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The Informational Effect of Choosing a Prison Sentence

Master Thesis – Economics of Management and Organisations*

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Abstract: In this paper, a game theoretical model is developed in order to study the effect of prison sentencing on criminal behaviour. A two-period model is built in which an individual has to decide between being legal or performing a criminal act and in which the police have to decide whether to sentence the individual to prison. The police have complete knowledge about the individual's inclination towards exhibiting criminal activity, whereas the individual does not and only receives a signal about his trait. The results of the model show that when the regime of the police is exogenous, a less strict regime will always lead to more criminal activity. Moreover, a corner solution is found in which a stricter regime leads to no criminal activity by the smallest margin. When the strictness of the regime is endogenous, the results indicate that a positive correlation between the strictness of the regime and the amount of criminal activity is possible, but only as a result of a change in one of the other parameters.

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1 Introduction

"Imprisonment is as irrevocable as death."

(George Bernard Shaw in *Man and Superman – Maxims for a Revolutionist*, 1903)

Although the death penalty is the only penalty that is truly irreversible, Nobel price winner George Bernard Shaw, already stated in 1903 that imprisonment changes people in such a way that this effect will last forever. The effectiveness of law enforcement and imprisonment is a thoroughly researched topic, also economically (Polinsky and Shavell, 1999). However, the effect of imprisonment that Shaw means, the effect on the behavior of the convicted individuals, is a subject that has gained less attention.

Looking at the recidivism rates, a great number of imprisoned individuals will perform a criminal act again in the future. In the United States, Langan and Levin (2002) found that 67,5% of the offenders was rearrested within the first three years of their release. Nearly two-third of this recidivism occurred within the first year. In The Netherlands the recidivism rates are lower, but it can also be seen here that recidivism occurs very often. Wartna et al. (2010) found that the Dutch two-year recidivism rate is somewhere between 49,4% and 55,1% for ex-convicts. Moreover, Spohn and Holleran (2002) even found evidence that drugs offenders that were sentenced to prison, have higher recidivism rates than offenders that were put on probation. So apparently, imprisonment might influence the behavior of the persons convicted. This, combined with the high recidivism rates, raises the question whether imprisonment is really the best way to prevent criminal activity in the future.

The dominating public opinion, however, is that most punishments are too soft. It is often said that we should put people into prison more quickly and that we need a harsher sentencing climate (Hough and Roberts, 1999). However, the studies above indicate that a great number of ex-convicts perform a criminal act again and that imprisonment might actually increase criminal activity. This paper takes a game theoretical approach in looking at the effects of choosing between imprisonment and freedom and studies how an individual adapts his behavior based on these two actions of the police. If people are rational, is it possible that knowingly not putting an individual into prison that has performed a criminal act, will lead to less criminal activity in the future, than by choosing imprisonment? So, in other words, might going against the public attitude towards punishment be a better way to reduce criminal activity than obeying it?

As stated before, the occurrence of criminal activity and the effectiveness of imprisonment are topics that have been thoroughly researched in economical studies. For example, Polinsky and Shavell (1999) look at the cost of criminal activity and imprisonment for the society and try to determine the optimal system of enforcement by maximizing social welfare. Not many papers, however, have taken a game theoretical approach to look at these topics. This paper does, by building a dynamic game in which there is an individual and a legal authority, the police. The individual has to decide whether he wants to perform a criminal act in both periods and the police have to decide whether they want to sentence the individual to prison after the first period. The police have full knowledge about the level of criminality of the individual, but the individual does not. The key aspect of this game is that the decision of the police contains information about the level of criminality of the individual. Since this decision is the only way to convey information, the individual takes the action of the police into account in his decision-making process. Therefore, with their decision-making, the police have to take into account that they convey information. So, in this paper the effect of imprisonment is studied by looking at the effect of updating of the initial beliefs.

Recent game theoretical studies have looked at the role of social status and social norms in criminal behavior, in addition to fines and imprisonment conducted by the police. In these studies it is argued that all these factors might deter criminal activity (Dur and Van der Weele, 2013). In this paper, however, we look at a new factor that can be an important deterrent. What does the individual learn from the fact that the police find him criminal enough to be sentenced to prison? Or on the opposite, what does he learn from the fact that he does not have to go to prison even though he did perform a criminal act? In this paper we try to address these questions by investigating the effect of the information that is transferred onto the individual based on the action taken by the police.

In the model, imprisonment is only an option when the individual has performed a criminal act. Therefore, the analysis starts with the assumption that the individual has performed a criminal act in the first period. It is shown that when the police choose imprisonment, the individual will always perform a criminal act in the second period again. So, with imprisonment, recidivism will always occur. When the police choose freedom, the strategy of the individual is not pure anymore and it is shown how the strategies of the police and the individual react to different changes in the parameters and the strategy of the other player. By taking the strategy of the police as exogenous, it is shown that a less strict regime will actually always lead to more criminality. When the strategies are endogenous it is possible to find a positive correlation between the strictness of the regime and criminal activity. This positive correlation is due to a change in one of the other parameters in the world, so it does not indicate that a less strict regime reduces criminal activity.

The model looks at imprisonment as the form of punishment and prevention of criminal activity. The model of this paper, however, is widely applicable to situations that are more or less similar. It can be applied to all situations in which there exists a party that can take actions that are labeled as not allowed or desirable and another party that can take counter measures to punish this behavior and stop it from happening in the future. For example, cheating on a test in school, where the teacher has to decide whether or not to give the student a bad grade. The model is also applicable to a situation of a completely different order, like the way in which asylum seekers should be treated when they illegally enter a country.

This paper is organized in the following way. In the next section, the related literature is reviewed. In the third section the criminal act game is presented, which is analyzed in section four. The last two sections consist of a discussion and the conclusion.

2 Related literature

The idea from this paper resolves from the Standford Prison Experiment, conducted by Haney, Banks and Zimbardo in 1971 (Haney et al., 1973). In this experiment, innocent people were placed in a simulated prison, half of them as prisoners and the other half as guards. Surprisingly, within thirty-six hours the individuals conformed to their roles. Guards became aggressive and enjoyed their power, whereas the prisoners started rebelling. The results of this experiment suggest that the action taken by the higher authority has an influence on behaviour. Apparently, the individual experiences that the choice of his role contains information about his personality and the individual starts acting in a way to conform to this role. Of course, in a good functioning legal system, innocent people will not be put into prison and so, this behaviour will not occur in real life. However, following from this experiment is the idea that the individual does not have perfect knowledge about his own personality and that a prison sentencing might induce the individual to belief that he is more criminal. Therefore, these ideas are captured in this paper by conducting a game theoretical model on criminal activity and the effect of the choice for imprisonment.

One of the first papers that uses a game theoretical approach to look at the effect of punishment on crime is Tsebelis (1990). Like in this paper, Tsebelis (1990) uses two types of actions for both players. Moreover, the result is that the police should be seen as a strategic actor, which is also the approach used for the model in this paper. An important difference with this paper is that Tsebelis (1990) studies whether higher penalties and more severe punishment reduce crime, whereas in this paper the punishment is constant, namely imprisonment. The strictness of the legal authority in this paper comes from how quickly the police choose imprisonment. So in other words, how criminal someone has to be to be sentenced to prison. Another important difference is that in our model only the police have complete knowledge, whereas in Tsebelis (1990) either both players have complete knowledge or both players have incomplete knowledge about the other player. Moreover, the model of Tsebelis (1990) is simultaneous, whereas in this model, the players choose their actions sequentially. First, the individual decides whether he performs a criminal act and after this, the police decide which action to take. Then, the individual can decide on the action for the second period. This approach is more in line with the real world, since in a functioning legal system, people will only be sentenced to prison after performing a criminal act.

This paper is also related to a recent study of Dur and Van der Weele (2013) that emphasizes that social status and norms can be a factor in deterring criminal activity, in addition to imprisonment and fines. This study is related in the sense that this paper also studies the message that is conveyed onto individuals by the action of the police. In the paper of Dur and Van der Weele (2013), this message is conveyed to other people and influences the social status of the individual. In this paper, however, the individual does not care about his social status. It is not about the other people's beliefs, but about the beliefs of the individual himself about his trait for being criminal. Opposed to the situation in Dur and Van der Weele (2013), in which people cannot observe each other's trait, in this paper, the individual does not know the value of his own trait for being criminal. Moreover, this analysis differs from this paper in the sense that our model is dynamic and consists of two periods. The focus lies on the actions the individual chooses in these periods and how the action of police can influence the decision-making. No differentiation is made in the severity of the criminal activity, which is done in Dur and Van der Weele (2013). We allow the individual to choose only between being criminal and being legal.

This paper does not intend to replace the existing theories on the effect of imprisonment. Rather it shows that there might be an additional factor that determines the effectiveness of imprisonment and the effect on the behaviour of criminal individuals.

The idea for the build-up of the model that is developed in this paper is based on recent literature on confidence management. Kamphorst and Swank (2013) model a Bayesian game in which the manager has to assign two tasks to two employees. Key in this study is that managerial decisions contain information about the ability of the employees and that these employees have incomplete knowledge about their own ability. Our model takes this approach, although it is used for a different purpose. Instead of promotion, we look at punishment in the form of imprisonment, but the main idea remains the same. The action of the higher authority contains information about the trait of the individual and this determines the strategy of the players. What is different in the model of this paper, opposed to Kamphorst and Swank (2013), is that we do not have two individuals but only one individual that updates his beliefs.

3 The criminal act game

In this section the criminal act game is described. Consider a world that consists of two periods. Individual i can choose between two activities $X_p \in \{0, 1\}$ in each period. If the individual chooses $X_P = 0$ this means that he is being legal in period P. When he chooses $X_P = 1$ this means that he performs a criminal act in period P.

The individual has a trait, $t \in [l, h]$ for being criminal, where $l < 0$ and $h > 0$. The higher t is, the more criminal the individual is. The trait can be interpreted as the individual's chance of regretting the criminal act in the future, so how bad he might feel about exerting criminal activities later. The higher the trait is, the lower this chance of regret is. The individual, however, does not exactly know how high this t is. The individual does receive a signal $s \in [l, h]$ about his trait in the first period. With probability π the signal is informative, which means that the signal the individual receives is correct ($s = t$). With probability $1 - \pi$ the signal is uninformative, which means that the signal does not contain information about his trait. The individual, however, does not know whether the signal is informative.

Next to the individual, the police c exist. After the individual makes a decision, the police can take an action $A \in \{0,1\}$ in the first period. The police can either decide to put the individual into prison ($A = 1$) or decide that the individual remains free ($A = 0$). The police can only sentence someone to prison when the individual has performed a criminal act ($X_1 = 1$). Choosing not to put someone into prison is possible regardless of the act of the individual. An important feature of the model is that the police have complete knowledge, so they observe the trait of the individual.

The police care about two things. First of all, they want to do justice, so they find it important to punish someone who has performed a criminal act. However, the police also care about the future and, therefore, want to prevent the individual from performing a criminal act in the next period. Therefore the payoff function for the police is the following:

$$U_c = \lambda A X_1 - \beta p_2(X_2 = 1) \tag{1}$$

where $\lambda \in [0,1]$ denotes a measure of the importance of punishment, $\beta \in [0,1]$ is a measure of the importance of prevention and $p_2(X_2 = 1) \in [0,1]$ denotes the probability that the individual performs a criminal act in the second period. So, Equation (1) shows that the payoff of the police depends on the two aspects, namely punishment and prevention. As can be seen, punishment is only activated in the payoff function of the police when the individual performs a criminal act in the first period ($X_1 = 1$) and the police decide to put the individual into prison ($A = 1$). The negative factor of prevention is activated with the probability of the individual performing a criminal act in the second period ($X_2 = 1$), because then prevention has failed.

After the action of the police, the individual starts updating his beliefs about his trait and he chooses the activity he wants to perform in the second period. The payoff function for the individual in both periods is as follows:

$$U_i = \begin{cases} E(t|s,A), & X = 1 \\ 0, & X = 0 \end{cases} \tag{2}$$

where $E(t|s,A)$ is the individuals expectation of his trait, conditional on his signal and the activity of the police. Equation (2) shows that the individual's payoff depends on his chance of regretting being criminal. A key feature of the model is that the action of the police can have an effect on the individual's perception of his trait on criminality and, therefore, on the action the individual chooses.

The timing of the model is as follows.

1. Nature determines the trait of the individual.
2. The individual receives a signal about his trait and decides which activity he wants to perform.
3. The police observe the trait of the individual and the action taken by the individual. They decide whether they want to sentence the individual to prison.

4. The individual updates his beliefs about his trait, based on the action taken by the police, and chooses an action for the second period.
5. The individual's payoff and the police's payoff are realized.

4 Analysis of the game

In this section, the criminal act game is solved using the method of backward induction. Because of the fact that the police can only choose between both actions when the individual has committed a criminal act in the first period, we assume $X_1 = 1$ since this is the most interesting situation. If the individual does not perform a criminal act in the first period, the police do not have the option to put the individual into prison, so no new information is learned for the second period. It is important for the rest of the solution of the game to keep in mind that assuming that the individual has committed a criminal act in the first period, means that the utility of this action is higher than the utility of being legal. Therefore, the following is true for the signal the individual has received:

$$\pi s + (1-\pi)\tfrac{1}{2}(l+h) > 0$$

$$s > \frac{1}{2\pi}(l+h)(\pi - 1)$$

Using the method of backward induction, we start by looking at the point at which the individual chooses his activity in the second period. The individual will choose to perform a criminal act in period two when the payoff of being criminal ($X_2 = 1$) is larger than the payoff off being legal ($X_2 = 0$). As can be deduced from Equation (2), this is the case when

$$E(t|s, A) > 0$$

As can be seen from this formula, the decision of the individual depends on the signal as well as on the action taken by the police. So, by calculating the threshold signal from which the individual will choose to perform a criminal act, we have to look at the two possible choices of the police separately.

4.1 The police have chosen imprisonment

The situation in which the police put the individual in prison ($A = 1$) is the more straightforward situation. Since we already know that the individual has performed a criminal act in the first period, choosing to take action $A = 1$ will always lead to $E(t|s, A = 1) > 0$. In other words, if the police choose to put the individual in prison this will always lead to the individual performing a criminal act in the second period again.[1] Therefore, the payoff of the police will be equal to $U_c(A = 1) = \lambda - \beta$, as can be seen from Equation (1).

4.2 The police have chosen freedom

The situation in which the police have taken action $A = 0$ is more complex. There are two threshold points in this situation. First of all, t^* represents the point at which the police are indifferent between putting the individual in prison or not. If the trait of the individual is higher than this threshold, the individual will be sentenced to prison. Secondly, s^* represents the value of the signal for which the individual is indifferent between choosing a criminal act or being legal in the second period, given the fact that the police have chosen $A = 0$ and the individual has performed a criminal act in the first period ($X_1 = 1$). If the signal the individual receives is higher than this point, he will perform a criminal act.

Regarding these indifference points, there are two possible situations. First of all, the indifference point of the individual is lower than the indifference point of the police, so s^* lies to the left of t^*. Secondly, a situation in which the indifference point of the individual is higher seems possible. However, this possibility leads to a contradiction in the model. As can be seen in Figure 1, the grey area represents the area in which the police will always choose imprisonment, since the trait is higher than the indifference point t^*. The individual, however, will only perform a criminal act when the signal he receives is higher than s^*. Therefore, in the striped area between t^* and s^*, the individual will not perform a criminal act, but the police will put the individual in prison. As stated in the previous section, it is assumed that the police can only put someone in prison that has performed a criminal act, so this situation is in contradiction with the set-up of the model. Therefore, s^* is always lower than t^*.

[1] The studies of Langan and Levin (2002) and Wartna et al. (2010) show high recidivism rates, but these rates do not equal a hundred per cent. The reason for the extreme result that is found here is the simplicity of the model. If the police would not have complete knowledge and if the individual would get a new signal for the second period, this extreme result might not be found.

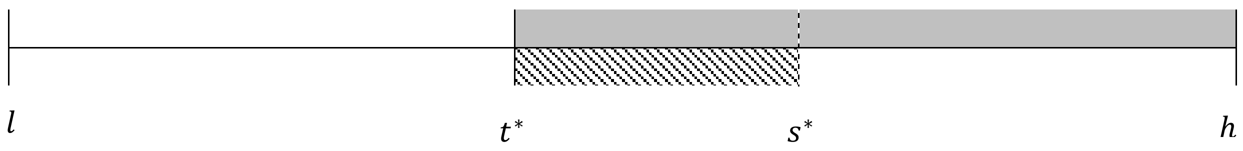

Figure 1: Graphical representation of the contradiction arising with $s^* > t^*$.

When the police have chosen freedom, there are two main options regarding the signal of the individual. First of all, the individual can receive a signal that is lower than the indifference point of the police ($s < t^*$). Since the individual has not been sentenced to prison, his trait must be lower than the indifference point of the police and therefore, the signal might be correct. Secondly, the individual can receive a signal that is higher than the indifference point of the police ($s > t^*$). Such a signal must be incorrect, since the individual would have been put into prison for a trait of that value. In the following sections, both options will be explained separately.

4.2.1 The signal can be correct

Suppose that $s < t^*$. As explained above, in this situation the individual learns that his signal could be right and, therefore, that his trait lies somewhere in the area between l and t^*, which is represented graphically in Figure 2.

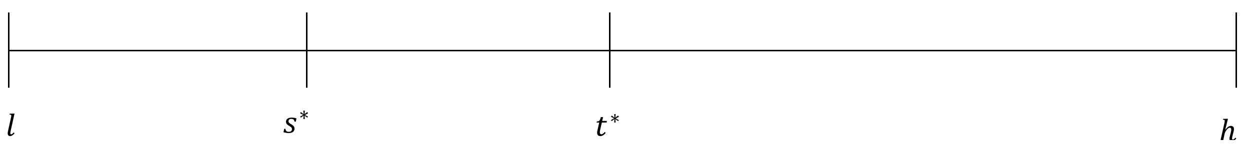

Figure 2: Graphical representation of the situation in which $A = 0$, $X_1 = 1$ and $s < t^*$.

Therefore, the expectation of the individual's trait is the following:

$$E(t|s, A = 0) = \hat{\pi}s + (1 - \hat{\pi})\frac{1}{2}(l + t^*)$$

where $\hat{\pi}$ is the updated chance that the signal the individual received is informative. By the action taken by the police, the individual learns that his signal can be correct and therefore, that the chance that his signal is correct is higher. This updated chance is calculated using Bayes' rule:

$$\hat{\pi} = \frac{\pi \frac{1}{t^* - l}}{\pi \frac{1}{t^* - l} + (1 - \pi)\frac{1}{h - l}}$$

which can be rewritten as:

$$\hat{\pi} = \frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)} \qquad (3)$$

From the formula it can be seen that in this model, it must be the true that $t^* - l \geq 0$. If $t^* - l < 0$, Equation (3) will lead to $\hat{\pi} > 1$ and since it is a probability, this is not possible.

By using Equation (2) and (3), the indifference point s^* is calculated in the following way:

$$\hat{\pi}s + (1 - \hat{\pi})\frac{1}{2}(l + t^*) = 0 \qquad (4)$$

$$\frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}s + \left(1 - \frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}\right)\frac{1}{2}(l + t^*) = 0$$

$$\frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}s = -\left(1 - \frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}\right)\frac{1}{2}(l + t^*)$$

$$s = \frac{\left(-\left(1 - \frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}\right)\frac{1}{2}(l + t^*)\right)}{\frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}}$$

$$s = -\frac{\left(\frac{1}{2}(l + t^*) - \frac{\frac{1}{2}\pi(l + t^*)(h - l)}{(h - l)\pi + (t^* - l)(1 - \pi)}\right)}{\frac{(h - l)\pi}{(h - l)\pi + (t^* - l)(1 - \pi)}}$$

$$s^* = \frac{(t^{*2} - l^2)(\pi - 1)}{2\pi(h - l)} \qquad (5)$$

Partially differentiating Equation (5) with respect to t^*, l, h and π yields the following, after some rewriting:

$$\frac{\partial s^*}{\partial t^*} = \frac{1}{\pi}\frac{t^*}{h-l}(\pi - 1) \qquad < 0$$

$$\frac{\partial s^*}{\partial l} = \frac{1}{2\pi(h-l)^2}(\pi - 1)(l^2 - 2hl + t^{*2}) \qquad < 0$$

$$\frac{\partial s^*}{\partial h} = \frac{1}{2\pi}\frac{(l^2 - t^{*2})}{(h-l)^2}(\pi - 1) \qquad > 0 \text{ or } < 0$$

$$\frac{\partial s^*}{\partial \pi} = -\frac{1}{2\pi^2}\frac{(l^2 - t^{*2})}{(h-l)} \qquad > 0 \text{ or } < 0$$

Normally, when we look at the strategy of a player in a game, this strategy is given the beliefs of the player and given the strategy of the other player, so that there is a Nash equilibrium. From Equation (4) the strategy of the individual can be determined. Here, however, we have partially differentiated with respect to Equation (5) and these derivatives do not fully represent the strategy of the individual in equilibrium. The derivatives show what will happen to the strategy of the individual when a specific parameter changes. All the other parameters are kept constant. This is not a complete game theoretical approach, because for there to be an equilibrium strategy, it requires that the change in the strategy of the other player is incorporated in the solution as well. Here, we do take into account that the beliefs of the individual are updated, but the strategy of the other player is kept exogenous. Therefore, the following part cannot be interpreted as fully representing the strategy of the individual in equilibrium. The derivatives, however, do give an inside in what will happen to the strategy of the individual when one of the parameters changes.

From the first partial derivative, it can be seen that when t^* increases, s^* decreases, keeping all other variables constant. So, when the police become less strict, the individual will perform a criminal act more quickly. This effect of t^* has two parts, a direct and indirect one. From Equation (4) it is seen that a higher t^* leads to a lower s^*, since the equation must remain equal to zero. However, t^* is also incorporated in the updated chance, as can be seen in Equation (3). There, it is seen that a higher t^* leads to a lower $\hat{\pi}$. The lower updated chance can have two effects on the indifference point of the individual. From Equation (4) it can be derived that if $s > \frac{1}{2}(l + t^*)$, the decrease in $\hat{\pi}$ will need to be followed by an increase in s^*, in order for this equation to hold. However, when $s < \frac{1}{2}(l + t^*)$, the indirect effect is that s^* will decrease due to the lower $\hat{\pi}$. So, the indirect effect of the lower updated chance can go two ways. If the signal is smaller than $\frac{1}{2}(l+t^*)$, it will intensify the negative direct effect. When the signal is larger, the lower chance on an informative signal will make the decrease in the indifference point of the individual less severe.

So, what can be derived from these results is that a less strict police directly leads to the individual performing a criminal act more quickly. This is logical, because the police will put fewer people into prison and therefore, it becomes more attractive to perform a criminal act. However, for the individual, the higher t^* means more uncertainty about the value of his trait, since the area in which he knows this trait lies becomes larger. This higher uncertainty especially plays a role when the signal is relatively high, so when the signal is higher than the expected value of the trait when the signal is incorrect. In the first period, the individual has performed a criminal act based on his signal. Now he learns that there is a lower chance that this high signal is correct and therefore, the individual has to rely more on the lower expected value of his trait and this means that he wants to perform a criminal act less quickly than before. So, when the signal is high enough, the indirect effect of a lower chance on an informative signal makes the decrease in s^* less steep. The direct effect of a less strict police, however, dominates and therefore, the overall effect of a less strict police is always that the individual performs a criminal act more quickly.

Looking at the research question stated in the introduction, this derivate indicates that the answer to this question is not affirmative. The negative derivative indicates that, for an individual that has not been put into prison, a less strict police will always make the individual perform a criminal act more quickly instead of less quickly. So, based on the negative value of this derivative, it can be seen that it is not possible that a less strict regime will lead to less criminal activity.

The second partial derivative shows that when l increases (becomes less negative), s^* decreases, which means that when the lower boundary of the trait becomes higher, the indifference point will become lower, ceteris paribus. Here, we can also see a direct and indirect effect of the increase in l. Equation (4) shows that the increase in the lower boundary directly leads to a lower s^*. This is because the increase in the lower boundary means that the trait can be less low and therefore, that the average trait in the model will be higher, which means more criminal. The increase in l indirectly leads to a higher $\hat{\pi}$, as can be seen from Equation (3). The increase in the lower boundary makes the area in which the trait of the individual lies smaller, so for the individual this means that he is more certain about the value of his own trait. As previously explained, this higher updated chance can have two effects on the indifference point of the individual. When $s > \frac{1}{2}(l + t^*)$, the higher updated chance will lead to a higher decrease in s^*. However, when $s < \frac{1}{2}(l + t^*)$, it will lead to an increase in s^*. Since the direct effect is stronger than the indirect effect, a higher lower boundary will lead to the individual performing a criminal act more quickly. When the signal is low enough, the higher chance that this signal is correct will make the decrease in the indifference point less severe.

The third derivative shows that when h increases, s^* either increases or decreases. So, when the upper boundary of the trait becomes higher, the indifference point of the individual will become higher or smaller, ceteris paribus. The change of the upper boundary only has an indirect effect on the indifference point of the individual via the updated chance $\hat{\pi}$, as can be seen in Equation (3). The increase in h leads to a higher $\hat{\pi}$, since he knows that his trait lies between l and t^* and that his signal could be right. The original area in which the trait of the individual could lie becomes larger through the increase in h, whereas the size of the area between l and t^* remains the same, so knowing that the trait lies in this area becomes more meaningful. This is the reason why an increase in the upper boundary leads to a higher updated chance. As explained before, there are two effects of a higher chance on an informative signal possible. The increase in the higher boundary will lead to a more criminal individual when the signal is higher than the expected value of the trait when the signal is incorrect. The individual will choose a criminal act less quickly when the signal is lower than the expected value. So, the increase in the upper boundary can either lead to choosing a criminal act less or more quickly, based on the values of the parameters.

When π increases, s^* either increases or decreases, ceteris paribus. This means that a higher chance of getting an informative signal, leads to an ambiguous effect on how quickly the individual will perform a criminal act. The effect of the increase in π on s^*, is indirectly through $\hat{\pi}$. Logically, a higher π also leads to a higher updated chance, which can be seen in Equation (3). As explained above, the higher updated chance can have two effects on the indifference point of the individual. So, the individual will either be criminal more quickly or choose a criminal act less quickly, based on the height of the signal relative to the height of the expected value of the trait.

As stated previously, in this model it must be true that $t^* - l \geq 0$. The above derivatives are calculated for all values $t^* - l > 0$. The situation in which $t^* - l = 0$ also seems to exist. Then, it is true that $\hat{\pi} = 1$ and from Equation (4) it follows that $s = 0$. So, when $t^* = l$, the chance that the signal the individual has received is informative is 1, so his trait is equal to zero. This is only a solution when both $l = 0$ and $t^* = 0$, because if they were smaller than zero, we would have $s > t^*$ and this would mean that the signal is wrong, which is in contradiction with $\hat{\pi} = 1$. However, since the model assumes $l < 0$, this is also not a possibility and, therefore, only $t^* - l > 0$ is possible.

The polices' payoff of choosing freedom ($A = 0$) depends on the probability that the individual will perform a criminal act again in the second period. As can be seen from Equation (1) the payoff is equal to $U_c(A = 0) = -\beta p_2(X_2 = 1)$. The individual knows that with probability π his signal is correct ($s = t^*$), which means that he will perform a criminal act in the second period as well. The signal is uninformative with probability $(1 - \pi)$, which means that the individual learns that his trait lies is in the area between l and t^*. Recall that the individual will only perform a criminal act when the signal is higher than the indifference point s^*. Adding these factors together, the probability of choosing a criminal act again is the following: $p_2(X_2 = 1) = \pi + (1 - \pi)\frac{t^* - s^*}{t^* - l}$. By using this formula and Equation (1), the indifference point t^* is equal to:

$$
\begin{gathered}
U_c(A = 0) = U_c(A = 1) \\
-\beta\left(\pi + (1 - \pi)\frac{t^* - s^*}{t^* - l}\right) = \lambda - \beta \qquad (6) \\
-\beta\pi - \beta(1 - \pi)\frac{t^* - s^*}{t^* - l} = \lambda - \beta \\
(-\beta + \pi\beta)\frac{t^* - s^*}{t^* - l} = \lambda - \beta + \pi\beta \\
\frac{-\beta t^* + \pi\beta t^* + \beta s^* - \pi\beta s^*}{t^* - l} = \lambda - \beta + \pi\beta \\
-\beta t^* + \pi\beta t^* + \beta s^* - \pi\beta s^* = (\lambda - \beta + \pi\beta)(t^* - l) \\
\lambda t^* = \beta s^* - \pi\beta s^* + \lambda l - \beta l + \pi\beta l \\
t = \frac{(1 - \pi)\beta s^*}{\lambda} + l + \frac{(\pi - 1)\beta l}{\lambda}
\end{gathered}
$$

$$
t^* = l + \frac{\beta(1 - \pi)(s^* - l)}{\lambda} \qquad (7)
$$

Partially differentiating Equation (7) with respect to s^*, l, β, λ and π yields the following, after some rewriting:

$$\frac{\partial t^*}{\partial s^*} = \frac{\beta}{\lambda}(1-\pi) \qquad > 0$$

$$\frac{\partial t^*}{\partial l} = \frac{1}{\lambda}(\lambda - \beta + \pi\beta) \qquad > 0 \text{ or } < 0$$

$$\frac{\partial t^*}{\partial \beta} = \frac{1}{\lambda}(l - s^*)(\pi - 1) \qquad > 0$$

$$\frac{\partial t^*}{\partial \lambda} = \frac{\beta}{\lambda^2}(l - s^*)(1-\pi) \qquad < 0$$

$$\frac{\partial t^*}{\partial \pi} = \frac{\beta}{\lambda}(l - s^*) \qquad < 0$$

Similar to the strategy of the individual, the strategy of the police in equilibrium is not fully represented here. The equilibrium strategy would be given the strategy of the individual. However, differentiating with respect to Equation (7) only predicts what happens to the indifference point of the police when one specific parameter changes. What happens to the strategy of the individual due to this change is not taken into account in this prediction and so, this is not a Nash equilibrium strategy. Therefore, the derivatives should not be interpreted as if they give inside in the equilibrium strategy, but rather as giving inside into what will happen to the strategy of the police, given the strategy of the other player.

From the first derivative, it can be seen that when s^* increases, t^* increases. This means that when the indifference point of the individual increases, the indifference point of the police will also become higher, ceteris paribus. As can be seen from Equation (6), a higher s^* would lead to a lower probability of the individual choosing a criminal act again and this means a higher utility for the police of not putting the individual in prison ($A = 0$). However, since the utilities of both actions must remain equal, t^* has to increase in order for Equation (6) to hold. So, the fact that the individual performs a criminal act less quickly increases the utility of not putting the individual in prison. This means that it is possible to put the individual into prison less quickly and still gain the same utility as before. For this reason, the increase in the indifference point of the individual results in a less strict police.

The second derivative shows that when l increases (becomes less negative), t^* either increases or decreases, ceteris paribus. So, when the lower boundary of the trait becomes higher, the indifference point will either increase or decrease, depending on the importance of prevention and punishment and on the chance the signal is informative. As can be seen from

Equation (6), the increase in the lower boundary leads to an increase in the probability that the individual will perform a criminal act, since the area in which the individual will perform the act (from s^* to t^*) becomes larger relative to the total area in which the trait of the individual lies (from l to t^*). This is conforming what we saw in the previous section, where a higher lower boundary led to the individual performing a criminal act more quickly. When punishment is more important than prevention ($\lambda > \beta$), the partial derivative is always positive, so the increase in the lower boundary will lead to a higher indifference point of the police, since Equation (6) must hold. The higher probability on a criminal act leads to a decrease in the utility of choosing $A = 0$, but the increase in t^* contradicts this negative effect on the utility of choosing $A = 0$, making Equation (6) to hold. So, when punishment is more important, the higher lower boundary leads to a less strict police, since the utility of the individuals that are put into prison is higher and therefore, the same utility is reached with fewer imprisonments. However, when prevention is more important than punishment ($\lambda < \beta$), the effect of the increase in the lower boundary is undefined, since the partial derivative can also be negative in this situation, which means that the indifference point of the police will decrease.

The third derivative shows that when β increases, t^* increases. In words, this means that when prevention becomes more important, the indifference point of the police will become higher, holding all other variables constant. Looking at Equation (6), it is shown that when prevention becomes more important, the utility of the police for putting someone into prison becomes lower. The utility of choosing not to put someone into prison also becomes lower, but this decrease is smaller, since the utility is based on the chance that the individual will perform a criminal act again, whereas with action $A = 1$, it is certain that the individual will perform a criminal act in the second period. Therefore, for Equation (6) to hold, t^* needs to increase, which means that the police will put less individuals into prison. Since this increases the probability that the individual performs a criminal act, it will further decrease the utility of not putting the individual in prison, which makes Equation (6) hold. So, when prevention is more important, the police can choose a less strict policy and still reach the same utility as when they would have put the individual into prison. The derivative, therefore, shows that when the police value prevention higher, they will choose a less strict policy.

From the next derivative, it can be seen that when λ increases, t^* decreases, ceteris paribus. This means that when punishment becomes more important, the indifference point of the police will become lower, which means that a larger range of traits is suitable for prison.

Here, the reasoning is the opposite of the previous reasoning. When the police value punishment higher, the utility of putting someone into prison increases, as can be seen from Equation (6). For the equation to hold, the utility of not putting someone into prison needs to increase as well. This is realised by a decrease in t^*, since this decreases the probability that the individual will perform a criminal act in the second period. A lower t^* means that the police will put the individual into prison more quickly, so this induces the individual not to perform a criminal act. Since, fewer people will then perform a criminal act, the probability of a criminal act in the second period decreases, which increases the utility of choosing not to put someone into prison. So, when the police value punishment higher, the police will put the individual into prison more quickly.

The last partial derivative shows that when π increases, t^* decreases. This means that when the chance that the signal the individual receives is informative becomes higher, the indifference point of the police will become lower, ceteris paribus. The chance on an informative signal partly determines the probability that the individual will perform a criminal act in the second period. A higher π means that the individual has more knowledge about the value of his trait and this leads to a higher probability of performing a criminal act, since he already performed a criminal act in period one with a lower probability on an informative signal. This would decrease the utility of the police of action $A = 0$. However, since a higher π does not have an effect on the utility of the police of choosing action $A = 1$, the utility of action $A = 0$, cannot change, as can be derived from Equation (6). This means that t^* decreases, because a lower indifference point means that the police is more strict and this decreases the probability that the individual will perform a criminal act, since he has a higher chance of going to prison. So, when it is more likely that the individual learns the value of his own trait, the police will become more strict to prevent the individual from performing a criminal act more quickly.

4.2.2 The signal is incorrect

Now, suppose $s > t^*$. As previously explained, this means that the signal the individual has received is wrong, since the individual would have been put in prison if he were that criminal. Therefore, the best estimate of his trait is equal to the half of the area between l and t^*, which is $E(t|s, A = 0) = \frac{1}{2}(l + t^*)$, as can be seen graphically in Figure 3.

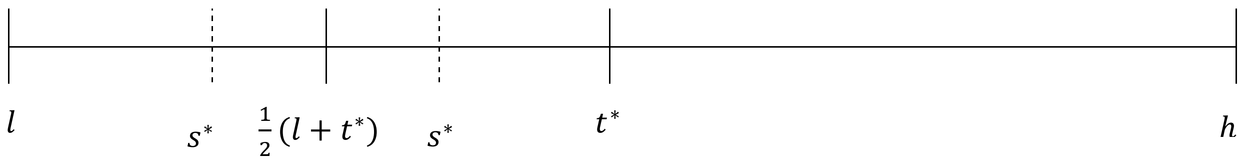

Figure 3: Graphical representation of the situation in which $A = 0$, $X_1 = 1$ and $s > t^*$.

Now, it is interesting to look at the position of the indifference point of the individual. Recall that for all values above the indifference point, the individual will perform a criminal act. So, when s^* lies to the left side of $\frac{1}{2}(l+t^*)$, the individual will choose $X_2 = 1$. However, when s^* lies to the right of the best estimate $\frac{1}{2}(l+t^*)$, the individual will not perform a criminal act. This means that the positioning of the indifference point with respect to the best estimate of the trait determines whether the individual will perform a criminal act again and this is important knowledge for the police. If in some way, t^* is at such a level that a $\frac{1}{2}(l+t^*)$ and $s^*$are equal, this would possibly be a corner solution of this model. In this situation, by the smallest margin, the individual will not perform the criminal act, so this is an attracting point for the police.

When s^* lies to the left side of $\frac{1}{2}(l+t^*)$, lowering t^* means that the individual will be put into prison more quickly. However, if the police lowers t^*, at some point the individual will not perform a criminal act again and, therefore, the police will not put the individual into prison. So, there is a jump in the pay-off of the police, since the individual does not perform a criminal act anymore. For this situation to be a corner solution, we need to check whether it is possible that $s^* = \frac{1}{2}(l+t^*)$ results in a stable equilibrium in which no player has the intention to deviate. The strategy of the individual can be calculated using Equation (4):

$$s^* = \frac{(1-\hat{\pi})\frac{1}{2}(l+t^*)}{\hat{\pi}}$$

and since $s^* = \frac{1}{2}(l+t^*)$, this results in the following:

$$s^* = \frac{(1-\hat{\pi})s^*}{\hat{\pi}}$$

$$s^* = 0$$

$$t^* = -l$$

This is represented graphically in Figure 4. What already can be seen from this figure is that this equilibrium is only possible in a relatively criminal world. The upper boundary h is larger than the absolute value of the lower boundary l, since $t^* = -l$. So, only when the world is criminal enough, this solution can be possible.

Figure 4: Graphical representation of the corner solution.

The individual does not have the intention to deviate, since he is following his decision making rule. Therefore, we only have to check whether the police do not have the intention to deviate from the equilibrium by choosing to put the individual into prison. The individual will perform a criminal act when his signal is in the area between $s^*$and t^* and since we determined that $s^* = 0$ and $t^* = -l$, this yields the following pay-off for the police of not choosing imprisonment:

$$U_c(A = 0) = -\left(\hat{\pi} + (1 - \hat{\pi})\frac{-l}{h - l}\right)\beta$$

This pay-off must be larger than the utility of choosing imprisonment, because otherwise, the police will deviate and choose imprisonment:

$$-\left(\hat{\pi} + (1 - \hat{\pi})\frac{-l}{h - l}\right)\beta > \lambda - \beta \tag{8}$$

What can be seen from Equation (8) is that if the part between brackets moves towards 1, the right side will always be higher. So, the lower the part between brackets, the more favourable this is for the utility of not putting the individual into prison. For this part to be smaller than 1, h should be high. This means that the more criminal the world becomes (higher h), the more choosing freedom will become favourable to choosing a prison sentencing. We already stated before that the corner solution is only possible in a world that is relatively criminal. From Equation (8) it can furthermore be seen that the more criminal the world becomes, the more likely it is that this solution exists.

Similar to the situation in which the signal could be correct, the situation in which the signal is incorrect does not provide an affirmative answer to the research question. The corner solution shows that the police can reach a point at which the individual will not perform a criminal act by the smallest margin. This point is reached by being more strict as the police. So, the corner solution shows that a stricter regime can lead to less criminal activity, whereas the researched question wonders whether it is possible to achieve less criminal activity with a less strict regime.

4.2.3 Equilibrium

In the previous sections, the strategy of the other player was kept exogenous. For this reason, the previous results were not representing Nash equilibrium strategies. However, it is likely that in the world it is not exogenously given whether there is a strict or looser regime or whether the individuals perform a criminal activity very quickly or not. It is reasonable to think that the police will determine the strictness of their regime based on the criminal behaviour of the individual and vice versa. For this reason, in this section the results of the model are explored in a game theoretical approach by using graphs. By plotting the curves of the indifference points of both the individual and the police in one graph, it is shown what happens to the equilibrium when one of the variables in the model changes. Recall that we are still in a world in which the individual has not been sentenced to prison.

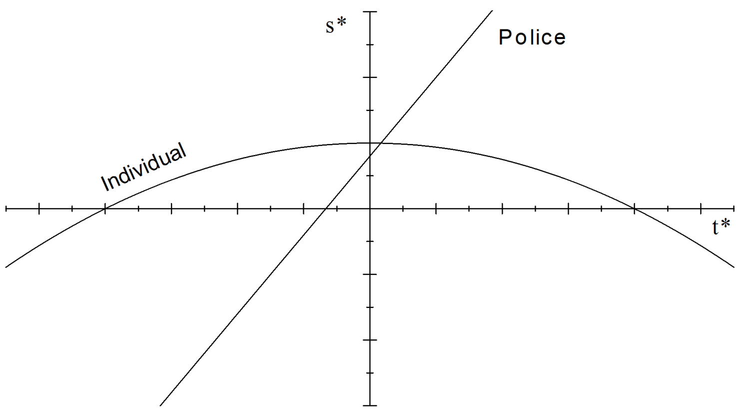

Figure 5: Graphical representation of the strategies of the individual and the police.

Figure 5 illustrates how both the indifference points of the individual and police behave with respect to the indifference point of the other player. The strategy of the individual is an exponential function, which is represented by the parabola. The strategy of the police is represented by a linear function. The equilibrium lies at the point where the plots of the strategies intersect.

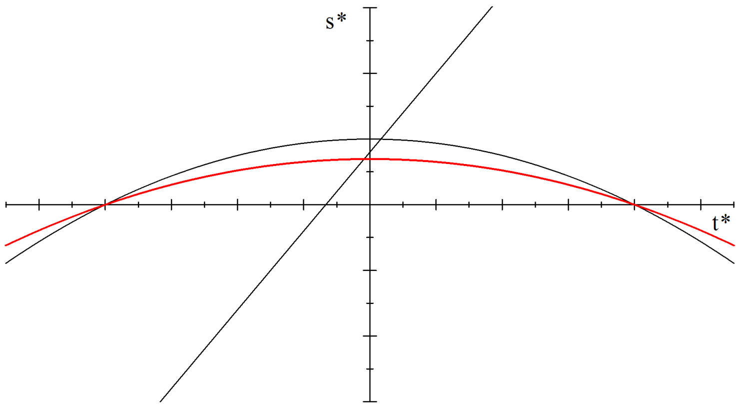

Figure 6: Graphical representation of an increase in h.

Now, we increase the upper boundary (h), so that we can see what will happen to the equilibrium. Since the increase in the upper boundary only has an effect on the indifference point of the individual, it is only this plot that changes. From the red line in Figure 6 it can be seen that the parabola is wider and has a lower top. So, when the upper boundary of the model increases, this mostly results in the individual performing a criminal act more quickly. The plot of the police remains the same, so as a result of the change in the strategy of the individual, the equilibrium lies at a point at which the police chooses imprisonment more quickly. However, when the plot of the police would lie at the complete right or left side of the graph, the situation is different. In these points, the indifference point of the individual becomes higher instead of lower due to the change in the upper boundary. This results in a higher indifference point for the police as well. So, what can be said is that if the world becomes more criminal (higher upper boundary), this will most of the time lead to an individual that is more criminal and to a police that will become more strict. However, when the intersections of the plots are found in the extremes of the graph, the outcome will be a world in which the individual performs a criminal act less quickly and in which the police is less strict. Therefore, it depends on the values of the parameters what will happen to the world due to an increase in the upper boundary.

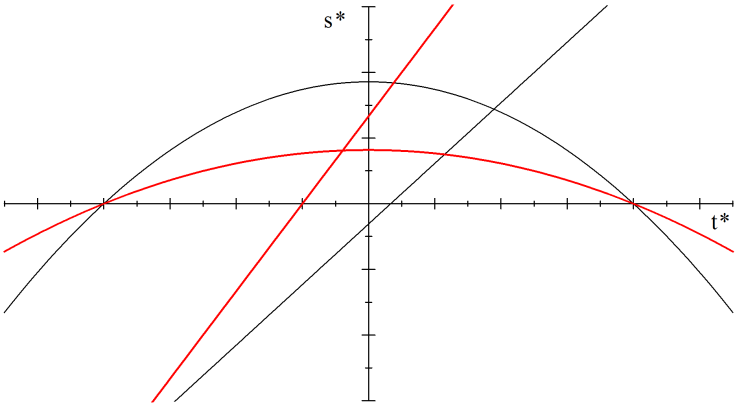

Figure 7: Graphical representation of an increase in π.

Figure 7 shows what happens to the strategies of the players in this game when the chance that the signal is informative (π) is increased. For the individual, a higher chance that his signal is informative will make the individual perform a criminal act more quickly most of the time, since he already performed a criminal act for a lower chance in the first period. This change in the strategy can be seen in the figure by the plot of the individual that is wider and has a lower top. The police also adapt their strategy due to the change in the chance on an informative signal and they will become more strict, to try to prevent the individual from being more criminal. This change in the strategy is represented by the plot of the police moving to the left. Now, it is based on the steepness of the parabola what will happen to the strategy of the individual in equilibrium. As can be seen in Figure 7, a higher chance will lead to an equilibrium in which the individual performs a criminal act more quickly and in which the police choose imprisonment more quickly. However, when the parabola is more steep, as in Figure 8, it is also possible that the indifference point of the individual increases.

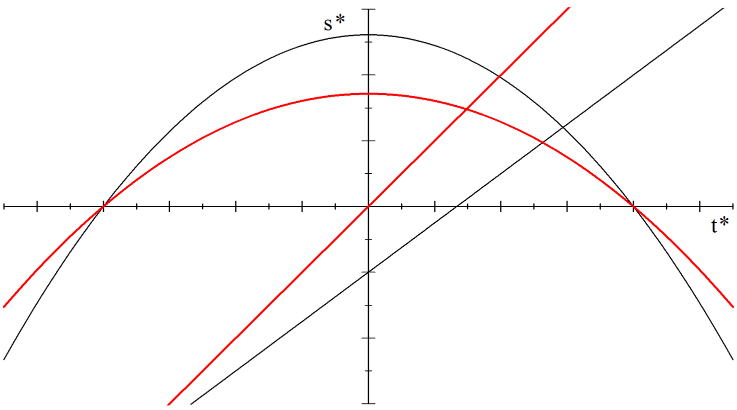

Figure 8: Graphical representation of an increase in π with a steep parabola.

A relatively steeper parabola exists in a world with a smaller chance on an informative signal or in a world that is not very criminal (absolute value of the upper boundary is lower than the absolute value of the lower boundary). So, in a world that is less criminal or has a low initial chance on an informative signal, an increase in the chance on an informative signal will lead to an equilibrium in which the police chooses imprisonment more quickly and in which the individual performs a criminal act less quickly.

It is not just the steepness of the parabola that causes mixed results. Similar to the situation in Figure 6, when the plot of the police is situated in the extreme right or left side, the equilibrium outcome will be different than when the plot is situated in the middle values. The police will always be more strict in equilibrium, but the change in the strategy of the individual is based on the specifics of the world the players are in.

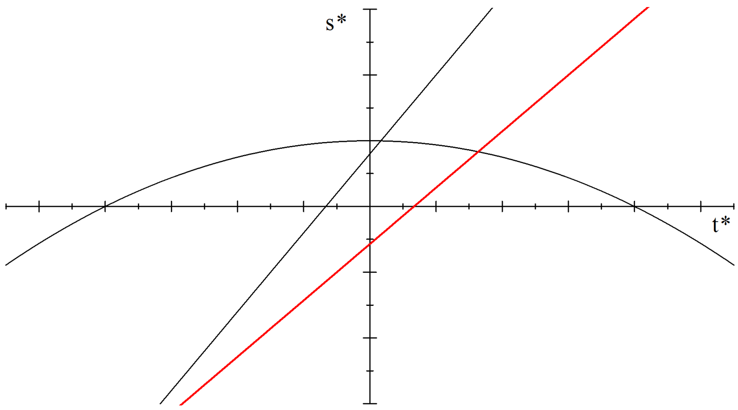

Figure 9: Graphical representation of an increase in β.

In Figure 9 it can be seen what happens to the equilibrium when the importance of prevention (β) increases. The importance of prevention only has an influence on the strategy of the police. The strategy of the individual remains the same. As prevention becomes more important, the police can choose imprisonment less quickly and still reach the same utility as before, as is illustrated by the movement of the red line to the right in Figure 9. So, in the new equilibrium the police will choose imprisonment less quickly. Because of the movement in the strategy of the police, the individual will perform a criminal act more quickly in equilibrium (lower s^*). So, when prevention becomes more important, the police will choose a less strict policy and the individual will be more criminal. However, this result is based on the values of the parameters. When the plot of strategy of the police and the increase in this strategy lie to the left side of the top of the parabola, the individual will perform a criminal act less quickly. So again, it is based on the values of the parameters what will happen in equilibrium. The police will become less strict and this either results in a more or in a less criminal individual.

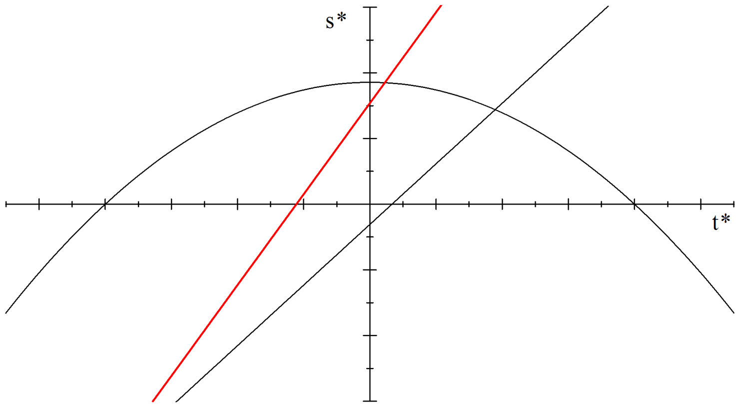

Figure 10: Graphical representation of an increase in λ.

Figure 10 illustrates what happens to the equilibrium due to an increase in the importance of punishment (λ). As with prevention, the importance of punishment only has an effect on the strategy of the police. When punishment becomes more important, the police will choose imprisonment more quickly. As can be seen by the higher s^*, for the individual this means that he will choose a criminal act less quickly in equilibrium. So, when punishment becomes more important, the police will become more strict and this results in a criminal that performs a criminal act less quickly. However, in line with the previous cases, this result is based on the specifics of the world the players are in. When the plot of the decrease in the strategy of the police lies to the left side of the top of the parabola, the individual can be more criminal in equilibrium.

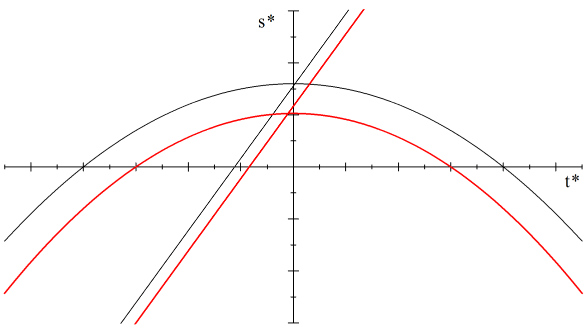

Figure 11a: Graphical representation of an increase in l, with $\lambda > \beta$.

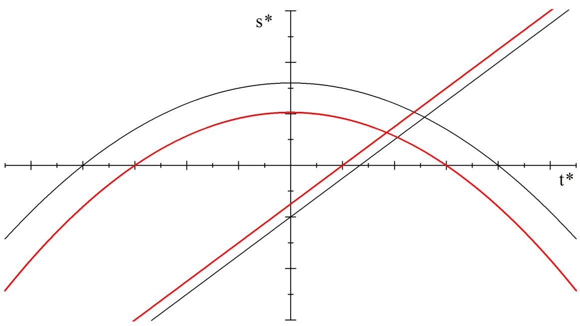

Figure 11b: Graphical representation of an increase in l, with $\lambda < \beta$.

What happens to the equilibrium as a result of an increase in l is more difficult to predict graphically. As already explained in the previous section, an increase in the lower boundary leads to a decrease in the indifference point of the individual. The effect on the indifference point of the police, however, was more complicated. When punishment is more important than prevention, the indifference point of the police will increase. So, in Figure 11a we see that the plot of the strategy of the individual decreases, whereas the plot of the strategy of the police increases. Therefore, the effect on the equilibrium point cannot be easily defined and Figure 11a is just an example of the possible movement of the equilibrium, since it is based on the values of all parameters. The decrease in the strategy of the individual will lead to a lower s^*, so an individual that chooses a criminal act more quickly. This would lead to an equilibrium with a more criminal individual and a more strict police. However, it is not just the strategy of the individual that is changing, the strategy of the police changes as well. The strategy of the police increases due to the higher lower boundary and this leads to an increase in the indifference point of the police. So, in equilibrium the individual will be more criminal due to the increase in the lower boundary, but it is unclear to predict whether the police become more strict.

If it is the case that prevention is more important, it is also possible that the strategy of the police decreases. Then, what happens to the equilibrium point is different, as can be seen in Figure 11b. Both the strategy of the individual and the strategy of the police decrease, which means that the equilibrium point becomes lower. Since, the increase in the lower boundary always has a stronger effect on the strategy of the individual, the values of both s^* and t^* will be lower than before the increase in the lower boundary. So, when prevention is more important, the increase in the lower boundary means that in that world the individual will perform a criminal act more quickly and the police will choose imprisonment more quickly. However, as stated in section 4.2.1, it is also possible that the indifference point of the police increases when prevention is more important than punishment. Then, the situation is equal to the situation in Figure 11a.

What can be said is that due to the increase in the lower boundary, the individual will perform a criminal act more quickly in equilibrium. So, the fact that the average trait in the model becomes higher, will lead to a more criminal individual. However, what happens to the value of the indifference point of the police in the new situation cannot be predicted graphically.

5 Discussion

What can be observed from all the graphs in section 4.2.3 is that it is very difficult to predict what will happen to the equilibrium state of the world. The graphs display the equilibrium in a game theoretical way, which means that they are based on the values of all the parameters. So, where we assumed in sections 4.2.1 and 4.2.2 that all the other parameters were exogenous, this is no longer the case in section 4.2.3. The strategy of the other player is now endogenous and this results in the fact that is far more hard to predict what will happen to the strategies of the players when one of the parameters changes. What can be said about all graphs is that it depends on the values of the parameters what will happen to the equilibrium.

As already explained before, in section 4.2.1 and 4.2.2, no support was found for the research question stated in the introduction. When we purely look at the strategy of the individual, without considering how the change in this strategy will influence the strategy of the police, it is shown that is not possible that the individual will become less criminal when the police become less strict. In the situation in which the signal the individual received can be correct, this result is shown by the negative derivative of t^* with respect to s^*. In the situation in which the signal is incorrect, it is shown by the possibility of the corner solution in which being more strict at some point leads to the individual not performing a criminal act anymore.

In the game theoretical approach of section 4.2.3 the answer to the research question becomes less straightforward to see. In Figure 12 we take a second look at one of the figures from this section, namely the graph that represents the increase in the chance on an informative signal. Recall that this is given the fact that the individual has not been sentenced to prison. Even though we found in earlier sections that a less strict regime leads to more criminal activity instead of less, Figure 12 gives the impression that an affirmative answer to the research question is possible. In this figure, a higher chance on an informative signal will lead to an equilibrium with a stricter police and a more criminal individual. If we turn this reasoning around, a lower chance leads to an equilibrium in which the police are less strict and the individual will perform a criminal act less quickly. The arrow in Figure 12 represents this movement in the equilibrium strategies. Looking at the other graphs in section 4.2.3, such a movement might be possible in all of the graphs, based on the values of the parameters.

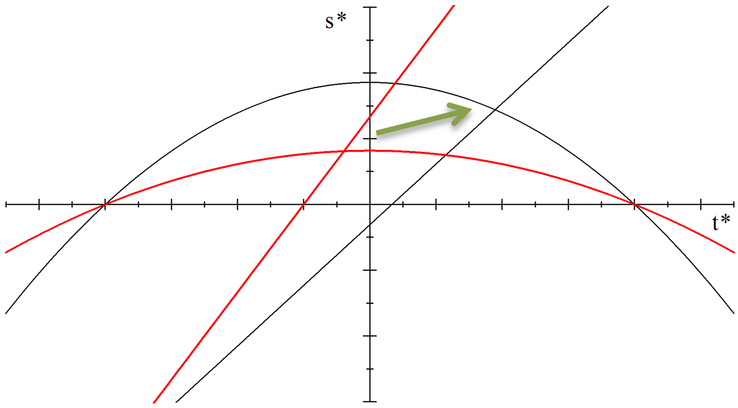

Figure 12: Representation of a situation in which a higher t^*coincides with a higher s^* as a result of a decrease in π.

So, when all the parameters are endogenous, the graphs in section 4.2.3 show situations in which a less strict police coincides with a less criminal individual. However, this does not mean that choosing a less strict regime as the police will lead to less criminal activity. The graphs only show that it is possible to find a positive correlation between the strictness of the regime and the amount of criminal activity, they do not indicate the existence of a causal relationship. The reason that the equilibrium in Figure 12 moves to an equilibrium with a less strict police and a less criminal individual, is the fact that the chance that the signal is informative has decreased. So, this decrease is the factor that in this figure causes the positive correlation between the strictness of the regime and criminal activity.

In section 4.2.1 and 4.2.2 the strategy of the other player is exogenous. In these sections, it became clear that a less strict regime will never lead to less criminal activity. If we make all the parameters endogenous, section 4.2.3 shows that it is possible to find a positive correlation between the strictness of the regime and the amount of criminal activity. Such a positive correlation can be found in a world with specific values of the parameters and is due to an increase or decrease in one of these parameters. So, it is not possible to reduce criminal activity with a less strict police, but it is possible to find situations in which a less strict regime occurs at the same time as less criminal activity due to a chance in one of the conditions in that world.

However, the difference in the results of section 4.1 and 4.2 does indicate an important factor of not choosing imprisonment in this model when the strategies are exogenous. In section 4.1 the police have chosen imprisonment. It can be seen that, with a prison sentencing, the individual will always perform a criminal act again. So, when the individual has been put into prison, a stricter regime will still mean that the individual performs a criminal act in the second period. In section 4.2 the individual has remained free and there, it can be seen that the individual will not always perform a criminal act in the second period. Here, it is shown that a stricter regime will decrease the occurrence of criminal activity and can even lead to no criminal activity. So, when the strictness of the regime is exogenous, the model of this paper predicts that a stricter regime does scare people who have not been sentenced to prison, whereas it does not reduce criminal activity for the individuals that have been sentenced to prison. This means that in this specific model, choosing imprisonment will never lead to a better outcome, whereas with choosing freedom, the possibility exists to scare people away from criminal activity with a stricter regime. So in other words, when the regime is considered exogenous, the police can only affect the amount of criminality with the strictness of their regime when they choose to not sentence the individual to prison.

6 Conclusion

In this paper, a model is developed in order to study the effect of prison sentencing on the criminal behaviour of an individual. In the model there are two periods in which an individual has to decide between being legal or performing a criminal act. The police have complete knowledge about the level of criminality of the individual, whereas the individual does not and only receives a signal about his trait. After the first period the police decide whether they sentence the individual to prison. Once the individual knows the action of the police, he will update his beliefs about his trait. The utility of the individual is solely based on the level of his trait, which represents his chance of regretting a criminal activity. The utility of the police depends on the importance of prevention and punishment.

When the individual is sentenced to prison, he will always perform a criminal act again in the second period. When the individual is not sentenced to prison, the results are less straightforward. It turns out that when we make the regime of the police exogenous, it can be seen that a less strict regime will always lead to more criminal activity. Moreover, a corner solution is found in which a stricter regime leads to no criminal activity by the smallest margin. So, no support is found for the research question that wonders whether a less strict regime can reduce the amount of crime. What should be kept in mind with this result is that, in this particular model, the strictness of the regime only influences the amount of criminal activity of the individuals that have remained free. The individuals that have been sentenced to prison will always perform a criminal act again, regardless of how strict the regime is.

When the strictness of the regime is endogenous in the model, it is shown that a positive correlation between the strictness of the regime and the amount of criminal activity is possible. However, this does not indicate that a less strict regime leads to less criminal activity, as was suggested in the research question, but only that it is possible that both strategies increase as a result of a change in one of the other parameters in the world.

This paper contributes to the existing literature by using a new approach to predict the effect of imprisonment. The informational effect of the decision on a prison sentence is studied as the reason why it might be possible that choosing a less strict regime will lead to less criminal activity. Recent literature of Dur and Van der Weele (2013) studied social norms as a deterrent of criminal activity and our paper adds a different factor to the literature, namely the effect of the information that is transferred onto the individual through the action of the police.

The results of this paper, however, do not indicate that a less strict regime reduces criminal activity. A positive correlation between the two can be found, but only as a result of a change in one of the parameters of the world we are in. The findings of this paper indicate that it is difficult to empirically test the effect of a more or less strict regime, for example in a specific country. This is only possible when all of the parameters of that country can be measured and monitored over time and this is not very likely. This has also important policy implications. The existence of positive correlation between the strictness of the regime and criminal activity does not indicate that the regime should be made less strict in order to reduce crime. It is only a result of a change in one of the other parameters in that world and this should be kept in mind with the decision-making.

The results of the model are based on various assumptions, which are made for simplicity reasons. It is assumed that the police have complete knowledge about the level of criminality of the individual. In real life, it is often the case that the police do not know exactly whether a person is guilty, so it would be more credible if the police would also obtain a signal about the trait of the individual. If the signals contain different information, the information asymmetry would still exist, which preserves the possibility of an informational effect of the decision of the police. So, a situation in which the police receive a better signal than the individual is a possible extension for future research.

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