Public Order and Private Payments: 
Paying for Police Services at Events

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Abstract

Should organizers of events, such as sport games or concerts, share the costs of maintaining public order in connection to the events? This question has been hotly debated in many countries, especially in connection to soccer hooliganism. Critics argue that organizers should do more to combat unruly behavior, which has significant external effects. The incentive to do so may be muted by the possibility of free riding on the police. We model how co-payments can address the under-provision of security on the part of organizers. However, it has been claimed that co-payments can backfire and lead financially constrained organizers to instead provide less, not more, security. We analyze under which circumstances this may be true. Finally, we exploit a natural experiment from the Swedish soccer league where police payments were introduced for some clubs only. The results are in line with the implications of the model.

Keywords: Public order; private security; public events; co-payments for police; free-riding; externality; hooliganism; natural experiment.

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1 Introduction

Violence and disorder in connection with large public events and sizable costs for deployment of police has attracted considerable media attention in Europe. Soccer hooliganism is perhaps the most notable example of this, but problems also arise in connection with other events, such as rock concerts, festivals and even political rallies.

A contentious issue is whether those who arrange, and profit from, events should also bear a fair share of the event’s cost to society, especially since the displacement of police resources carries an opportunity cost.\(^1\) In many countries, organizers of commercial events are in fact required to share the cost for police. For instance, this is the case in the UK.\(^2\) The police recovers approximately £3m out of £6m annually for large events requiring more than 300 police officers (Metropolitan Police, 2009).\(^3\) The New York Police Department has also begun to recoup costs from event organizers, including, for example, the New York Marathon.\(^4\) A recent, and controversial, Dutch government bill proposes that event organizers, but initially not soccer clubs, pay for police (Ministry of Justice and Security, 2011). Despite the ongoing discussion in Italy regarding who should pay for policing of soccer games (see De Ponti, 1999, for an early discussion) clubs still do not pay for police. In Germany, there is an discussion on how to reduce hooliganism, but clubs are not required to contribute to police payments (Zeit, 2010).

In Sweden, co-payments were recently abolished after a heated media debate and two recent Official reports of the Swedish government with conflicting views on the matter (Erikson, 2012; Svensson, 2013).

Apart from fairness concerns, co-payments also influence the organizers’ incentives

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\(^1\)For example, Marie (2010) finds that police displacement during soccer games increases property crime.

\(^2\)In its guidance paper on setting charges The Association of Chief Police Officers distinguish between different categories of events: commercial events, non-commercial events, i.e., charitable or community events and statutory events reflecting constitutional rights or processes. They then go on to note that “Authorities are strongly recommended to charge the full economic cost of special police services provided for commercial events” Association of Chief Police Officers (2011).

\(^3\)It also spends £25m on football matches nationwide where £8m is recouped from clubs (Hughes, 2010). However, it has been questioned whether the payment mechanism has the intended consequences (House of Commons Home Affairs Committee, 2009).

\(^4\)See, e.g., Belson (2012) who also notes that the organizers plan to increase the size of the events, partly to offset the higher costs.
to mitigate unruly behavior, or its consequences. Organizers can clearly influence the risk of unruly behavior, including when and where events are arranged, the pricing and admissions policies, and security arrangements at arenas, such as personnel, gates and fences, and installation of CCTV systems. The police command a different set of tools. It monitors and acts on activities also outside of the arenas, decides on the resources to commit to an event, use police intelligence units and, of course, may use physical force and arrest and incarcerate troublemakers. It is therefore important to provide incentives that generate an appropriate mix of efforts from organizers and the police. The organizer’s efforts to reduce unruly behavior typically have positive external effects and, in the absence of appropriate incentives, therefore tend to be under-provided from a societal point of view. Moreover, since the ultimate responsibility for public order rests with the police, inadequate security arrangements by organizers forces the police to compensate for this by committing more resources. Thus, there is a built in free-riding incentive for organizers of events.

In this paper, we try to shed light on these incentive problems and how co-payments might address them in a simple theoretical model capturing both the externality and the free-riding aspect. The model differs from a standard public finance model in that private and public efforts jointly affect the outcome, and that the public actor has a "bail-out" responsibility. In view of the latter aspect, the model has a sequential structure, where a utility maximizing event organizer first decides on its efforts to reduce unruly behavior, anticipating the police’s behavior. The police takes the organizer’s choice as given and deploys police to maximize social welfare. Not surprisingly, this leads to an inefficient outcome with inadequate private security and too much police. We then examine how co-payments might restore efficiency and the determinants of optimal co-payments.

Our analysis focuses on the effects of co-payments in view of the controversy these have sparked, but there are of course also other ways of addressing these problems.

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5Recent evidence shows that both private efforts (House of Commons Home Affairs Committee, 2009; Priks, 2013a) and certain types of police (Poutvaara and Priks, 2009) are indeed efficient in reducing violence.
For example, regulation mandating certain security standards to be met are already in place in many countries. Subsidies targeting organizers’ efforts to improve security and fees on unruly behavior are other options. We briefly discuss the relative merits of such approaches in the context of our model.

A commonly voiced objection to co-payment schemes concerns the financial burden they impose on event organizers, which could make some events non-viable, even if they would be socially beneficial. However, a more efficient allocation of effort to reduce unruly behavior involves cost savings, and we discuss how these may be used to at least partially compensate organizers.

A related concern, which organizers of events sometimes express, is that levying of fees will lead to less, not more, spending on private security since the budget will be too small. We analyze this by introducing "quality of the event" as a second variable in the organizer’s maximization problem. We find that this claim can be true if the organizers do not maximize profits, and if benefit of quality is sufficiently sensitive to spending on quality. Organizers may den prefer to reduce security investments rather than quality and co-payments alone cannot ensure efficiency. One solution could be to use lump-sum subsidies to compensate the organizers to the extent that their behavior conforms to the society’s optimum.

We explore the implications our model using a unique natural experiment from the highest Swedish soccer league *Allsvenskan*. Starting in the spring season 2012, clubs that were organized as corporations were required to pay for police services in connection to matches, while those organized as non-profit organization were not. Initially the former had to pay for 25 percent of the police cost, which on July 1, 2012 was increased to 100 percent. We exploit this variation in a difference-in-difference design where 13 out of 16 clubs were not incorporated and therefore did not have to pay for police. Using information from internal police reports, filed game by game, we find that private investments in terms of guards in incorporated clubs indeed increased

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6Absent credit market imperfections or informational problems, profit maximizing organizers would not face binding budget constraints. Organizers with other objectives, such as winning games or promoting culture, are likely to do so.
significantly subsequent to the introduction of payments. The evidence also indicates that unruly behavior inside stadiums went down during these clubs’ home games, as predicted by the basic model.

The paper proceeds as follows. In section 2 we introduce a simple model, examine the organizer’s incentive to invest, derive the optimal co-payment and discuss how it may be influenced by the efficiency of police efforts. We also discuss the scope for alleviating the financial burden of payments for organizers. In the following section, we discuss alternative policies. In section 4, we consider whether the effect of co-payments could be severely muted, or even reversed, for financially constrained organizers. In section 5 we examine empirical evidence from the Swedish soccer league. Section 6 concludes.

2 The Model

We examine a simple model where public events can give rise to unruly behavior and where private and public actions to prevent such behavior jointly produce positive external effects. The actions consist of the efforts, \( x \), of a private organizer of an event to mitigate unruly behavior, and the level of public resources, \( y \), committed to maintaining public order in connection to the event. The organizer may be required to pay a fraction \( \tau \in [0, 1] \) of the expenses for the latter, which we henceforth refer to as co-payments. The co-payment rate is set before the choices of \( x \) and \( y \) are made.

The private organizer chooses \( x \) with regard to his own welfare, \( W^o \), which may reflect monetary gains as well as a consumption utility from the event itself. The public authority is assumed to maximize social welfare, which is taken to be the sum of \( W^o \)

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\(^7\)This is also in line with the findings in an internal survey by the Swedish police. A senior officer in each police district was asked “Do you believe that the costs for police which organizers have to pay for public events affect their attitude to take a larger responsibility for security in upcoming events?” (Swedish police, 2012). Nine out of eleven districts that charged for events in 2012 answered yes.
and the welfare of the rest of society, $W_r$. Social welfare is thus given by

$$W_r(x, y) + W_o(x, y) - c_o x - c_p y, \quad (1)$$

where $c_o$ and $c_p$ denote the constant marginal costs for $x$ and $y$ respectively. Social welfare is unaffected by co-payments, which only constitute transfers between the parties.

$W^o$ and $W^r$ are assumed to be twice continuously differentiable, strictly increasing and strictly concave in $x$ and $y$. The cross effects $W^o_{xy}$ and $W^r_{xy}$, where subscripts denote derivatives, are also assumed to be negative. Moreover, we assume that there exist a socially optimal allocation of $x$ and $y$, which entails assuming that $(W^r_{xx} + W^r_{xy})(W^o_{yy} + W^r_{yy}) > (W^o_{xy} + W^r_{xy})^2$, at least at the optimum point.

The ultimate responsibility for public order rests with the police, and in connection to an event the police needs to provide an appropriate level of police resources given the security arrangements of the private organizer. The decisions in the model are therefore assumed to be sequential, with the private organizer choosing $x$ first and the police choosing $y$ in response to this.

### 2.1 Equilibrium safeguards

We solve the model backwards, beginning with the police’s choice of $y$, given an observed level of $x$. The first-order condition for a welfare maximizing choice of $y$ is

$$W^r_y + W^o_y - c_p = 0. \quad (2)$$

This condition implicitly defines the police’s optimal choice of $y$ in response to the organizer’s choice of $x$. We denote this best response function $y(x)$ and note that:

**Lemma 1.** The police’s best response $y(x)$ has a strictly negative slope ($y_x < 0$).

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$^8$ $W^r$ could be interpreted as a measure of aggregate benefits not including positive utility derived from unruly behavior, in the spirit of Stigler (1970). Alternatively, it could be viewed as a utilitarian measure including also such utility, in line with Polinsky and Shavell (2000), but where the net effect is negative.
Proof. The slope \( y_x = -\frac{(W_r^x + W_o^x)/(W_y^x + W_y^o)}{W_y^x + W_y^o} < 0 \) since all 2nd derivatives of \( W \) are strictly negative.

Henceforth we also assume that conditions are such that \( y(x) \) is convex, so that the reduction in police deployment in response to an increase in \( x \) becomes smaller as the level of \( x \) increases. To that end we assume that \( W_{xx}^i \) and \( W_{yyy}^i \geq 0 \), where \( i \in \{ r, o \} \).

In addition to the marginal cost for \( x, c_o \), the organizer also faces a co-payment for police expenditures, which is assumed to be proportional to \( y \) and given by \( \tau y \). The organizer then chooses \( x \) to maximize

\[
W_o(x, y) - c_o x - \tau y(x). \tag{3}
\]

The first-order condition for the organizer’s choice of \( x \) is

\[
W_x^o + (W_y^o - \tau) y_x - c_o = 0. \tag{4}
\]

This condition characterizes a unique optimal effort, \( x^o \), provided that the following second order condition holds,

\[
W_{xx}^o + 2W_{xy}^o y_x + W_{yy}^o (y_x)^2 + (W_y^o - \tau) y_xx < 0. \tag{5}
\]

For low \( \tau \), the last term is positive and the condition essentially requires that the diminishing direct benefit of \( x \) is not dominated by its indirect effect on the return from free riding on \( y \). We assume that this condition holds.\(^9\)

Below we provide a simple example, which is also used for the graphs in the paper.

**Example.** In a simple parameterized example, we can illustrate how the productivity of the parties’ efforts influence the problem and the level of unruly behavior. Specifically, let \( W^o = K^o - \alpha v(x, y) \) and \( W^r = K^r - \beta v(x, y) \), where \( v(x, y) = \gamma x^{-\rho} y^{-\theta} \) captures how unruly behavior is affected by \( x \) and \( y \) respectively, and \( \alpha \) and \( \beta \) how this affects organizers and the rest of society. The constants \( \rho \) and \( \theta \) reflect the productivity of

\(^9\)The condition holds when the first-order condition is satisfied, if \( \tau \) is sufficiently close to the optimal level. See Proposition 3 below.
these efforts and $\gamma$ the tendency to unruly behavior.\footnote{Unruly behavior may reflect utility maximization on the part of individuals with preferences for violence, $v$. For example, $v(x, y)$ may be derived from the problem

$$\max_v \gamma \ln v - v x^\theta y^\rho,$$

where utility is concave in $v$, and $x$ and $y$ both reduce the utility from $v$.} It is straightforward to verify that condition (5) holds here (see the appendix). We will return to the example further below.

### 2.2 Optimal co-payments

Let us now contrast expression (4) with the condition for the socially optimal level of $x$, denoted $x^*$:

$$W^o_x + W^r_x - c_o = 0. \quad (6)$$

Note that the above expression takes into account the effect of $x$ on the rest of society ($W^r_x$), a positive externality, which is not present in condition (4). The organizer, however, does take into account that the police is responsive to the organizer’s efforts ($y_x$), giving the organizer an incentive to ”free ride”, unless $\tau$ exceeds the marginal value of $y$ to the organizer. Not surprisingly, both effects lead the organizer to choose a lower $x$ than what would be socially optimal.\footnote{In addition, recent evidence shows that soccer clubs tend to win more games the more organized supporters they have in the stadiums (Priks, 2013b). The value of having a large and active crowd means that is could be tempting for clubs to adopt a relative lax stance to admitting supporters to arenas, or to undertake security measures that risk reducing attendance. In terms of the model, this concern reduces the clubs’ return to spending on $x$ and further aggravates the incentive problem.}

**Proposition 1.** For $\tau = 0$ the equilibrium choice of $x$ falls below the socially optimal level, i.e., $x^o < x^*$, while the opposite is true for $y$.

**Proof.** Conditions (4) and (6), evaluated at $\tau = 0$, can express as $W^o_x - c_o = -W^o_y y_x > 0$ and $W^o_x - c_o = -W^r_x < 0$. Since $W^o_{xx} < 0$, any $x$ satisfying the former condition must be lower than the $x$ satisfying the latter. The last claim follows from $y_x < 0$. \hfill $\square$

Below, we examine how co-payments affect the organizer’s choice of $x$ and whether the first-best allocation can be achieved, i.e., whether they can correct for both the
externality and the free-riding incentive. To begin with, we note that co-payments do prompt organizers to increase $x$.

**Lemma 2.** The organizer’s choice of $x$ increases in co-payments, i.e. $x_{\tau} > 0$.

**Proof.** Follows from implicit differentiation of expression (4) using condition (5).

To realign the organizer’s incentives with those of society, the rate of co-payment $\tau$ needs to compensate both for the externality and the free-riding incentive. A comparison between expressions (4) and (6) reveals that this requires that

$$-\tau y_x = W^r_x - W^0_y y_x.$$  \hfill (7)

The first term on the right hand side reflects the external effect, and the second term the free riding incentive. The optimal co-payment rate, $\tau^*$, is derived by evaluating the above expression at the social optimum $(x^*, y^*)$. It is easy to see that $\tau^*$ also implements the social optimum. First, $x^*$ obviously satisfies condition (4) for $\tau = \tau^*$. Second, condition (5) ensures that this is a unique solution. In sum,

**Proposition 2.** The first best allocation can be achieved by setting an appropriate co-payment, $\tau^* = W^o_y(x^*, y^*) - \frac{W^r_y(x^*, y^*)}{y_x(x^*)}$.

Since both distortions operate on the same variable, one policy instrument suffices to correct for both.

If there is no externality ($W^r_x = 0$) the co-payment simply compensates for the organizer’s free riding incentive, i.e., his own marginal benefit of $y$. In this case $\tau^* \leq c_p$, with strict inequality if spending on $y$ is partly motivated by direct benefits for the rest of society, $W^r_y > 0$. Conversely, if the organizer derives no benefit from $y$ then $\tau^*$ is set so that $\tau^* y_x$ just takes care of the externality. Clearly, $\tau^*$ may exceed $c_p$, which would be the case if $W^r_y$ is zero, or small compared to the externality.\footnote{Using (4) and (7), the relation between $\tau^*$ and $c_p$ can be expressed as follows: $\tau^* - c_p = -W^r_x(x^*, y^*)/y_x(x^*) - W^r_y$ or $-(\tau^* - c_p) y_x(x^*) = W^r_x(x^*, y^*) + W^r_y y_x(x^*)$.} Co-payments then exceed total expenditures on $y$.\hfill 8
The object of the efforts of the organizer and the police – unruly behavior – has hitherto only appeared implicitly in the analysis. To examine the effect of introducing co-payments on the level of unruly behavior we need to make some explicit assumptions about how efforts influence unruly behavior and how the the parties’ welfare is affected by unruly behavior. We assume that welfare is affected by the parties’ efforts only through their effects on unruly behavior, which we denote \( v \), and that \( W^i_v < 0 \) and \( W^{ij}_v < 0 \), for \( i \in \{o,r\} \). Moreover, unruly behavior is assumed to strictly decrease at a decreasing rate in \( x \) and \( y \). The cross-effect is also taken to be negative, so that increased efforts by one party reduces the marginal effect of effort by the other party. Thus, \( v_x, v_y < 0 \) and \( v_{xx}, v_{yy} \text{ and } v_{xy} \geq 0 \).

Now, the effect on unruly behavior of an increase in \( x \), say prompted by the introduction of co-payments, is given by

\[
\frac{dv}{dx} = v_x + v_y \frac{dy}{dx}.
\]

(8)

Note that \( dy/dx \) is given by the same expression as before but that the constituent terms can now be expanded using the assumptions above, e.g., \( W^o_{xy} = W^o_{v,v} v_x v_y + W^o_{v,v_x} v_y \), and so on. The effect on unruly behavior can then be expressed as follows.

**Proposition 3.** An increase in \( x \) reduces unruly behavior if \( \left| \frac{v_{xy}}{v_x} \right| < \left| \frac{v_{yy}}{v_y} \right| \).

**Proof.** In the Appendix.

The effect depends on the relative decline in marginal productivity of private vs police efforts induced by more police. Specifically, if the cross-effects are relatively less important than the own-effects then the reduction in \( y \) following an increase in \( x \) will not extinguish the positive effect and a policy leading to more \( x \) will also reduce unruly behavior.

**Example cont.** In our example, the optimal mix between \( x \) and \( y \) can be characterized in terms of their relative costs and productivity: \( x^*/y^* = (\rho/c_o)/(\theta/c_p) \). This ratio is greater the more productive and less expensive the organizer’s efforts are compared to those of the police. Without co-payments, the equilibrium effort mix is \( x/y = x^*/y^*(1+ \)
$\theta^{-1}(1 + \beta/\alpha)^{-1}$. The mix is distorted towards $y$, and the bias increases in the strength of the externality, $\beta/\alpha$.

The optimal co-payment here is $\tau^* = c_p[1 + \theta^{-1}\beta/((\alpha + \beta))]$. Not surprisingly, it increases in the cost of police, $c_p$, and the externality $\beta$. Moreover, police efficiency (high $\theta$) alleviates the externality problem and allows for a lower $\tau^*$. Finally, the example satisfies $|v_{xy}/v_x| < |v_{yy}/v_y|$ for all parameter values and the level of unruly behavior thus decreases in $x$.

2.3 Compensating organizers for co-payments?

Introducing large co-payments may well be politically unfeasible or could even make events commercially non-viable in the first place. However, if the motive for introducing co-payments is to restore efficiency, rather than to raise public revenues, the financial burden of the co-payment could be alleviated. For example, organizers could receive a lump-sum reimbursement for co-payments up to the efficient $y^*$. This leaves incentives undistorted, and would not harm the public sector budget in comparison with the situation before the introduction of co-payments.

In fact, since the co-payment scheme moves the equilibrium from a situation with inefficiently high spending on $y$ it entails savings of public expenditures amounting to $c_p(y(x^o) - y^*)$, where $y(x^o) - y^* = \int_{x^o}^{x^*} \frac{\partial y(\xi)}{\partial \xi} d\xi$. These could be used to, at least partially, compensate private organizers for the increased spending on $x$, $c_o(x^* - x^o)$. (Whether compensation for lost opportunities to free-ride is fair is another issue). The net financial cost of restoring efficiency is then

$$c_o(x^* - x^o) - c_p(y(x^o) - y^*).$$

(9)

Without further assumptions on public and private welfare, and the cost of mitigating unruly behavior, we cannot say much more than that there is scope for some compensation. One might expect that the cost savings depend how distorted the initial allocation is. Important factors here are the strength of the external effect and
the efficiency of police efforts. A strong externality increases police deployment. If the police is efficient, this effect is reinforced since there is more free-riding. This can be illustrated using our example. Figure 1 shows how savings in police costs as a percentage of the increased cost for the organizer change with the size of the externality for three different values of productivity of police efforts, relative to the organizer’s efforts. The dashed line indicates where $\alpha = \beta$, i.e., where the effect on the organizer and the rest of society are equal. The upper curve illustrates a case where police efforts are more efficient than private efforts, the middle curve a situation where they are equally efficient and the bottom curve a case where private efforts are most efficient. In the first case, the reduction of police costs is substantial and may even surpass the cost increase for the organizer. In the last case, police efforts are less productive and the reduction of police costs plays a lesser role.

3 Subsidies, fines for incidents and regulation

While co-payments have been used in practice in connection to commercial events such as games and concerts, textbook economics often suggest other remedies for inefficiencies arising from externalities such as Pigouvian taxes or subsidies.
We can incorporate a subsidy, $s$, in the model with a slight change of the organizer’s payoff: $W^o(x, y) - (c_o - s) x$. The optimal subsidy $s^*$ can be derived using appropriately adjusted analogues of expressions (4) and (6). As one would expect, $s^*$ restores efficiency. However, subsidies can be a hard sell if people feel that organizers should share the costs the event imposes on society. Subsidies could then be coupled with lump-sum fees imposed on organizers, but such schemes run the risk of alienating both the general public and organizers.

Another possibility is to levy a Pigouvian tax on unruly behavior, or the risk of such behavior. However, since unruly behavior does not appear explicitly in the model (it is interpreted in terms of unruly behavior) we consider a modified objective function for the organizer: $K^o(x, y) - tv(x, y) - c_o x$, where $v(x, y)$ measures unruly behavior and is twice continuously differentiable and strictly decreasing in $x$ and $y$. The optimal tax is again derived using analogues of (4) and (6), and restores efficiency.

We summarize the optimal policies below.

**Proposition 4.** The optimal subsidy is $s^* = W^r_x - W^o_y y_x$ and the optimal Pigouvian tax is $t^* = -s^*/(V_x + V_y y_x)$.

Note that the optimal subsidy simply equals the sum of the external effect and the free-riding incentive.

**Example cont.** In our example, the optimal subsidy is $s^* = c_o - c_o(1+\theta)^{-1}(1+\beta/\alpha)^{-1}$ and increases in the externality $\beta/\alpha$ and the productivity of police efforts. The optimal tax is $t^* = \beta + \theta(\alpha + \beta)$, where $\beta$ reflects the externality. The second term reflects the free-riding problem which is proportional to the productivity of police effort. Note also that payments for police $\tau^* y^*$ and payments based on outcome $t^* v(x^*, y^*)$ are identical.

Another option, discussed further below, is to regulate the organizer’s responsibility for providing an adequate level of security in order to achieve an efficient outcome.
3.1 A comparison of policies

Subsidies and regulation require *ex ante* specification of what is to be subsidized or regulated. An organizer may improve security in a host of different ways including security personnel, CCTV cameras, youth programs, alcohol policies and efforts to change the composition of spectators. The optimal level and mix of such efforts is likely to be highly context dependent and vary between different types of events. While a local organizer or the police may be able to take such contingencies into account, at least to some extent, they are difficult to capture in an *ex ante* contract and subsidies and regulation may therefore result in some misallocation of resources.

Co-payments for police, or payment based on incidents, are more flexible in this respect since they are based on assessments by the police (about the risk of unruly behavior, in the former case, and concerning the gravity of incidents, in the latter) and does not bias the organizer’s behavior. They also provide incentives to come up with new and innovative ways of addressing the problems.

However, these mechanisms rely on well functioning assessments, which may not always be the case. First, both types of payment schemes may be subject to uncertainty regarding, for instance, how the police responds to an increase in private security or whether a disturbance might be classified as an incident or not. For example, if organizers’ doubt that increased effort on their part lead to lower co-payments then the incentives are severely muted. Second, the police may not maximize social welfare. One possibility is that the police simply pockets the money from fees, which would bias police deployment. Another possibility is that increased police presence reduces the individual risk for the deployed officers. They may therefore prefer larger deployments than is socially optimal.\(^\text{13}\)

One objection against co-payments has been that it pits the organizers against the police which may make coordination and cooperation more difficult. However, from a cost perspective this has the advantage of giving the organizers a strong incentive to

\(^{13}\text{In the UK, for example, there has been a concern that the police deploy too many officers to soccer games. See, e.g., the section on costs in the report by the House of Commons Home Affairs Committee (2009).}\)
protest against excessive police deployment. By contrast, in a system with payments based on incidents, organizers have every reason to welcome increased police deployment since this reduces the risk of incidents, and thus also payments. In addition, more police may allow organizers to reduce their own spending on security. Thus, in this case there is an obvious risk of too much police deployment. The incentives are similar in a regulated system except, of course, that there are no payments.

In a soccer hooliganism context, there may also be strategic considerations. For example, co-payments may fuel unruly behavior by visiting hooligans if the home team picks up the tab. Similarly, violence may increase regulated safety requirements for the arena in question, raising the home team’s costs. By contrast, subsidies reduce the organizer’s cost for mitigating unruly behavior and provides no incentives for ”sabotage”.

4 Financially constrained event organizers

Events are organized for different reasons. For instance, some organizers arrange concerts for profit while others do so to promote culture, or perhaps to rally for some other cause. For many professional sports teams the ultimate goal may be to win rather than to turn a profit. In an influential paper, Sloane (1971) argued that this is a plausible characterization of the owners of soccer clubs. It is not uncommon to see teams with huge revenues from television rights and merchandising nevertheless teetering near the brink of bankruptcy in pursuit of highly priced talent. The idea that club owners’ may be motivated by win maximization rather than profit maximization also has some empirical support (see Atkinson et al., 1988, for American football and Garcia-del-Barrio and Szymanski, 2009, for soccer).14

14As a recent consultant report puts it “Running as normal companies, the /soccer/ leagues in Spain, England and Italy would be bankrupt within two years”. The only parties interested in entering football are “those in search of trophy glory, needing to build political capital, or to fulfill a childhood dream.”(Kearney, 2009, p. 1 and p. 5). American commentators seem more supportive of the idea that sport franchises mainly have commercial objectives (e.g., Zimbalist, 2003). The American major leagues (baseball, American football, and basketball) are actually much more financially stable than European football (Lago et al., 2006). There is also some evidence that price setting in the NHL is consistent with profit maximizing (Ferguson et al., 1991).
In models with profit maximizing actors, budget constraints typically play no part, in the absence of information problems, since funding would be available for profitable ventures. However, for actors with other motivations, budget constraints tend to be binding. If organizers are subject to financial constraints, increased spending on $x$ has an immediate opportunity cost in terms of less money to spend on talent, or, more generally, quality. In this case, we need to consider whether income effects influence how incentive schemes, such as co-payments, affect behavior. Potentially, income effects could reduce the behavioral response to incentives, or even lead to perverse responses.

Below we extend the model to encompass a budget constraint and a quality variable, $z$, subject to choice by the organizer representing other dimensions of spending than security. We assume that quality only affects the organizer, that $W^o$ strictly increases at a decreasing rate in $z$ and that $z$ enters $W^o$ in an additively separable way. We also assume that the organizer’s budget is fixed at $M$ (i.e., it is independent of $x$, $y$ and $z$) and the marginal cost of $z$ is constant and equal to 1. These assumptions imply that there is no interaction between the choices of $x$ and $z$ except via the budget constraint, and that $z$ does not influence the police’s choice of $y$. Other aspects of the model, such as the reaction function $y(x)$, remain unchanged.

The organizer chooses $x$ and $z$ simultaneously subject to a budget constraint which yields the following the first-order conditions:

$$\begin{align*}
W^o_x + W^o_y y_x - \lambda (\tau y_x + c_o) &= 0 \\
W^o_z - \lambda &= 0 \\
M - c_o x - \tau y - z &= 0
\end{align*}$$

(10)

where the shadow price of the constraint, $\lambda$, equals the organizer’s marginal valuation of quality. Since the constraint is assumed to bind, $\lambda > 1$. Note also that $\tau y_x + c_o$ is the organizer’s effective marginal cost for $x$, i.e., the marginal resource cost for $x$ net of the marginal reduction in co-payments.

Below we examine the comparative static effect of introducing co-payments on private spending on security and quality, and whether co-payments could actually result
in lower spending on security. This a standard consumption theory problem with a slightly unconventional twist: An increase in \( \tau \) effectively leads to a reduced marginal cost of \( x \), since reductions in \( y \) then become more valuable, while it at the same time eats into the organizer’s budget, via increased expenditures for the current level of \( y \). The substitution effect and the income effect therefore go in different directions, even though both \( x \) and \( z \) are normal goods. (As long as the effective marginal cost of \( x \) is strictly positive). The sign of the effect can be shown to be determined by

\[-W^o_zy_x - W^o_zy_\tau (\tau y_x + c_o),\]  

(11)

where the first term reflects the substitution effect, via \( y \), and is strictly positive. The second term measures the income effect, again via \( y \), where \( z_\tau = -y \) and \( W^o_zy \leq 0 \). Hence, the second term is negative if \( \tau y_x + c_o > 0 \), that is as long as the organizer has a positive marginal cost for \( x \). This is the case as long as \( \tau \) is not too large.

**Proposition 5.** \( \partial x/\partial \tau < 0 \) only if \( W^o \) is sufficiently concave in \( z \), in terms of relative risk aversion, and \( \tau y_x + c_o > 0 \).

**Proof.** In the appendix.

The intuition for this result revolves around the income effect. A higher \( \tau \) forces the organizer to cut expenses, which it can do by spending less on \( x \) and \( z \). If the marginal effect of \( z \) on organizer’s welfare is very sensitive to reductions in \( z \), then it could conceivably be optimal to only reduce \( z \) marginally and instead make up for the required savings by a reduction of \( x \), further magnified by the resulting increase in co-payments for \( y \). Hence, the degree of concavity in \( z \) is key here. For example, if \( W^o \) is linear in \( z \) then there is no income effect and \( \partial x/\partial \tau > 0 \).

The organizer’s decision problem can be illustrated in a simple consumption theory graph depicting indifference curves and a budget constraint. In Figure 2 the indifference curves map sets of \( x \) and \( z \) yielding a constant \( W^o \) but the budget constraint is non-standard in the sense that it is non-linear in \( x \) (unless \( y(x) \) happens to be linear). A higher \( \tau \) causes the budget curve to shift down. The left panel in Figure 2 show
Figure 2: The effect of a higher co-payment on the organizer’s choice of $x$. In the left panel $x$ increases in $\tau$, whereas it decreases in the right panel. Cases where an increase in $\tau$ leads to an increase in $x$ and the right panel depicts cases where it actually results in a reduction in $x$. Both cases are based on our parametric example (with $c_o = c_r = \theta = \rho = 1$ and $M = 4$) and differ only in that the organizer’s sub-utility function for $z$ is assumed to equal $z$ and $-1/z$ respectively.

As we have seen, the critique that co-payment may lead to the perverse effect of reducing the organizers’ own security efforts could have merit under certain circumstances. In particular, the organizer must face a binding budget constraint — a situation especially relevant for non-profit organizers — and the benefit of the event as perceived by the organizer must be quite sensitive to the quality of the event in some respect.

A simplistic use of co-payments could thus be problematic in contexts where budget constraint are likely to bind. However, as noted in section 2.3, a more efficient allocation of resources entails cost savings which could be used to relax the budget constraint. The upshot is that it in this case may be difficult to move towards an socially efficient allocation merely by tweaking $\tau$. A combination of co-payments and transfers would therefore be preferable. Alternatively, $x$ could be subsidized, which simultaneously aligns marginal incentives and relaxes the budget constraint. As mentioned before, a drawback is that this requires the policy maker to point out which activities that are to be subsidized. In all likelihood, the organizer is better informed about how to best allocate spending on different measures to prevent unruly behavior.
Finally, a limitation of our discussion here is that we, for simplicity, have assumed that the quality of the event does not influence the welfare of the rest of society. In practice it can sometimes be reasonable to assume that quality may also benefit society more generally. There may be spillovers in terms of media coverage benefiting broader groups and fans not attending the event may still derive benefits from a good performance. Moreover, social welfare exceeds the organizer’s benefit as long as the organizer cannot price to extract all consumer surplus. When there are positive externalities from quality too little will be provided, which would also have to be taken into account in a welfare analysis. However, under some circumstances the organizer’s choice of $z$ could also be too high from a social perspective. For instance, this could be the case in contest-like contexts such as tournaments or sports leagues where one team’s win is another team’s loss. Here, the benefits a club might derive from adjusting $z$ to improve its chance of winning do not correspond to benefits to society, and over-investment is a likely outcome.

Subsidies of the organizer’s investments in security can also be analyzed in this framework. The difference is that organizers’ ”effective marginal cost” is now given by $c_o - s$ where $s$ again is the subsidy. Can higher subsidies lead to less investments in security? It can if $-W_z^o - W_{zz}^o z \tau (c_o - s) < 0$, i.e., if the income effect dominates the substitution effect. Note that we here have a standard problem without the indirect effect of $x$ through the number of police $y$.

## 5 An empirical application

On November 14, 2011, the Swedish police implemented a reform whereby sport clubs organized as corporations were required to pay for police at games. This sparked a heated debate about the effects and the fairness of the reform. The latter concern was fueled by the fact that clubs set up as non-profit organizations were excluded from payments, although the clubs are in fact very similar to other clubs.\footnote{Notably, the Swedish Sport Confederation requires that 51 percent of the shares of incorporated sport clubs are held by a non-profit association. Moreover, a recent government report (Svensson,}
Unwittingly, the design of the reform provides a unique possibility to test implications of our model in a difference-in-difference framework. Specifically, we look at the effect of introducing co-payments on the number of guards provided by the organizer, police deployment and the level of unruly behavior (Propositions 1-3 in the model).

We use data from internal police reports game by game in the highest Swedish soccer league *Allsvenskan* from March, 2011 to September 11, 2013 when it was announced that payments will no longer be used. The reports include information on the number of guards hired by clubs, the number of police officers, pre-game risk assessments by the police (1-4 where 4 denotes a very high risk) and actual unruly behavior during games (1-4 where 4 denotes a calm game without incidents). Three clubs were incorporated before the reform and are therefore treated while the other 13 clubs were non-profit organizations and constitute the control group. During the first half of the 2012-soccer season, the co-payment was 25 percent of the police costs and from July 1, 2012, clubs had to pay the full police cost near stadiums (approximately €100 per hour). We exploit this variation in three dummy variables $P^0$, $P^{25}$ and $P^{100}$ where $P^0$ captures games without payments, $P^{25}$ games with 25 percent payments and $P^{100}$ full payments for police. The dummy variables $Ltd * P^0$, $Ltd * P^{25}$ and $Ltd * P^{100}$ capture the effect of paying for police in the treated clubs under the three different payment regimes. We control for home-team fixed effects since the variation in payments occur at this level. (Summary statistics are provided in Table A.1 in the appendix).

We therefore obtain the difference-in-difference estimators using the following model:

$$\text{Outcome}_{it} = \alpha + \beta Ltd_i + \gamma P^0_t + \theta P^{25}_t + \rho P^{100}_t + \mu Ltd_i * P^0_t + \tau Ltd_i * P^{25}_t + \psi Ltd_i * P^{100}_t + \theta_t + e_{it}.$$  

$\text{Outcome}_{it}$ denotes the outcome (private guards, police or unruly behavior) in group $i$, where $i$ is the treatment group (limited company) or the control group (not limited company), in game $t$. $\theta_t$ denotes time-specific effects and the error term is denoted $e_{it}$. 

---

2013) notes that clubs which are corporations and non-profit in reality have the same aim of earning profits, achieving success in their sport and wish to provide entertainment to the audience. 

16The clubs have constantly appealed and actually not paid any dues so far. They have, however, put money aside since they have been aware of the fact that their appeals may be declined.

17The incorporated clubs are AIK and Djurgårdens IF from the Stockholm area, and Örebro SK from central Sweden.
There may be a concern that the composition of games is different before and after treatment either due to that high-risk games take place at different time during the season or due to entry and exit of teams in Allsvenskan. To address this possibility, we introduce a dummy variable capturing the derbies (in Stockholm, Gothenburg and the southern county Skåne), which are very special events where the level of security and unruly behavior are far higher than during normal games. In our data set, there are for example 5 times more police commanded to these games. We also use a Sunday dummy variable, since games played on Sundays, according to the police reports, have a different composition of spectators and are typically calmer than games that take place on other days. We finally control for risk assessments made by the police prior to every game. As this variable may be endogenous to the payment reform, we use risk assessments game combination by game combination in 2011, prior to the reform.\footnote{Due to this endogeneity, we exclude match combinations which only occurred after the introduction of payments, when new teams entered the league. The results in the other regressions remain by and large the same with this sample restriction.}

Recall that the theory implied that payments should induce more private guards, fewer police and less unruly behavior. Table 1 shows the results for private guards.

<table>
<thead>
<tr>
<th>Sample</th>
<th>[1]</th>
<th>[2]</th>
<th>[3]</th>
<th>[4]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ltd * P(_{25})</td>
<td>2.79</td>
<td>3.41*</td>
<td>3.37*</td>
<td>3.64</td>
</tr>
<tr>
<td></td>
<td>(1.72)</td>
<td>(1.71)</td>
<td>(1.77)</td>
<td>(2.31)</td>
</tr>
<tr>
<td>Ltd * P(_{100})</td>
<td>8.31***</td>
<td>9.06***</td>
<td>9.01***</td>
<td>11.30**</td>
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<td>(3.66)</td>
</tr>
<tr>
<td>P(_{25})</td>
<td>1.74</td>
<td>−0.67</td>
<td>−0.61</td>
<td>1.14</td>
</tr>
<tr>
<td></td>
<td>(3.64)</td>
<td>(3.58)</td>
<td>(3.64)</td>
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</tr>
<tr>
<td>P(_{100})</td>
<td>1.52</td>
<td>−0.48</td>
<td>−0.45</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>(3.10)</td>
<td>(3.22)</td>
<td>(3.17)</td>
<td>(4.81)</td>
</tr>
<tr>
<td>Derby</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sunday</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Risk assessment before game</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<td>(R^2)</td>
<td>0.41</td>
<td>0.45</td>
<td>0.45</td>
<td>0.62</td>
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<tr>
<td>Observations</td>
<td>529</td>
<td>529</td>
<td>529</td>
<td>452</td>
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</tbody>
</table>

Note: *** indicates significance at the 1 percent level and * at the 10 percent level. The regressions include half-year fixed effects, home-team fixed effects and home-team specific trends. The standard errors are clustered at the level of the home teams.
In Column 1, there are only time-fixed effects, in Column 2 we add a control for derbies, in Column 3 a Sunday dummy and in Column 4 we control for the risk assessments in 2011. The coefficients are similar independently of specification. With the 25-percent payment there were approximately 15 percent more guards compared to games without payments. When clubs had to pay 100 % there were approximately 50 percent more guards. This result is highly significant in all regressions. While we cannot exclude the possibility that clubs are concerned about quality, and would have perhaps spent even more on guards otherwise, the critique that co-payments would actually lead financially constrained organizers to spend less on guards, which we explored theoretically in section 4, receives no support here.

Table 2 shows the results for the number of police officers present at games. We use the same four specifications as in Table 1. All but one coefficient have negative signs, as predicted, but the coefficient estimates are insignificant.

<table>
<thead>
<tr>
<th>Sample</th>
<th>[1]</th>
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<th>[3]</th>
<th>[4]</th>
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</thead>
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<tr>
<td>Ltd * P₂⁵</td>
<td>-10.38</td>
<td>-0.27</td>
<td>1.07</td>
<td>-5.15</td>
</tr>
<tr>
<td></td>
<td>(9.57 )</td>
<td>(12.38)</td>
<td>(13.83)</td>
<td>(11.65)</td>
</tr>
<tr>
<td>Ltd * P₁⁰₀</td>
<td>-20.63</td>
<td>-5.57</td>
<td>-3.97</td>
<td>-1.36</td>
</tr>
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<td>(16.22)</td>
<td>(12.65)</td>
<td>(12.93)</td>
<td>(14.52)</td>
</tr>
<tr>
<td>P₂⁵</td>
<td>23.16</td>
<td>-10.17</td>
<td>-12.91</td>
<td>13.51</td>
</tr>
<tr>
<td></td>
<td>(17.13)</td>
<td>(15.85)</td>
<td>(16.99)</td>
<td>(12.59)</td>
</tr>
<tr>
<td>P₁⁰₀</td>
<td>11.08</td>
<td>-18.37</td>
<td>-20.40</td>
<td>2.45</td>
</tr>
<tr>
<td></td>
<td>(19.78)</td>
<td>(20.12)</td>
<td>(21.12)</td>
<td>(22.93)</td>
</tr>
<tr>
<td>Derby</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sunday</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Risk assessment before game</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.20</td>
<td>0.35</td>
<td>0.36</td>
<td>0.66</td>
</tr>
<tr>
<td>Observations</td>
<td>523</td>
<td>523</td>
<td>523</td>
<td>446</td>
</tr>
</tbody>
</table>

Note: The regressions include half-year fixed effects, home-team fixed effects and home-team specific trends. The standard errors are clustered at the level of the home teams.

Table 3 shows the effects on unruly behavior inside stadiums. Under the 25 % regime there were approximately 10-percent reductions in unruly behavior inside stadiums. When clubs paid 100 % there were approximately 20 percent less unruly beha-
behavior. The coefficients are similar and significant in all specifications. At the same time, there was an general increase in unruly behavior inside stadiums.

Table 3: The effect of co-payments on unruly behavior

<table>
<thead>
<tr>
<th>Sample</th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ltd * P²⁵</td>
<td>0.30**</td>
<td>0.27*</td>
<td>0.25*</td>
<td>0.31*</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.14)</td>
<td>(0.15)</td>
<td>(0.16)</td>
</tr>
<tr>
<td>Ltd * P¹⁰⁰</td>
<td>0.72*</td>
<td>0.68**</td>
<td>0.66**</td>
<td>0.68**</td>
</tr>
<tr>
<td></td>
<td>(0.36)</td>
<td>(0.30)</td>
<td>(0.26)</td>
<td>(0.25)</td>
</tr>
<tr>
<td>P²⁵</td>
<td>-1.05**</td>
<td>-0.91**</td>
<td>-0.89**</td>
<td>-0.88**</td>
</tr>
<tr>
<td></td>
<td>(0.47)</td>
<td>(0.42)</td>
<td>(0.37)</td>
<td>(0.37)</td>
</tr>
<tr>
<td>P¹⁰⁰</td>
<td>-1.18**</td>
<td>-1.06**</td>
<td>-1.05***</td>
<td>-1.08***</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.49)</td>
<td>(0.34)</td>
<td>(0.32)</td>
</tr>
<tr>
<td>Derby</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sunday</td>
<td>No</td>
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<td>Yes</td>
</tr>
<tr>
<td>Risk assessment before game</td>
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<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.19</td>
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<tr>
<td>Observations</td>
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<td>529</td>
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<td>453</td>
</tr>
</tbody>
</table>

Note: *** indicates significance at the 1 percent level, ** at the 5 percent level and * at the 10 percent level. The regressions include half-year fixed effects, home-team fixed effects and home-team specific trends. The standard errors are clustered at the level of the home teams.

In sum, in line with the basic model, the introduction of payments for police increased the number of guards and reduced unruly behavior. The results on police deployment were insignificant but generally had the right signs. However, there are only 17 games with 25-percent treatment and 26 games with 100-percent treatment so we need to be cautious when drawing conclusions from such a small sample.

6 Concluding discussion

The simple premise for this paper is that private provision of security in connection to events can be subject to both externalities and free-riding, which typically leads to an inefficient allocation of efforts. We focus our attention on how co-payments for publicly provided security may alleviate the incentive problem since the co-payment mechanism has been much debated, and also used in practice.

Note that the co-payment mechanism is intimately connected to the free-riding problem — it is the close relationship between the organizer’s action and police’s re-
sponse that both gives rise to free-riding and makes the response a useful variable for incentive purposes. Therefore it is not surprising that co-payments may not suitable in situations involving similar externalities and private provision of effort but where the free-riding aspect is weak. For example, pubs and restaurants may have incentives to sell more alcohol than is socially desirable, resulting in more unruly behavior and more police work. However, a single establishment typically has a very small effect on police deployment, which diminishes the free-riding incentive, and it would be exceedingly difficult to disentangle individual proprietors’ influence on police costs. Similarly, inadequate security at banks or shops can result in increased police cost and inconvenience and harm for patrons. Again, there are many establishments and the free-riding aspect is likely to be insignificant.

One concern when basing incentives for one party on another party’s actions is whether the latter is impartial or whether it has incentives to bias its actions in response to the incentive mechanism. This could, for example, be the case if the co-payments directly benefited this party. Therefore it is preferable if payments go to the state coffer rather than to the police budget. There may also be other incentives working in the same direction. For instance, safety in numbers is a natural reason for police officers to prefer larger deployments than what might be socially optimal. Theoretically, co-payments can be adjusted, or incentives provided to the police, to counter this.

Another concern has been that the financial burden of co-payments would hurt the organizers and could not only harm the quality of the events but even result in less spending on security, simply because the organizers cannot afford it if they are subject to co-payments. While income effects could potentially work in that direction for organizers that do not merely maximize profit, as was discussed in the paper, it would also be possible to at least partially compensate organizers for these payments ex ante since a move to a more efficient allocation of efforts among the organizers and the police entails cost savings.

\[Incident-based payments could reduce this problem, at least for incidents occurring inside establishments, but they may lead to under-reporting of incidents. In practice, other measures are used, such as regulation of opening hours, revoking of liquor licenses and alcohol taxes.\]
An aspect which we have not discussed is that event organizers may be able to influence the composition of spectators attending events thereby affecting the risk of outbreaks of unruly behavior. This is especially relevant if the composition influences social norms regarding acceptable behavior in the group. One way of influencing the group composition is the pricing of events. In a related paper (Nyberg and Priks (2014)), we examine the effect of pricing on unruly behavior if the income distribution between troublemakers and others differ, and also account for population based social norms. We discuss whether this to some extent may explain the absence of hooliganism in North America and whether a high price strategy may be less successful if the income distribution is more compressed.

References


Appendix

The second order condition in the example

In our example, \( W_{xx}^o = -\alpha v(x, y)\rho(1 + \rho)x^{-2} \), \( W_{xy}^o = -\alpha v(x, y)\rho\theta x^{-1}y^{-1} \), \( W_{yy}^o = -\alpha v(x, y)\theta(1 + \theta)y^{-2} \) and \( W_y^o = -\alpha v(x, y)\theta y^{-1} \). Insertion into expression (5) then yields \(-\alpha v(x, y)\left(\rho(1 + \theta(1 + \theta)B^2 + \theta B_{xy})\right)\), where \( A = 1/x > 0 \) and \( B = y^{-1}x^{-(\alpha + 1)/(\alpha + \theta)}((\alpha + \beta)/c)_{1/\theta} > 0 \). It is easy to see that the expression is negative if we rearrange it: 

\[-\alpha v(x, y)\left(\rho A - \theta B\right) + \rho A^2 + \theta B^2 + \theta B_{xy} < 0.\]

**Proof of Proposition 3.** Inserting the appropriate expression for \( \frac{dy}{dx} \) into expression (8) and simplifying gives us,

\[
\frac{dv}{dx} = v_x + v_y \frac{dy}{dx} = v_x \left[ 1 - \frac{(W_{vv}^x + W_{vo}^x)v_y + (W_{v}^x + W_{vo}^x)v_{xy}/v_x}{(W_{vv}^y + W_{vo}^y)v_x + (W_{v}^y + W_{vo}^y)v_{yy}/v_y} \right].
\]

(A.1)

The numerator and the denominator are both positive and differ only in the last terms. Thus, \( dv/dx \) is strictly negative if \(|v_{xy}/v_x| < |v_{yy}/v_y|\). □

**Proof of Proposition 5.** Differentiation of (10) with respect to \( \tau \), expressed in matrix form, yields

\[
\begin{pmatrix}
    d^2W^o/dx^2 & 0 & -(\tau y_x + c_o) \\
    0 & d^2W^o/dz^2 & 1 \\
    -(\tau y_x + c_o) & -1 & 0
\end{pmatrix}
\begin{pmatrix}
    \partial x/\partial \tau \\
    \partial z/\partial \tau \\
    \partial \lambda/\partial \tau
\end{pmatrix}
= \begin{pmatrix}
    \lambda y_x \\
    0 \\
    y
\end{pmatrix}
\]

(A.2)

where the first matrix is the bordered Hessian, \( H \). Note that \( d^2W^o/dx^2 \) includes the effects via \( y \), and is equal to the expression in condition (5) (which was assumed to be negative) minus \( \lambda \tau y_{xx} \). \( (d^2W^o/dz^2 = W_{zz}^o) \). The determinant of \( H \), \( |H| \), is 

\(-d^2W^o/dx^2 - d^2W^o/dz^2(\tau y_x + c_o)^2 > 0 \). Thus the second order condition is satisfied for the organizer’s maximization problem.

Using Cramer’s rule, and that \( \lambda = W_{zz}^o \), the effect of \( \tau \) on \( x \) can be expressed as

\[
\frac{\partial x}{\partial \tau} = \frac{-W_{z}^o y_x + W_{zz}^o y (\tau y_x + c_0)}{|H|}.
\]

(A.3)

The first term of the numerator is positive and the second negative, if \( \tau y_x + c_o > 0 \). For \( W_{zz}^o = 0 \) it is strictly positive, and it can only become negative if \(|W_{zz}^o/W_z^o|\) is sufficiently large. □
Table A.1: Summary Statistics

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<tr>
<th>Treatment = 1</th>
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<th>St. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Obs.</th>
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<tbody>
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<td>Police $P^{100}$</td>
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<td>Unruly behavior $P^0$</td>
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