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THE MODEL OF CORRUPTION AND PUNISHMENT ON AN ILLEGAL MARKET

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The present paper examines the relationship between illegal activity and corruption as a means to overcome legal prohibition of the former. This relationship is modeled by endogenous determination of probability of punishment for illegal activity, which is assumed to depend both on the actions of illegal market participants and on the functioning of law enforcement system (to be specific, on the amount of resources available to it in order to counteract illegal activities). Model analysis allows for efficiency evaluation of various measures to combat illegal activity and shows, in particular, that with corrupt law enforcers increased punishment for illegal activity, though being able to restrict its scope, could at the same time aggravate the issue of corruption.

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Introduction

Illegal markets as markets for goods, production and/or consumption of which is unlawful, are an integral part of the world economy, though being varied in scale and range of supply. Economically, a distinction between illegal markets and legal ones lies in different types of contract enforcement mechanisms and, consequently, different levels of transaction costs. While contracts in the markets for legal goods are enforced by the state (i.e. by the judiciary), there is no such enforcement in illegal, or 'shadow' markets. At the same time, because illegal markets agents are subject to state prosecution, informal contract enforcement mechanisms they employ become subjected to similar sanctions. Counteraction to these sanctions may mean attempts to bribe law enforcers responsible for that, that is, creates incentives for establishing corrupt relations with them. In other words, interaction between the state and the illegal sector creates a substantial potential for corruption, which as a means to overcome prohibition may be seen as a specific feature of such markets.

A typical example of an illegal market is the market for illegal prostitution. It is relatively more open to observation in contrast to other illegal markets, such as illegal drugs or weapons market: sexual services are widely advertised in the media and over the Internet, street prostitutes being part of urban landscape in many European cities. With all that, most of the factors specific to many illegal markets can be revealed by analysis of illegal market for commercial sex.

Though there are different legal regimes with regard to prostitution, the fact often is that the laws do not work in the sense that they either do not reach their goals or are not observed by individuals as well as law enforcement system as a whole (Davis, 1993; Elias et al., 1998; Reynolds, 1986; Sharpe, 1998). As a result, in countries where prostitution is completely prohibited, it continues to exist illegally, and in countries where some types of prostitution are allowed, parallel to the legal sector there is an illegal market for commercial sex, encompassing both allowed and prohibited types of prostitution.

In Russia prostitution is an administrative offence. However, the legislation does not properly define the essence of wrongdoing, law enforcement practice with respect to the relevant Article 6.11 of the Administrative Code thus being quite limited. Chief operating officer of the Ministry of the Interior Eugene Snytkin says that over the second half of 2002 over 2500 people were charged with prostitution (*Moskovskie novosti*, N 24, 2003), while the number of prostitutes in Moscow is estimated at 5 to 20 thousand (14 thousand according to Fedorova, 2002).

Law enforcers' policy towards prostitution in Russia can be largely deemed as non-interference. Despite its unlawfulness, street prostitution in Moscow is widely spread, and even common citizens are well aware of the main "spots" where one can "hook" a prostitute. Obviously, the police are also aware of that, especially as multiple illegal brothels and "saunas" advertise openly. There is plenty of evidence that law enforcers extort bribes from prostitutes in form of money or sexual services (e.g. (Aral et al., 2003); (*Prima information agency*, May 30, 2001; *Moskovskie Novosti*, N 24, 2003). Moreover, current situation in Russia is that "with minor exception, commercial sex sphere is controlled by malfeasant police and special services officers" (*Nezavisimaya Gazeta*, December 23, 2002).

Numerous papers on economics of corruption (see, for example, a review in (Levin, Tsirik, 1998)) do not tend to show any explicit links between those who give bribes and their involvement in any kind of illegal activity. There is little research on economic modeling of commercial sex market (Edlund and Korn, 2002; Giusta et al., 2003), and it does not consider functioning of commercial sex market. At the same time the efficiency of various measures counteracting the negative effects of commercial sex market under corruption cannot be evaluated without economic models of interaction between prostitution (as illegal type of employment) and corruption.

This paper is aimed at filling at least part of this gap and introduce formal economic analysis of interaction between the two illegal markets: the market for prostitution and the market for corruption. Note that the model below is applicable to analysis of various illegal markets. Prostitution, however, is one of the most striking examples of a situation where formally prohibited activity is obviously thriving, in some cases with the connivance of law enforcers, in other cases under their patronage.

The paper is organized as follows. First, the model of prostitute's behavior is developed, which is followed by the model for a law enforcer's behavior. Then the analysis of comparative statics is performed with regard to impact of various control instruments on commercial sex market, and conclusions follow.

The model

Prostitution is in one way or other prohibited in most countries, which makes most of the transactions in commercial sex market illegal. "Illegal status makes prostitutes absolutely powerless and provides wide opportunities for corruption both in law enforcement agencies and in state institutions" (*Nezavisimaya Gazeta*, December 23, 2002). A tentative suggestion can be made that under these circumstances illegal status of prostitution is advantageous for the law enforcement system in general and for individual officers, because it allows them to raise public funds assigned to combating prostitution, as well as receive revenues from corruption related to this illegal business. It is required that the two markets – corruption and commercial sex markets – should be examined in their interrelation in order to see if this suggestion is valid and answer a few other questions.

We will be developing a model of interaction between prostitution and corruption markets basing on the model by Liew (Liew, 1992) modified for the case of commercial sex market and generalized for an arbitrary increasing punishment function. We assume that in case of detention by the police for illegal prostitution a prostitute has to pay a fine as administrative punishment (the size of fine depending on the "market activity" of the prostitute). On the other hand, a prostitute can try to reduce the risk of legal prosecution by paying bribes to corrupt law enforcers, i.e. to "insure" oneself from detention and punishment. Thus we assume that the probability of detention is determined endogenously by the amount of bribes paid (the more bribes, the lower the probability of detention) and the amount of public resources allocated by the state to law enforcers in order to combat prostitution. In a similar way, a law enforcer who receives bribes also faces the risk of being caught and prosecuted, the probability of punishment being positively dependent on the amount of funds allocated to combat corruption among law enforcers. To describe agents' behavior under uncertainty we will assume that their preferences can be represented by expected utility functions with differentiable state-contingent elementary utility functions.

Modeling a prostitute

Assume that elementary utility function for a prostitute is state-contingent. Assume also that in case of detention (the probability of which equals P_p) her utility function is $u_{pa} = wL_p - f_p \cdot \phi_p(L_p) - qb_p$, where w – price of a single commercial sexual act, L_p – quantity of sexual services offered, $f_p\phi_p(L_p)$ – fine for prostitution, where $\phi_p(L_p)$ is a function that determines the "market activity" of a prostitute ($\phi_p'(L_p) > 0$, $\phi_p''(L_p) > 0$, otherwise maximization of a convex function will give border solution only), f_p – basic fine rate, b – the quantity of bribes paid, q – size (price) of one bribe. If a prostitute is not detained (with probability $(1 - P_p)$), her elementary utility function is $u_{pna} = wL_p - qb_p$, i.e. she earns from selling commercial sex and spends on bribe payments only. Therefore, a prostitute's expected utility function is

$$U_p = P_p(wL_p - f_p \cdot \phi_p(L_p) - qb_p) + (1 - P_p)(wL_p - qb_p).$$

As noted above, the probability of detention in this model is determined endogenously and depends on the quantity of bribes paid and amount of public funds spent on combating prostitution: $P_p = P_p(b_p, M_p)$, $P_p(b_p, M_p) \in [0, 1]$, with

$$\frac{\partial P_p(b_p, M_p)}{\partial b_p} < 0, \quad \frac{\partial^2 P_p(b_p, M_p)}{\partial b_p^2} > 0, \quad \frac{\partial P_p(b_p, M_p)}{\partial M_p} > 0 \text{ и } \frac{\partial^2 P_p(b_p, M_p)}{\partial b_p \partial M_p} > 0.$$

In other words, larger quantity of bribes paid reduces (at a declining rate) the probability of punishment for prostitution, while larger amount of resources spent on combating prostitution raises the probability of punishment for prostitution and reduces the efficiency of bribes. Therefore, a prostitute's expected utility maximization problem is as shown below:

$$\max_{L_p, b_p \geq 0} P_p(b_p, M_p)(wL_p - f_p \cdot \phi_p(L_p) - qb_p) + (1 - P_p(b_p, M_p))(wL_p - qb_p) \quad (1)$$

F.O.C for (1) with respect to L_p yields the supply of commercial sex:

$$w - P_p(b_p, M_p) f_p \phi'_p(L_p) = 0. \quad (2)$$

In a similar way, F.O.C for (1) with respect to b_p describes the supply of bribes (i.e. demand for "insurance"):

$$-\frac{\partial P_p(b_p, M_p)}{\partial b_p} f_p \phi_p(L_p) - q = 0. \quad (3)$$

Suppose that (inverse) demand for commercial sex is given exogenously by the function

$$w = D_p(L_c, R), \quad (4)$$

where R – risks related to buying commercial sex from a prostitute (we will take R as fixed and hereinafter omit it from the arguments of the demand function),

L_c – the amount of sex services, $D_p'(L_c) < 0$, $D_p''(L_c) > 0$.

Modeling a law enforcer

We now turn to a law enforcer's problem. Similarly to the above model, we assume that his elementary utility is state-contingent. With probability P_m he can be arrested for receiving a bribe, and in this case his utility equals $u_{ma} = s + qb_m - f_m \cdot \phi_m(b_m)$, where s is his wage (fixed), b_m – quantity of bribes received, q – size (price) of one bribe, $f_m \phi_m(b_m)$ – fine for bribery, depending on the degree of "corruptness" (f_m – basic fine rate, $\phi_m'(b_m) > 0$, $\phi_m''(b_m) > 0$). With probability $(1 - P_m)$ the law enforcer goes unpunished and his elementary utility is determined by his income from bribes: $u_{mna} = s + qb_m$. Then the expected utility of a law enforcer will be the following:

$$U_m = P_m\left(s + qb_m - f_m \phi_m(b_m)\right) + (1 - P_m)\left(s + qb_m\right).$$

We also assume that the probability that a corrupt law enforcer will be punished for bribery is endogenous as well and depends on the amount of public resources assigned to fighting corruption among law enforcers:

$P_m = P_m(M_m)$, $P_m(M_m) \in [0, 1]$,

where $P_m'(M_m) > 0$, i.e. larger amount of resources increases the probability of punishment.

Therefore a law enforcer solves the following problem

$$\max_{b_m \geq 0} P_m(M_m)(s + qb_m - f_m \phi_m(b_m)) + (1 - P_m(M_m))(s + qb_m). \quad (5)$$

F.O.C. for (5) yields the law enforcer's demand for bribes (in other words, the supply of insurance available to prostitutes):

$$q - P_m(M_m) f_m \phi_m'(b_m) = 0. \quad (6)$$

Equilibrium. Allocation (L_p, L_c, b_p, b_m) and prices (w, q) constitute an equilibrium in this model, if

1) The pair (L_p, b_p) solves (1) at equilibrium prices;
2) L_c is determined by (4);
3) b_m solves (5) at equilibrium prices;
4) The market for bribes and the market for commercial sex are balanced: $L_p = L_c$ and $b_p = b_m$. Denote $L_p = L_c \equiv L$ and $b_p = b_m \equiv b$.

Hence, equations (2)—(4) and (6) determine the equilibrium in the market for bribes and the market for commercial sex. Equilibrium in commercial sex market is given by equality of demand for and supply of commercial sex (equations (4) and (2), respectively):

$$D_p(L) = P_p(b, M_p) f_p \phi'_p(L). \quad (7)$$

Equilibrium in bribes market is given by equality of demand for and supply of bribes (that is, supply of insurance and demand for it) (equations (3) and (6), respectively):

$$-\frac{\partial P_p(b, M_p)}{\partial b} f_p \phi_p(L) = P_m(M_m) f_m \phi_m'(b). \quad (8)$$

Comparative statics

We now begin to analyze the impact of policies aimed at combating prostitution and bribery, on commercial sex market, namely, the impact of fines f_p, f_m, and public funds spent on fighting prostitution and corruption, M_p и M_m, on equilibrium levels of prostitution and bribery.

Let us introduce the following notation. Denote $S_p(L, b) = P_p(b, M_p) f_p \phi'_p(L)$ – (inverse) supply function of commercial sex; Denote $D_m(b) = P_m(M_m) f_m \phi_m'(b)$ –

the (inverse) bribe demand function (supply of insurance), and $S_m(L,b) = -\frac{\partial P_p(b,M_p)}{\partial b} f_p \phi_p(L)$ – the (inverse) bribe supply function (demand for insurance). Thus, a very general form of the system of comparative statics equations for control instruments $I = f_p, f_m, M_p, M_m$ will be as follows:

$$\begin{cases} \left(\frac{\partial S_p}{\partial L} - \frac{\partial D_p}{\partial L}\right) \cdot \frac{\partial L}{\partial I} + \left(\frac{\partial S_p}{\partial b} - \frac{\partial D_p}{\partial b}\right) \cdot \frac{\partial b}{\partial I} = -\frac{\partial S_p}{\partial I} + \frac{\partial D_p}{\partial I} \\ \left(\frac{\partial S_m}{\partial L} - \frac{\partial D_m}{\partial L}\right) \cdot \frac{\partial L}{\partial I} + \left(\frac{\partial S_m}{\partial b} - \frac{\partial D_m}{\partial b}\right) \cdot \frac{\partial b}{\partial I} = -\frac{\partial S_m}{\partial I} + \frac{\partial D_m}{\partial I} \end{cases},$$

or, using matrix notation,

$$\begin{pmatrix} \frac{\partial S_p}{\partial L} - \frac{\partial D_p}{\partial L} & \frac{\partial S_p}{\partial b} - \frac{\partial D_p}{\partial b} \\ \frac{\partial S_m}{\partial L} - \frac{\partial D_m}{\partial L} & \frac{\partial S_m}{\partial b} - \frac{\partial D_m}{\partial b} \end{pmatrix} \cdot \begin{pmatrix} \frac{\partial L}{\partial I} \\ \frac{\partial b}{\partial I} \end{pmatrix} = \begin{pmatrix} -\frac{\partial S_p}{\partial I} + \frac{\partial D_p}{\partial I} \\ -\frac{\partial S_m}{\partial I} + \frac{\partial D_m}{\partial I} \end{pmatrix}.$$

Because $\frac{\partial D_p}{\partial b} = \frac{\partial D_m}{\partial L} = \frac{\partial D_p}{\partial I} = 0$, we ultimately have

$$\begin{pmatrix} \frac{\partial S_p}{\partial L} - \frac{\partial D_p}{\partial L} & \frac{\partial S_p}{\partial b} \\ \frac{\partial S_m}{\partial L} & \frac{\partial S_m}{\partial b} - \frac{\partial D_m}{\partial b} \end{pmatrix} \cdot \begin{pmatrix} \frac{\partial L}{\partial I} \\ \frac{\partial b}{\partial I} \end{pmatrix} = \begin{pmatrix} -\frac{\partial S_p}{\partial I} \\ -\frac{\partial S_m}{\partial I} + \frac{\partial D_m}{\partial I} \end{pmatrix}. \tag{9}$$

For convenience, denote the first matrix on the left-hand side of equation (9) as A, $A = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$, where

$$a_{11} \equiv \frac{\partial S_p}{\partial L} - \frac{\partial D_p}{\partial L} = P_p(b,M_p) f_p \phi_p''(L) - D_p'(L) > 0, \tag{10}$$

$$a_{12} \equiv \frac{\partial S_p}{\partial b} = \frac{\partial P_p}{\partial b} f_p \phi_p'(L) < 0 \tag{11}$$

$$a_{21} \equiv \frac{\partial S_m}{\partial L} = -\frac{\partial P_p}{\partial b} f_p \phi_p''(L) > 0, \tag{12}$$

$$a_{22} \equiv \frac{\partial S_m}{\partial b} - \frac{\partial D_m}{\partial b} = -\frac{\partial^2 P_p}{\partial b^2} f_p \phi_p(L) - P_m f_m \phi_m''(b_m) < 0. \tag{13}$$

Generally, the sign of $\det A = a_{11}a_{22} - a_{12}a_{21}$ is undefined, as implied by (10)—(13). To find the conditions under which the sign will be unambiguous, we transform equations (10)—(13):

$$a_{11} = P_p(b,M_p) f_p \phi_p''(L) - D_p'(L) = \frac{S_p \phi_p''(L)}{\phi_p'(L)} - D_p'(L) =$$

$$= \frac{S_p \varepsilon(\phi_p'(L),L)}{L} - \frac{D_p(L)\varepsilon D_p((L),L)}{L},$$

where $\varepsilon(\phi_p'(L),L) = \frac{\phi_p''(L) \cdot L}{\phi_p'(L)}$ is elasticity of $\phi_p'(L)$ with respect to L; similarly, $\varepsilon(D_p(L),L) = \frac{D_p'(L) \cdot L}{D_p(L)}$ is elasticity of $D_p(L)$ with respect to L.

In equilibrium $S_p = D_p$, therefore, we ultimately obtain

$$a_{11} = \frac{S_p}{L}(\varepsilon(\phi_p'(L),L) - \varepsilon(D_p(L),L)). \tag{14}$$

Other elements of matrix A are transformed in a similar way.

$$a_{12} = \frac{S_p}{b} \varepsilon(P_p(b,M_p),b), \tag{15}$$

where $\varepsilon(P_p(b,M_p),b) = \frac{\partial P_p(b,M_p)}{\partial b} \cdot \frac{b}{P_p(b)}$ is elasticity of $P_p(b,M_p)$ with respect to b.

$$a_{21} = \frac{S_m}{L} \varepsilon(\phi_p(L),L), \tag{16}$$

where $\varepsilon(\phi_p(L),L) = \frac{\phi_p'(L) \cdot L}{\phi_p(L)}$ is elasticity of $\phi_p(L)$ with respect to L.

$$a_{22} = \frac{S_m}{b}\left(\varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon(\phi_m'(b),b)\right), \tag{17}$$

where $\varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) = \frac{\partial^2 P_p}{\partial b^2} \cdot \frac{b}{\partial P_p / \partial b}$ is elasticity of $\frac{\partial P_p}{\partial b}$ with respect to b, and $\varepsilon(\phi_m{}'(b), b) = \frac{\phi_m{}''(b) \cdot b}{\phi_m{}'(b)}$ is elasticity of $\phi_m{}'(b)$ with respect to b.

The determinant of matrix A can thus be put down as shown below:

$$\det A = \begin{vmatrix} \frac{S_p}{L}(\varepsilon(\phi_p{}'(L), L) - \varepsilon(D_p(L), L)) & \frac{S_p}{b}\varepsilon(P_p(b, M_p), b) \\ \frac{S_m}{L}\varepsilon(\phi_p(L), L) & \frac{S_m}{b}\left(\varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon(\phi_m{}'(b), b)\right) \end{vmatrix} =$$

$$= \left(\frac{S_p \cdot S_m}{L \cdot b}\right) \cdot \begin{vmatrix} \varepsilon(\phi_p{}'(L), L) - \varepsilon(D_p(L), L) & \varepsilon(P_p(b, M_p), b) \\ \varepsilon(\phi_p(L), L) & \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon(\phi_m{}'(b), b) \end{vmatrix}. \quad (18)$$

To make it more clear, we introduce the following notation:

$\tilde{a}_{11} = \varepsilon(\phi_p{}'(L), L) - \varepsilon(D_p(L), L)$;

$\tilde{a}_{12} = \varepsilon(P_p(b, M_p), b)$;

$\tilde{a}_{21} = \varepsilon(\phi_p(L), L)$;

$\tilde{a}_{22} = \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon(\phi_m{}'(b), b)$.

Then $\det A = \left(\frac{S_p \cdot S_m}{L \cdot b}\right)\left(\tilde{a}_{11}\tilde{a}_{22} - \tilde{a}_{21}\tilde{a}_{12}\right)$.

Suppose that elasticity $\phi_p(L)$ with respect to L is constant, $\varepsilon(\phi_p(L), L) = const$. It means that a ratio of percentage change in the amount of sexual services offered by a prostitute to a percentage change in punishment is approximately constant.

We prove that in this case $\varepsilon(\phi'_p(L), L)$ is also constant and $\varepsilon(\phi_p(L), L) > \varepsilon(\phi'_p(L), L)$[1]. Indeed,

$$\frac{d\varepsilon(\phi_p(L), L)}{dL} = \frac{\phi_p{}''(L) \cdot L}{\phi_p(L)} + \frac{\phi_p{}'(L)}{\phi_p(L)} - \left(\frac{\phi_p{}'(L)}{\phi_p(L)}\right)^2 \cdot L =$$

$$= \frac{\varepsilon(\phi_p(L), L)}{L}(\varepsilon(\phi'_p(L), L) + 1 - \varepsilon(\phi_p(L), L)).$$

With $\varepsilon\left(\phi_p(L), L\right) > 0$, $L > 0$ and $\varepsilon\left(\phi_p(L), L\right) = const$, it yields $\varepsilon\left(\phi'_p(L), L\right) = = \varepsilon\left(\phi_p(L), L\right) - 1 > 0$, which means that $\varepsilon\left(\phi'_p(L), L\right)$ is constant and $\varepsilon\left(\phi_p(L), L\right) > \varepsilon\left(\phi'_p(L), L\right)$.

Therefore we have

$$\varepsilon\left(\phi_p{}'(L), L\right) - \varepsilon\left(D_p(L), L\right) = \varepsilon\left(\phi_p(L), L\right) - 1 - \varepsilon\left(D_p(L), L\right) > \varepsilon\left(\phi_p(L), L\right), \quad (19)$$

i.e. $\tilde{a}_{11} > \tilde{a}_{21}$, when the demand for prostitutes' services is inelastic ($-\varepsilon\left(D_p(L), L\right) > 1$)[2], and

$$\varepsilon\left(\phi_p{}'(L), L\right) - \varepsilon\left(D_p(L), L\right) = \varepsilon\left(\phi_p(L), L\right) - 1 - \varepsilon\left(D_p(L), L\right) < \varepsilon\left(\phi_p(L), L\right), \quad (20)$$

i.e. $\tilde{a}_{11} < \tilde{a}_{21}$, when the demand for prostitutes' services is elastic ($-\varepsilon\left(D_p(L), L\right) < 1$).

Then, if $-\tilde{a}_{22} > -\tilde{a}_{12}$ and (19) holds, inequality $-\tilde{a}_{11}\tilde{a}_{22} > -\tilde{a}_{21}\tilde{a}_{12}$ also holds and $\det A < 0$. If $-\tilde{a}_{22} < -\tilde{a}_{12}$ and (20) holds, $-\tilde{a}_{11}\tilde{a}_{22} < -\tilde{a}_{21}\tilde{a}_{12}$ and $\det A > 0$. In other cases the sign of $\det A$ is undefined.

In terms of elasticities the condition $-\tilde{a}_{22} > -\tilde{a}_{12}$ is equivalent to the condition $\varepsilon\left(\phi_m{}'(b), b\right) - \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) > -\varepsilon\left(P_p(b, M_p), b\right)$, which can be interpreted as a condition of high enough probability of being punished for prostitution. Indeed, this condition can be put down as $P_p(b, M_p) > \dfrac{-b \cdot \frac{\partial P_p}{\partial b}}{\varepsilon\left(\phi_m{}'(b), b\right) - \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right)} > 0$.

[1] Note that for power functions of the type $\phi p(L) = L^k$, $k > 1$, as can be easily seen, $\varepsilon(\phi_p(L), L) = k$.

[2] Because $\varepsilon(D_p(L), L) = D_p{}'(L)\frac{L}{D_p(L)} = \frac{1}{\delta(L)}$ where $\delta(L)$ is the (direct) elasticity of demand for commercial sex with respect to price.

Similarly, the condition $-\tilde{a}_{22} < -\tilde{a}_{12}$ can be interpreted as a condition of low probability of punishment, because in this case $P_p(b, M_p) < \dfrac{-b \cdot \dfrac{\partial P_p}{\partial b}}{\varepsilon(\phi_m'(b), b) - \varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right)}$.

Therefore we limit the scope of our analysis to the cases of $\det A < 0$ (the probability of punishment for prostitution is high, demand for prostitution is inelastic) and $\det A > 0$ (probability of punishment for prostitution is low and demand is elastic).

Impact of punishment for prostitution f_p

Take $I = f_p$. On the right-hand side of the system (9) we have a matrix $\begin{pmatrix} -P_p(b, M_p)\phi_p'(L) \\ P_p'(b, M_p)\phi_p(L) \end{pmatrix} = \begin{pmatrix} -S_p / f_p \\ -S_m / f_p \end{pmatrix}$. By Kramer's rule,

$$\frac{\partial L}{\partial f_p} = \frac{\begin{vmatrix} -S_p / f_p & S_p \varepsilon\left(P_p(b, M_p), b\right) / b \\ -S_m / f_p & S_m \left(\varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \right) / b \end{vmatrix}}{\det A} = \tag{21}$$

$$= \frac{\left(S_p S_m / f_p b\right) \begin{vmatrix} -1 & \varepsilon\left(P_p(b, M_p), b\right) \\ -1 & \varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \end{vmatrix}}{\det A}.$$

Consider the determinant in the numerator of (21) and denote it $\det B$. Then $\det B = \varepsilon\left(\phi_m'(b), b\right) - \varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right) + \varepsilon\left(P_p(b, M_p), b\right)$. If the probability of punishment for prostitution is high enough, $\det B > 0$[3], and then $\det A < 0$ when demand is inelastic, as shown above. If $\det B < 0$, then $\det A > 0$ when demand is elastic.

[3] This is equivalent to the condition $-\tilde{a}_{22} > -\tilde{a}_{12}$.

It follows that $\dfrac{\partial L}{\partial f_p} < 0$, i.e. in both cases higher fine for prostitution leads to a decline in the supply of commercial sex.

$$\frac{\partial b}{\partial f_p} = \frac{\left(S_p S_m / f_p L\right) \begin{vmatrix} \varepsilon\left(\phi_p'(L), L\right) - \varepsilon\left(D_p(L), L\right) & -1 \\ \varepsilon\left(\phi_p(L), L\right) & -1 \end{vmatrix}}{\det A}. \tag{22}$$

Denote the determinant in the numerator of (22) as $\det C$, $\det C = \varepsilon\left(D_p(L), L\right) - \varepsilon\left(\phi_p'(L), L\right) + \varepsilon\left(\phi_p(L), L\right)$. If the demand for commercial sex is inelastic, equation (19) implies that $\det C < 0$, and if the demand for commercial sex is elastic, equation (20) implies that $\det C > 0$. Then $\dfrac{\partial b}{\partial f_p} > 0$, i.e. higher fine for prostitution leads to greater corruption.

Therefore, in both cases analyzed more punishment for prostitution leads to shrinking of commercial sex market, but increases corruption. The reason for this is that more punishment for prostitution increases the costs of commercial sex provision, and simultaneously makes "insurance" (offering bribes to corrupt law enforcers) more profitable. As a result, the former reduces prostitution, the latter increases corruption.

Impact of punishment for corruption f_m

Take $I = f_m$. Then $\dfrac{\partial S_p}{\partial f_m} = \dfrac{\partial S_m}{\partial f_m} = 0$ and $\dfrac{\partial D_m}{\partial f_m} = P_m(M_m)\phi_m'(b) = \dfrac{D_m}{f_m}$.

$$\frac{\partial L}{\partial f_m} = \frac{\begin{vmatrix} 0 & S_p \varepsilon\left(P_p(b, M_p), b\right) / b \\ D_m / f_m & D_m \left(\varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \right) / b \end{vmatrix}}{\det A} =$$

$$= \frac{\left(S_p D_m / f_m b\right) \begin{vmatrix} 0 & \varepsilon\left(P_p(b, M_p), b\right) \\ 1 & \varepsilon\left(\dfrac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \end{vmatrix}}{\det A}. \tag{23}$$

The determinant in the numerator of (23) equals $-\varepsilon\left(P_p(b,M_p),b\right)>0$. If $\det A<0$, then $\frac{\partial L}{\partial f_m}<0$, i.e. the supply of commercial sex falls somewhat. On the other hand, if $\det A>0$, then $\frac{\partial L}{\partial f_m}>0$, i.e. there is an increase in the supply.

$$\frac{\partial b}{\partial f_m}=\frac{\left(S_p D_m / f_m L\right)\begin{vmatrix}\varepsilon\left(\phi_p\,'(L),L\right)-\varepsilon\left(D_p(L),L\right) & 0\\ \varepsilon\left(\phi_p(L),L\right) & 1\end{vmatrix}}{\det A}. \qquad (24)$$

The sign of the determinant in the numerator of (24) is always positive, $\varepsilon\left(\phi_p\,'(L),L\right)-\varepsilon\left(D_p(L),L\right)>0$. It implies that if $\det A<0$, then $\frac{\partial b}{\partial f_m}<0$ (the level of bribery goes down) and if $\det A>0$, then $\frac{\partial b}{\partial f_m}>0$ (the level of bribery goes up).

An increase in punishment for corruption has an ambiguous effect on the level of bribery. On the one hand, increased punishment of a corrupt law enforcer means higher cost of bribe-taking, hence the level of bribery falls. On the other hand, higher costs of providing corruption services require compensation, implying higher prices for these services, and thus lead to more bribery. The resulting effect depends on which of the factors dominates. If $\det A<0$, the former effect dominates, and the level of corruption falls. If $\det A>0$, the latter effect dominates, and the level of corruption rises.

Similar effects take place in commercial sex market as well. When the level of corruption rises, "insurance" from legal prosecution becomes more profitable, which results in expansion of commercial sex market. When the level of corruption falls, the probability of being prosecuted for prostitution rises, i.e. risks related to employment in commercial sex market go up and make the supply of sex services go down.

Impact of resources spent on combating corruption M_p

We now turn to examination of another regulatory instrument: public funding of fight with illegal prostitution. In this case the matrix on the right-hand side of (9) will be

$$\begin{pmatrix}-\frac{\partial S_p}{\partial I}\\ -\frac{\partial S_m}{\partial I}+\frac{\partial D_m}{\partial I}\end{pmatrix}=\begin{pmatrix}-\frac{S_p}{M_p}\varepsilon\left(P_p(b,M_p),M_p\right)\\ -\frac{S_m}{M_p}\varepsilon\left(\frac{\partial P_p}{\partial b},M_p\right)\end{pmatrix}.$$

Then, by Kramer's rule

$$\frac{\partial L}{\partial M_p}=\frac{\left(S_p S_m / M_p b\right)\begin{vmatrix}-\varepsilon\left(P_p(b,M_p),M_p\right) & \varepsilon\left(P_p(b,M_p),b\right)\\ -\varepsilon\left(\frac{\partial P_p}{\partial b},M_p\right) & \varepsilon\left(\frac{\partial P_p}{\partial b},b\right)-\varepsilon\left(\phi_m\,'(b),b\right)\end{vmatrix}}{\det A}. \qquad (25)$$

The determinant of the matrix in the numerator of (25) has a uniquely defined sign, because

$$-\varepsilon\left(P_p(b,M_p),M_p\right)\left[\varepsilon\left(\frac{\partial P_p}{\partial b},b\right)-\varepsilon\left(\phi_m\,'(b),b\right)\right]+$$
$$+\varepsilon\left(\frac{\partial P_p}{\partial b},M_p\right)\varepsilon\left(P_p(b,M_p),b\right)>0.$$

Therefore, the impact of the amount of public funds assigned to combating prostitution on equilibrium level of commercial sex depends on the sign of the denominator in (25): if $\det A<0$, more funds will lead to a decline in provision of commercial sex services, $\frac{\partial L}{\partial M_p}<0$. If $\det A>0$, however, the result will be the opposite: more funds will make the market expand, $\frac{\partial L}{\partial M_p}>0$.

The impact on equilibrium bribery is quite similar. Because

$$\begin{vmatrix}\varepsilon\left(\phi_p\,'(L),L\right)-\varepsilon\left(D_p(L),L\right) & -\varepsilon\left(P_p(b,M_p),M_p\right)\\ \varepsilon\left(\phi_p(L),L\right) & \varepsilon\left(\frac{\partial P_p}{\partial b},M_p\right)\end{vmatrix}>0,$$

if $\det A<0$ then $\frac{\partial b}{\partial M_p}<0$, i.e. bribery declines; if $\det A>0$, bribery increases, $\frac{\partial b}{\partial M_p}>0$.

The result obtained under $\det A < 0$ is quite obvious, hence we turn to $\det A > 0$. Increased allocation of resources to combat prostitution as illegal employment raises the costs of commercial sex provision and reduces the efficiency of bribing corrupt law enforcers. It entails reduced supply of commercial sex, but higher risks are compensated by higher prices, which leads to market expansion. Under $\det A > 0$ the latter factor turns out to be more significant, and the level of prostitution eventually rises. In the market for corruption services the situation is generally the same.

Impact of resources spent on combating corruption among law enforcers M_m

Taking $I = M_m$, we have $\frac{\partial S_p}{\partial M_m} = \frac{\partial S_m}{\partial M_m} = 0$ and $\frac{\partial D_m}{\partial M_m} = \frac{S_m}{M_m}\varepsilon\left(P_m(M_m), M_m\right)$. Then, if we look at the effects on prostitution,

$$\frac{\partial L}{\partial M_m} = \frac{\left(S_p S_m / M_m b\right)\begin{vmatrix} 0 & \varepsilon\left(P_p(b, M_p), b\right) \\ \varepsilon\left(P_m(M_m), M_m\right) & \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \end{vmatrix}}{\det A}. \tag{26}$$

As in the previous section, we obtain that the determinant in the numerator of (26) is always positive:

$$\begin{vmatrix} 0 & \varepsilon\left(P_p(b, M_p), b\right) \\ \varepsilon\left(P_m(M_m), M_m\right) & \varepsilon\left(\frac{\partial P_p}{\partial b}, b\right) - \varepsilon\left(\phi_m'(b), b\right) \end{vmatrix} =$$

$$= -\varepsilon\left(P_p(b, M_p), b\right)\varepsilon\left(P_m(M_m), M_m\right) > 0,$$

because $\varepsilon\left(P_p(b, M_p), b\right) < 0$, a $\varepsilon\left(P_m(M_m), M_m\right) > 0$.

Turning to the level of bribery, we have

$$\frac{\partial b}{\partial M_m} = \frac{\left(S_p S_m / M_m L\right)\begin{vmatrix} \varepsilon\left(\phi_p'(L), L\right) - \varepsilon\left(D_p(L), L\right) & 0 \\ \varepsilon\left(\phi_p(L), L\right) & \varepsilon\left(P_m(M_m), M_m\right) \end{vmatrix}}{\det A},$$

with the determinant in the numerator being equal to $\left[\varepsilon\left(\phi_p'(L), L\right) - \right.$ $\left. - \varepsilon\left(D_p(L), L\right)\right]\varepsilon\left(P_m(M_m), M_m\right) > 0.$

Therefore, under $\det A < 0$ both $\frac{\partial L}{\partial M_m} < 0$ and $\frac{\partial b}{\partial M_m} < 0$, that is, the levels of both prostitution and corruption fall. Under $\det A > 0$ both $\frac{\partial L}{\partial M_m} > 0$ and $\frac{\partial b}{\partial M_m} > 0$, the levels of both prostitution and corruption rise. It implies that additional funds spent on fighting corruption in law enforcement agencies have effects similar to increased punishment for bribery and thus do not require additional discussion.

Main results of the analysis performed are shown in Table 1.

Table 1. The impact of policies aimed at combating illegal prostitution and corruption

Policies	**Inelastic demand for commercial sex; relatively high probability of punishment for prostitution**		**Elastic demand for commercial sex; relatively low probability of punishment for prostitution**	
	$\frac{\partial L}{\partial I}$	$\frac{\partial b}{\partial I}$	$\frac{\partial L}{\partial I}$	$\frac{\partial b}{\partial I}$
Punishment for prostitution, $I = f_p$	< 0	> 0	< 0	> 0
Punishment for bribery, $I = f_m$	< 0	< 0	> 0	> 0
Funds allocated to combat prostitution, $I = M_p$	< 0	< 0	> 0	> 0
Funds allocated to combat bribery, $I = M_m$	< 0	< 0	> 0	> 0

Conclusion

We have analyzed the model describing the interaction between prostitution and corruption. The model assumes that a prostitute, being involved in an illegal activity, can "insure" herself from legal prosecution (reduce legal risks) by bribing a corrupt law enforcer. Formally, this is described by endogenously determined probability of detention and punishment. The probability is negatively related to the amount of bribes paid. On the other hand, regulation of illegal prostitution through allocation of public funds to combat it tends to increase the probability of punishment for a prostitute and decrease the efficiency of bribes. Similarly, it is assumed that punishment probability for a corrupt law enforcer depends on the amount of public funds assigned to combat corruption.

The analysis has shown that in general case the effects of various policy measures (such as punishment for prostitution f_p, punishment for bribery f_m, allocation of public funds to combat prostitution and corruption, M_p and M_m, respectively) cannot be characterized in an unambiguous way. Due to this the analysis is limited to two cases: 1) the probability of being punished for prostitution is relatively high and demand for commercial sex is inelastic; 2) the probability of being punished for prostitution is relatively low and demand for commercial sex is elastic.

The analysis shows that if the demand for commercial sex is elastic, spending additional funds on fighting prostitution and corruption, as well as increasing punishment for bribery lead to higher levels of both prostitution and corruption. This paradox can be explained by the fact that elastic demand for commercial sex is not characteristic of this market. Elasticity of demand with respect to price depends primarily on the availability of substitutes: the more substitutes there are, the more elastic the demand is. However, most researchers point out that sex services offered by a prostitute and sex services received within "traditional relationship" cannot be thought of as substitutes (Sharpe, 1998; Monto, 2000; Cameron and Collins, 2003). The reason why clients turn to prostitutes is often rooted in their need for specific kinds of sexual contacts, which cannot be provided by "traditional" partners. Many clients are attracted to commercial sex by possible satisfaction of sexual needs without emotional involvement etc.

Due to this we emphasize the results for the case of inelastic demand for commercial sex (columns 2 and 3 in table 1). As shown above, increased punishment for bribery and increased amount of funds allocated to law enforcers, help reach the goal: both the level of corruption and the level of prostitution fall. However, if the police are corrupt, increased punishment for prostitution, though reducing prostitution, will lead to more corruption, and vice versa, lower punishment for prostitution will reduce corruption. Therefore, the widespread policy of combating prostitution by increasing punishment cannot be considered efficient, because "heavy criminal sanctions have lead to greater police corruption and criminal involvement in prostitution" (Pinto, Scandia, and Wilson, 1990).

A situation when lower, not higher punishment for prostitution leads to lower corruption has taken place in New South Wales (Australia). Prostitution industry there has been marked with pervasive police corruption. Street prostitutes paid the police in order to avoid arrest and to protect themselves from new competitors (who were detained by the police immediately). The police corruption has reached its peak during 1960s to 1979, because legal prohibition of prostitution over 1968-1979 was stricter than ever in the history of New South Wales, while the prostitution market flourished. Thus, there was an obvious contradiction between formal prohibition of prostitution and great demand for commercial sex, which gave the police wide opportunities of prosecuting (or not prosecuting) prostitutes by law.

Key deterrence factor in police corruption was decriminalization of street prostitution in 1979. Empirical research in early 1980s has shown that it has essentially destroyed the system of prostitutes' payments to the police (Egger and Harcourt, 1993). A combination of relatively liberal prostitution laws with active anticorruption campaign has reduced the involvement of corrupt police in commercial sex industry, especially in street prostitution, to the lowest level in years.

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