calibrated to match: i) the observed quantity of prostitution exchanged in equilibrium; ii) the price; iii) the probability of being victim of a violent crime in the prostitution market; iv) the probability to be

[9] Given 365*30 years=10950 days of expected residual life, 50 days of wage is 50/10950=0.45% of the income capacity, while 6 months are 0.5/30=1.67% The weighted average is therefore 0.85(0.45%)+0.15(1.67%)=0.63%

victim of a violent crime for women outside the prostitution market; v) the risk of being sentenced for violent crimes; vi) the total number of denounces for violence (rape and assault). The price of prostitution in Sweden is reported to be between a minimum of 500 SEK for a street transaction in Malmo (newspapers reports), to a maximum of roughly 2(k) SEK per hour for escorts that procure online (research conducted on various specialized webpages). We consider a benchmark target level of 1(k) SEK.

For the target quantity we start instead from the 10% fraction of male residents that reported to have purchased sex at least once during their life. Out of this total figure, 37.5% declared to have purchased prostitution just once, 24.5% twice or three times, 25.3% between 4 and 10 times, and 12.7% more than 10 times (of which 2.8% are actually regular users, with more than 50 times). The average number of purchase per customers is thus 7.65 or 0.25 times per year (once every 4 years) given 30 years of residual life expectancy. Therefore we end up with a yearly demand of $0.25(10\%) = 2.5\%$.

In the survey, 12.8% of the women who never sold sex reported to have been victim of violence, while 37.5% of the women who sold sex reported the same. Since this percentages are cumulative over the entire past lifespan, we divide these figures by the average age of the sex workers, 31 year, minus 18, to focus only on the adult age, assuming that this probability is time invariant. We end up with $\pi^{sw} = 0.0288$ and $\pi_h^{sw} = 0.0098$. The total number of denounced violent act against women (rape+assault) in 2016 is 35855. This total is for both women who supplied sex and women who did not. This is equal to the number of episodes of violence inside and outside the market multiplied by the respective fractions of women who denounce inside and outside the market. The number of episodes is in turn equal to the number of individuals multiplied by the violence risk. Since sex workers in the market are matched, on average, with more partners with respect to comparable individuals outside the market, we multiply the violence risk in the market by a coefficient equal to the average reported number of episodes of sale of sexual services in the survey, $\beta = 11$. It follows that $35855 = \pi^{sw}\beta S(\pi^c/\gamma) + \pi_h^{sw}(1-S)(\pi_h^c/\gamma)$, where S is the prostitution supply and where π^c/γ is the fraction of sex workers who denounce and π_h^c/γ the fraction of women outside the prostitution market who denounce.

The resulting parameter values are $k = 0.0160$, $v = 0.03$, $s^{sw} = 0.0750$, $\bar{\delta} = 0.0180$, $x = 0.4832$ and $\pi_h^c = 0.0090$.[10]

[10]The model is solved with a simple guess and verify procedure over a grid of values for the enforcement risk for the customers. For each enforcement risk we compute demand, violence risk outside the prostitution market and violence risk in the prostitution market, all of which are functions of the

C. Comparative Statics

In this section we evaluate numerically the effects of alternative policies on equilibrium quantity, violence and violence risk inside and outside the market, denounce risk, and total harm.[11] To fully understand the effects of our main policies it is important to notice the key forces driving our numerical results. First, since in our model individuals are "intrinsically" violent, they do not have the choice between being violent or not. Therefore, as an effect of the policy, they change their demand for prostitution services, that is they choose between being violent in the prostitution market or outside of it. In other words, public intervention changes the relative proportion of violent individuals inside and outside the prostitution market, without decreasing the overall number of violent individuals in society. Moreover, the possibility of being violent outside the prostitution market implies that violent individuals' demand is more elastic with respect to enforcement for prostitution and to enforcement for violence than non-violent individuals' demand. Second, violent individuals, when outside the prostitution market, are violent with exogenous frequency x, while, when in the market, they are violent with frequency 1. $x > 1$ means that violent individuals are more prone to express their violence outside the market, while $x < 1$ that they are more likely to be violent when they demand prostitution. Since our calibrated x is lower than 1, we have that any policy that drives one violent individual outside the market reduces total expected harm.

The first policy we study is the introduction of a punishment for buying prostitution services, akin to moving from a laissez-faire regime to a Nordic Model where buying, but not selling, prostitution is prosecuted.

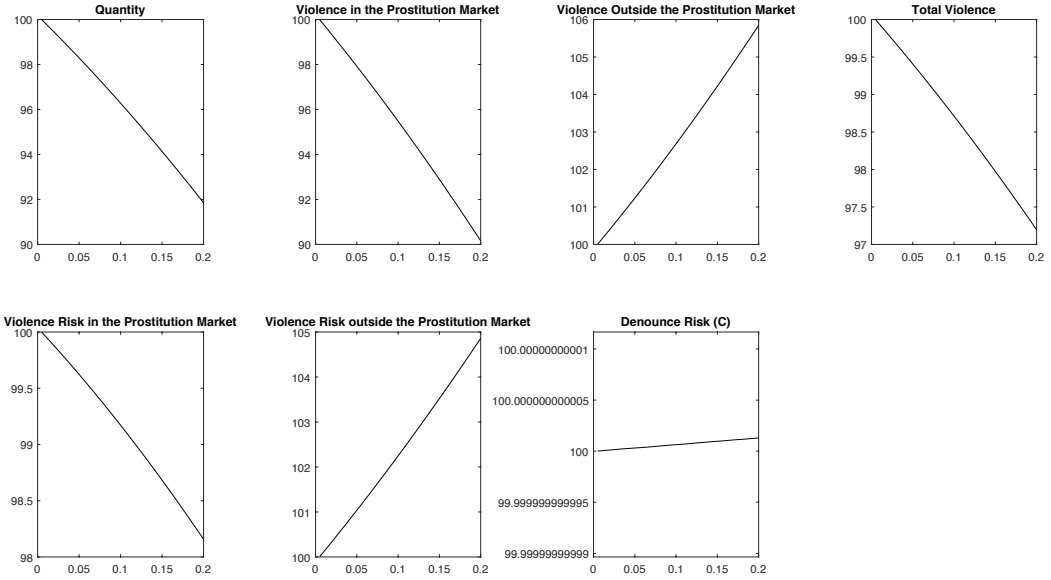
Enforcement for buying prostitution. Since all that matters is the product fF, we consider the comparative statics with respect to the probability of being sanctioned f (see Figure 9) while we omit the one with respect to the sanction F[12]. We start at value of $f = 0$, which corresponds to a regime where buying prostitution

price. We also compute demand, as a function of price, integrating numerically over delta with a simple quadrature. We then select the equilibrium price at which demand and supply are equal. Once we have the equilibrium supply, demand and violence risk for each guess, we compute the implied enforcement risk for customers, which is the one consistent with the equilibrium price. We then select the equilibrium value for the enforcement risk as the one such that the implied enforcement risk is equal to the initial guess, and compute the final solution using the same procedure.

[11] Since the model does not have a closed form solution we focus on numerical results.

[12] Notice that the proposal raised with the occasion of the tenth jubilee of the law, by the police and some former sex workers interviewed for a report, to double the sanction for buying sex would go in this same direction.

FIGURE 9: **Effect of enforcement for buying prostitution (f)**



Notes: Enforcement for buying prostitution f varies from 0.5% to 8.5%. All magnitudes are standardized to 100 for the benchmark calibration $f = 0.48\%$.

is not illegal. Moving from $f = 0$ to a positive f entails adopting what we call the Scandinavian approach towards prostitution. Increasing f decreases the demand both from violent and non-violent customers, but the demand from violent customers is more elastic to f because they can be violent outside the prostitution market. In greater detail, the different relative sensitivity of the demand from violent and non-violent customers to policy changes depends on three factors: i) the relative proportion of violent individuals $(v/(1-v))$; ii) the shape of the income distribution $(G_\omega(.))$; and iii) the different sensitivity to policy changes of the threshold income level above which violent $(q/(k - fF - \alpha^c(\pi^c - \pi_h^c)))$ and non violent individuals $(q/(k - fF))$ choose to demand prostitution. This difference is due to violent individuals being subject to a

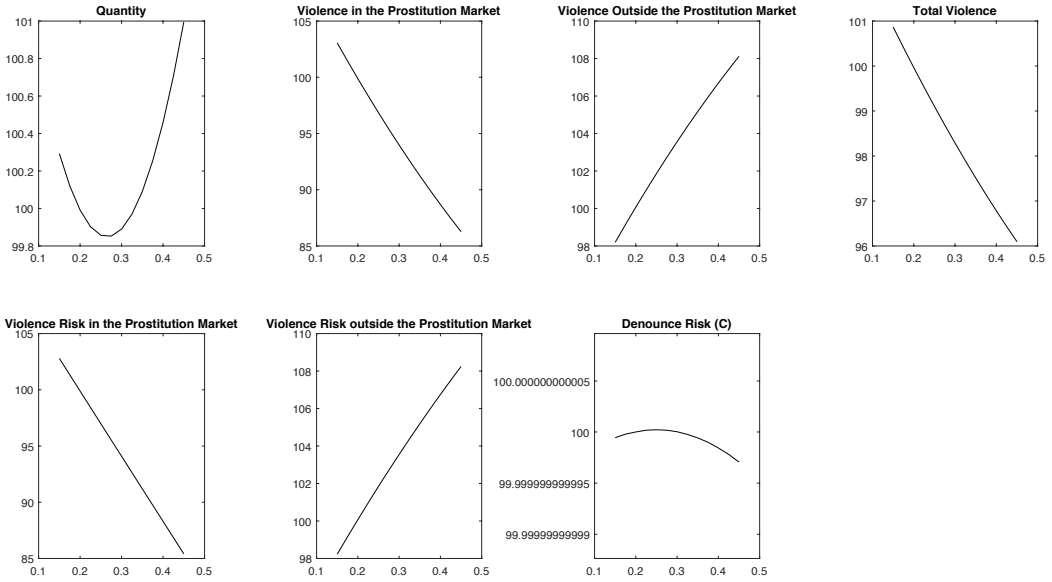
double enforcement risk — for buying prostitution and for violence — while non violent individuals only to the former. The magnitude of this latter effect (iii) is affected by the former two factors so that the net effect highlighted in Figure 9 is indeed a numerical result. Since, as explained above, violent individuals in the market decrease more rapidly than non-violent customers the individual risk for the sex workers decreases and, therefore, violence in the prostitution market goes down. The equilibrium price also decreases as an effect of the lower demand. The final outcome is a smaller, cheaper and less violent market. The quantity decrease, however, is not very large, because the prostitution market is relatively safer than before, which stimulates supply. Moreover, since both the individual cost of denouncing δ and the expected benefit from a denounce γb are not affected by the enforcement for buying prostitution, the fraction of sex workers who denounce and, therefore, the enforcement risk for violent customers does not vary. The side effect of an increase in f is that violent individuals, who are displaced from the prostitution market, increase violence risk and violence itself outside the market. The effect of the increase in f on total violence is therefore twofold: it increases as an effect of the increased violence outside the market and it decreases as an effect of the decreased violence in the market. However, since violent individuals outside the market are violent with a (calibrated) frequency $x < 1$, the net effect of an increase in f is a slight decrease of total violence.

In the rest of the section we consider three other comparative statics: an increase in the sanction for violent behaviors both inside and outside the market; an investment which increases judicial efficiency in trials following denounces for violent behavior, leading more often to a conviction (equivalently, to an investment which increases the reparation damages following a conviction); an increase in the stigma for sex workers.

Enforcement for violence. In Figure 10 we consider the comparative statics with respect to the sanction against violence, α^c. Increasing the enforcement for violence decreases the demand from violent customers only, thereby significantly decreasing violence risk for the sex workers. The intuition for this result is specific to our numerical exercise with Swedish data. Specifically, since the endogenous probability π^c of being denounced for violent crimes when in the prostitution market is larger than the calibrated (for Swedish data) risk of being denounced for violence outside the prostitution market π_h^c, violent individuals choose to exit from the market when α^c increases, thereby increasing violence outside the market. This decreased individual risk for the sex workers stimulates supply. The net effect of the decreased demand from violent individuals and of the increased supply is first a decrease and then an increase

which leaves almost unchanged the equilibrium quantity.The significantly lower risk in the prostitution market, combined with the very small changes in equilibrium quantity, determines a less violent prostitution market. However violent individuals who are displaced from the prostitution market increase the violence risk and violence outside the prostitution market. The net effect on total violence is a decrease. Notice that, as we already stressed above, violent individuals in our model cannot choose to be violent, but they can only choose whether to demand or not prostitution. If they don't, they stay outside the market and they are violent with frequency $x < 1$.

FIGURE 10: **Effect of enforcement for violence** (α^c)



Notes: Enforcement for violence α^c varies from 15% to 40%. All magnitudes are standardized to 100 for the benchmark calibration $\alpha^c = 19.8\%$.

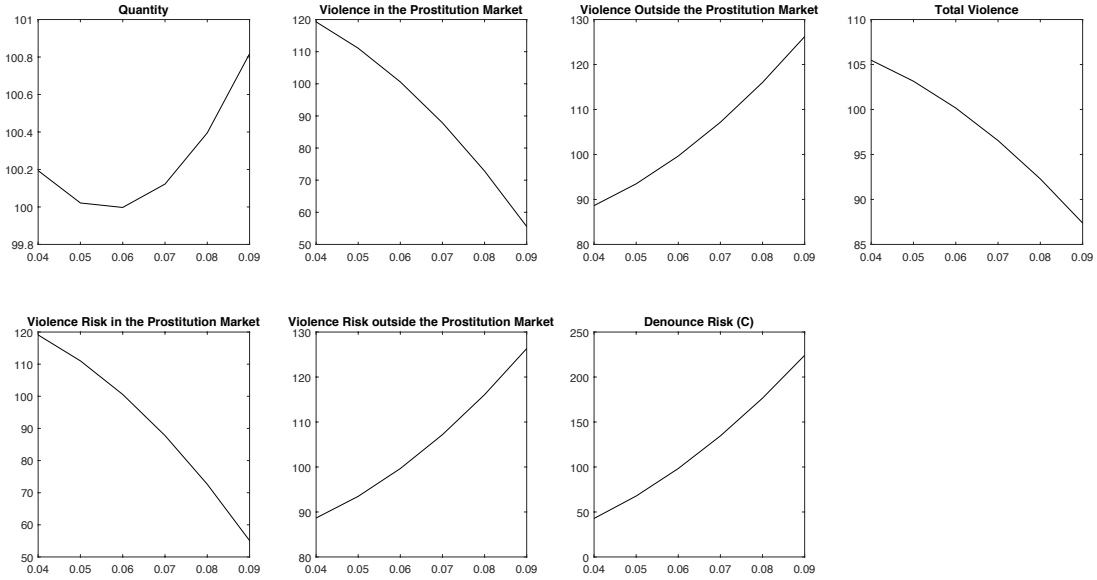
Effectiveness of courts. In Figure 11 we change the efficiency of the courts at converting denounces into convictions, γ. We omit the comparative statics with respect

to the benefit b because what matters is the product γb. If the courts become more efficient at converting denounces into sentences, i.e. higher γ, there will be an increase in the fraction of sex workers who denounce, so an increase of the enforcement risk for violent customers. This bigger enforcement risk decreases demand from violent individuals, thereby reducing both violence and violence risk in the market. In turn, this lowers the equilibrium price and stimulates supply, albeit there is only a small increase of equilibrium quantity. As in the case of the enforcement for violence, the violent individuals who are displaced from the market will increase violence risk and violence outside the prostitution market. The net effect on total violence is a significant decrease, which depends on the massive displacement of violent individuals outside the market togheter with the calibrated lower frequency of violence ($x < 1$) of those individuals outside the market.

Stigma. In Figure 12 we increase the stigma for the sex workers. Such a change in the stigma entails moving in the direction of a prohibition regime where the social sanction for being a sex worker is higher.[13] Bigger stigma translates into a lower supply and higher price, which decreases demand both from violent and non violent customers. As in the case of an increase in f, the demand from violent customers decreases more, thereby reducing violence risk and, therefore, violence in the prostitution market. The final outcome is a smaller, more expensive and less violent market. However, violence increases outside the prostitution market, since the violent individuals who live the prostitution market increase the violence risk outside the market. The net effect on total violence is a decrease, once again as an effect of the estimated frequency of violence by violent individuals outside the prostitution market $x < 1$, as compared to 1 in the market.

[13] On the relation between legal regimes and stigma see Immordino and Russo (2015).

FIGURE 11: **Effect of the efficiency of the courts (γ)**



Notes: Efficiency of the courts γ varies from 4% to 9%. All magnitudes are standardized to 100 for the benchmark calibration $\gamma = 6.05\%$.

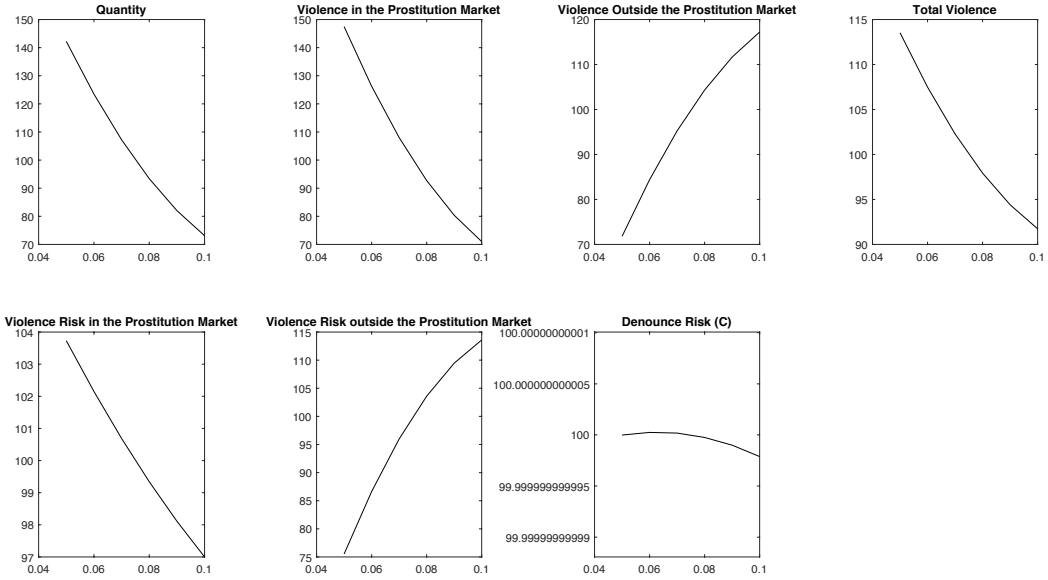
VI Conclusions

When adopting a version of the Nordic Model in 2014, the Canadian Department of Justice stated that the "overall objectives [of the reform] are to:

- Protect those who sell their own sexual services;
- Protect communities, and especially children, from the harms caused by prostitution; and
- Reduce the demand for prostitution and its incidence."

The analysis in this paper suggests that the Nordic Model results in a smaller prostitution market, in line with the third objective. However the displacement of violent

FIGURE 12: **Stigma for sex workers (s)**



Notes: Stigma for sex workers s varies from 5% to 10%. All magnitudes are standardized to 100 for the benchmark calibration $s = 7.5\%$.

individuals has important spillover effects, namely an increase in violence outside the prostitution market, most notably in the form of domestic violence. This is in line with previous research, showing that restrictions on the sexual services market, rather than the sex trade itself, have substantial negative impacts on communities and sex workers. Moreover, consider that our estimates of the spillover are most likely a lower bound of the true effect since they do not take into account "exported violence" against sex workers in other countries. [14]

[14]Data on sex tourism, that would allow to investigate this extra effect, are not available. We are working on estimates based on proxies in another project.

Nevertheless it is understandable that legislators in many countries, sharing similar concerns and expectations as expressed by the Canadian DoJ, find it unattractive to legalize prostitution. Our primary goal is to inform the debate on the effects of different legal regimes of prostitution. The positive effects, namely a smaller and probably safer market for sexual services, must be necessarily weighed against the increase in other forms of gender-based violence. Taking into account side-effects such as the ones we highlight, might reveal the need for complementary policies, in order to avoid unexpected and counterproductive consequences. The study of the optimal mix of policies, which we leave for further research, calls for a richer model encompassing the possibility to repress — as opposed to simply transferring — violence. For the time being we believe that assuming a fraction of intrinsically violent individuals is a realistic assumption and a good starting point.

References

[1] Amnesty International. 2016. "The human cost of 'crushing' the market; criminalization of sex work in Norway," executive summary.

[2] Arunachalam R. and Shah M. 2008. "Prostitutes and Brides?" *American Economic Review Papers and Proceedings*, 98, 516–522.

[3] Bisschop P., Kastoryano S. and Van der Klaauw B. 2017. "Street Prostitution Zones and Crime", *American Economic Journal: Economic Policy*, 9, 28–63.

[4] Cameron, S. 2002. "The Economics of Sin," Edward Elgar Publishing Limited, Cheltenham.

[5] Cameron, S., Alan Collins and Neill Thew. 1999. "Prostitution Services: An Exploratory Empirical Analysis," *Applied Economics*, 31: 1523-9.

[6] Cameron, S. and Alan Collins. 2003. "Estimates of a Model of Male Participation in The Market for Female Heterosexual Prostitution Services," *European Journal of Law and Economics*, 16: 271-88.

[7] Cameron L., Muz J. and Shah M. 2016. "Crimes of Morality: Unintended Consequences of Criminalizing Sex Work," (UCLA Working Paper).

[8] Ciacci, Riccardo and Maria M. Sviatschi, 2018. "The Effect of Indoor Prostitution on Sex Crime: Evidence from New York City," available at http://www.micaelasviatschi.com/wp-content/uploads/2018/07/sex_cr_17_7_18.pdf

[9] Ciacci, Riccardo, 2019. "Banning the purchase of prostitution increases rape: evidence from Sweden,"

[10] Cunningham, Scott, Gregory DeAngelo, and John Tripp, 2019. "Craigslist Reduced Violence Against Women," available at http://scunning.com/craigslist110.pdf

[11] Cunningham, Scott, and Manisha Shah, 2018. "Decriminalizing indoor prostitution: Implications for sexual violence and public health," *The Review of Economic Studies*, 85.3, 1683-1715.

[12] Della Giusta, Marina, Laura Di Tommaso, Maria, Jewell, Sarah L., 2016. "Stigma and risky behavior among clients of prostitutes," in Handbook of the Economics of Prostitution, S. Cunningham and M. Shah eds., Oxford University Press.

[13] Della Giusta, Marina, Maria Laura Di Tommaso, and Steinar Strom. 2009. "Who is watching? The market for prostitution services," *Journal of Population Economics*, 22: 501-516.

[14] Edlund, L. and E. Korn. 2002. "A theory of prostitution," *Journal of political Economy,* 110(1),181–214.

[15] Gertler, Paul, Manisha Shah and Stefano M. Bertozzi. 2005. "Risky Business: The Market for Unprotected Prostitution," *Journal of Political Economy,*113, 518-550.

[16] Gertler, Paul and Manisha Shah. 2011. "Sex Work and Infection: What's Law Enforcement Got to do with it? "*Journal of Law and Economics*, 54(4), 811-840.

[17] Immordino, Giovanni and Francesco F. Russo. 2015. "Laws and stigma: the case of prostitution", *European Journal of Law and Economics*, 40, 209-223.

[18] Immordino, Giovanni and Francesco F. Russo. 2015. "Regulating prostitution: an health risk approach", *Journal of Public Economics*, 121, 14-31.

[19] Immordino, Giovanni and Francesco F. Russo. 2016. "Optimal prostitution policy", in Handbook of the Economics of Prostitution, S. Cunningham and M. Shah eds., Oxford University Press.

[20] Immordino, Giovanni and Francesco F. Russo. 2017."Commercial Sex and Health", Encyclopedia of Law and Economics, Marciano and Ramello ed. Springer.

[21] Iyer, Lakshmi, A. Mani, P. Mishra, and P. Topalova, 2012. "The power of political voice: women's political representation and crime in India," *American Economic Journal: Applied Economics,* 4.4, 165-93.

[22] Lee S., and Persson P. 2015. "Human Trafficking and Regulating Prostitution," (IFN Working Paper No. 996).

[23] Lee S., and PERSSON P. 2016. "Violence and Entry in the Market for Sex," in Handbook of the Economics of Prostitution, S. Cunningham and M. Shah eds., Oxford University Press.

[24] Jakobsson, N., and Kotsadam, A. 2011. "Gender equity and prostitution: An investigation of attitudes in Norway and Sweden," *Feminist Economics*, 17(1), 31–58.

[25] Jakobsson, N., and Kotsadam, A. 2013. "The law and economics of international sex slavery: prostitution laws and trafficking for sexual exploitation," *European Journal of Law and Economics*, 35(1), 87âĂŞ107.

[26] Kotsadam, Andreas and Niklas Jakobson. 2011. "Do laws affect attitudes? An assessment of the Norwegian prostitution law using longitudinal data.," *International Review of Law and Economics*, 31(2), 103-115.

[27] Kotsadam, Andreas and Niklas Jakobson. 2014. "Shame on you, John! Laws, stigmatization, and the demand for sex," *European Journal of Law and Economics*, 37(3), 393-404.

[28] Miller, Amalia R., and Carmit Segal, 2018. "Do Female Officers Improve Law Enforcement Quality? Effects on Crime Reporting and Domestic Violence," *The Review of Economic Studies*, available at https://academic.oup.com/restud/advance-article/doi/10.1093/restud/rdy051/5101317

[29] Moffatt, Peter G. and Simon A. Peters. 2004. "Pricing Personal Services: An Empirical Study of Earnings in the UK Prostitution Industry," *Scottish Journal of Political Economy,* 51: 675-690.

[30] Priebe, Gisela and Carl Goran Svedin. 2012. "Prostitution i Sverige "Lunds University and Linkopings University Working Paper.

[31] Rao, Vijayendra, Indrani Gupta, Michael Lokshin and Smarajit Jana. 2003. "Sex Workers and The Cost of Safe Sex: The Compensating Differential for Condom Use Among Calcutta Prostitutes," *Journal of Development Economics*, 71: 585-603.

[32] SOU. 2010. "Förbud mot köp av sexuell tjänst. En utvärdering 1999-2008. ," *SOU 2010:49*, available at

https://www.regeringen.se/49bb8a/contentassets/2ff955c847ed4278918f111ccca880dd/forbud-mot-kop-av-sexuell-tjanst-en-utvardering-1999-2008-sou-201049

[33] Vanwesenbeeck, Ine. 2017. “Sex Work Criminalization Is Barking Up the Wrong Tree,” Arch Sex Behav.