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CRIME CAN BE A GIFFEN GOOD: THE ROLE OF NEED IN CRIMINAL LABOR SUPPLY

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ABSTRACT

Building upon the Becker (1968)-Ehrlich (1973) model of crime, this paper shows that under the appropriate conditions crime is a Giffen good: increasing deterrence can lead to an increase in crime. This result relies upon two conditions. The first is that individuals are choosing between how much time to allocate between leisure and crime as an income earning activity. Second, in the absence of income from criminal activity, individuals do not have access to sufficient resources to fund necessary consumption. Evidence consistent with this hypothesis is discussed. This in turn may provide an additional reason why crime reduction is so challenging. The optimal policy is derived, and it is shown that it entails a combination of redistribution and an appropriately set level of deterrence that varies with the level of social inequality.

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1 Introduction

The notion of a Giffen good has a long and controversial history (Stigler (1947)). This is because it implies that under certain conditions the law of demand fails. In the context of a consumption good this means that an increase in the price leads to a *fall* in demand. In the context of labor supply, this means that an increase in the wage leads to a fall in labor supply. This paper shows that when criminal deterrence is viewed as a tax on criminal labor supply then crime is a Giffen good for needy individuals.[1] This in turn implies that an increase in deterrence leads to an increase in crime among such individuals.

Becker (1968)'s seminal work on the economics of crime shows that that an increase in deterrence decreases crime. The puzzle is why society doesn't simply set very high penalties to ensure that there is a negligible level crime? Becker and Stigler (1974) provide a detailed discussion of the costs of enforcement and point out that increasing deterrence is expensive. Hence, the observed level of crime is the result of a trade-off between the benefits of crime reduction weighted against the cost of enforcement.[2] This paper presents an additional source of persistent crime based upon variation in observable characteristics of individuals. It is shown that deterrence can be equivalent to a *tax* on criminal labor. For some individuals, particularly very poor individuals, such crime can be a Giffen good: an increase in deterrence (tax on crime) may lead to *increased* crime.[3] For such individuals it is shown that there is a clear optimal policy for crime reduction, namely lump sum transfers of income. This policy that is consistent with insights from optimal tax theory that highlight the benefits of lump sum transfers relative to inefficient taxation (Feldstein (1999), Slemrod and Kopczuk (2002)).

The result relies upon transforming the standard Becker model of deterrence into one for which deterrence is a tax on criminal labor. The benefit of this transformation is that one can now link the literature on criminal deterrence to the vast public finance literature. The transformation begins with Ehrlich (1973)'s observation that crime is fundamentally a time allocation problem. In his original formulation individuals allocate time between leisure activity, legitimate work and illegitimate or criminal work. This paper considers the case in which an individuals allocates time between leisure and crime, and hence it is most appropriate for those individuals with limited employment opportunities.[4]

[1] Labor is said to have a backward bending labor supply in this case. I use the term "Giffen good" for both cases since they both arise when the income effect dominates the substitution effect. In price theory the "good" in the case of labor supply is leisure, while labor supply is total time available less the amount supplied to income earning labor.

[2] In an earlier paper, Stigler (1970) makes the point that public enforcement may be at an inefficiently low level.

[3] More precisely, leisure is the Giffen good. The price of leisure is measured by the opportunity cost of not engaging in crime. It is a Giffen good when an increase in the opportunity cost of leisure (an increase in the criminal wage) leads to an increase in leisure.

[4] We know from the work of Grogger (1998) that when individuals have opportunity to engage in legitimate work, the evidence suggests that crime falls with an increase in legitimate wages. However, as MacLeod and Rivera (2024) point out, this effect may depend upon the type of legitimate work available to individuals.

The transformation builds upon the well known Shapiro and Stiglitz (1984) model in which individuals choose their activity levels over time. These activities in turn generate a noisy measure of performance that is used to reward or punish the individual. In the criminal context, the individual chooses how much time to allocate to crime each period, anticipating the fact that a higher level of crime results in a higher probability of detection and punishment. The return for each unit of time is the criminal wage, while the cost in terms of detection and punishment corresponds to a tax on criminal activity.[5] This cost in turn can reduce (or increase in the case of a Giffen good) the amount of time allocated to criminal activity.

Once deterrence is viewed as a tax, then the level of crime can be viewed as a standard labor supply problem - the amount of crime depends upon the wage from criminal labor supply (denoted by ω), less the "deterrence tax" τ. This results in a net wage of $w = \omega - \tau$. The amount of criminal labor supply entails specifying preferences over consumption and criminal activity that determines the level of crime as a function of the net wage w, denoted by $l(w)$. Individual choice is modeled using a variant of King et al. (1988) preferences. These preferences are widely used in macro economics because they are able to capture the phenomena of *inelastic* labor supply, a feature of many macro-economic times series. A nice feature of these preferences is that they can be extended to provide a convenient model of the conditions under which labor supply is a Giffen good.

Stigler (1947, 1948) provides a review of the (controversial) development of the concept of a Giffen good.[6] In his 1895 book on the *Principles of Economics,* Marshall argued that since wheat is the cheapest necessity for poor individuals, then an increase in the tax on wheat may lead to an increase in demand.[7] In the context of labor supply, when labor is a normal commodity, then an increase in the wage results in an increase in labor supply. When deterrence can be viewed as a tax on wages, this implies that an increase in deterrence leads to a decrease in criminal labor supply. However, when criminal labor supply corresponds to a Giffen good, then an increase in deterrence leads to an *increase* in criminal labor supply.

A simple example illustrates the idea.[8] Suppose the criminal needs \$100; otherwise her family goes hungry, resulting in a infinite utility loss. Each hour of crime brings ten dollars. To cover the minimum needed income, she devotes 10 hours to crime. Suppose the detection goes up—or more accurately, suppose the police, upon detection, increases the size of the disgorgement of the money

[5] This approach is similar identical to the notion of a risk premium in finance where risky outcomes are tranformed to an equivalent sure price. See section 3.3 of MacLeod (2022) for details and further references. The appendix also discusses the case with incarceration and shows that for very needy individuals, an increase in the probability of detection can lead to an increase in crime.

[6] It has been called a Giffen good because Alfred Marshall attributes the concept to Mr. Giffen in his 1895 version of the *Principles.* Stigler points out that the notion is quite old and used to explain why the demand for bread would rise with a rise in the price. See also Dwyer and Lindsay (1984) and Jacoby (1993) for recent evidence on Giffen goods.

[7] See Stigler (1947)'s discussion of this example.

[8] The author is grateful to the editor, Scott Baker, for providing this example.

from crime that can be obtained via criminal forfeiture proceedings. Now, each hour brings in, say, $5 of income. The criminal has no choice: she must devote less time to leisure and more time to crime, upping her crime hours from 10 to 20. Increases in disgorgement penalties lead to increases in crime.

This can be explained in the context of the neo-classical model of labor supply that divides the effect of a tax on labor supply into two components. The first is a substitution effect - an increase in criminal deterrence makes leisure relatively more attractive, and hence tends to decrease criminal labor supply. However, there is also an income effect. An increase in deterrence *reduces* the income from crime, which in turn results in an increase in criminal labor supply. The net effect depends upon whether or not the substitution effect dominates the income effect.

The question then is whether or not we might observe situations where the income effect is larger than the substitution effect. On average, as the large literature on deterrence has shown, the substitution effect tends to dominate the income effect, and hence an increase in deterrence leads to less crime (,Chalfin and McCrary (2017), Lee and McCrary (2017)). However, individuals engaging in crime are a self selected group who are on average are less educated and have fewer financial resources. Barzel and McDonald (1973) show that when an individual's resources are limited, and their income is close to their consumption need, then labor supply can be a Giffen good. Barzel and McDonald (1973) provide some descriptive evidence of labor supply that falls with the wage using data from early in the 20th century. Pencavel (1986, 2021) has refined this analysis, updated this analysis, and also finds a negative correlation between hours supplied and the wage.

These studies depend upon evidence from a population of individuals and hence one does not know how individual labor supply varies. Existing evidence on deterrence faces a similar difficulty. There is good evidence on the negative relationship between crime and deterrence on average, but these estimates are very noisy.[9] This fact, combined with the observation that these estimates are for a large, heterogeneous population, implies that there is large variation in individual responses to deterrence.

Thus, it is useful to complement these studies with estimates of variation in labor supply at the individual level. Farber (2015) has recent, high-quality, evidence on individual labor supply from a panel of taxi drivers in New York. The main finding is that successful taxi drivers have upward slopping labor supply, consistent with standard price theory. However, he also finds evidence of *low quality* drivers for whom this is not the case. This is suggestive evidence that workers who have marginal skills may have a downward sloping labor supply curve.

The gold standard for measuring the causal effect of a treatment is an experiment that randomly allocates treatments to a population of subjects. Fehr and Goette (2007) conduct an experiment with delivery workers and find that some workers reduce effort in response to a wage increase.

[9] This is discussed in more detail in section 3. See also the discussions in Chalfin and McCrary (2017) and Lee and McCrary (2017).

Table 1: Ordinary Least-Squares (OLS) and Two-Stage Least-Squares (2SLS) Estimates of the Effect of Wages on Hours for Workers Holding Jobs in Regular and Underground Sectors

	Regular Sector		Underground Sector	
	OLS	2SLS	OLS	2SLS
Regular sector wage	0.566	0.507	-0.770	- 0.689
	(0.183)	(0.179)	(0.265)	(0.253)
Underground wage	0.281	0.297	-0.360	-0.298
	(0.110)	(0.117)	(0.151)	(0.159)

Source: Table 3 of Lemieux et al. (1994).

Hence we might expect a large number of individuals who are at risk to commit crime also have a downward sloping labor supply curve.

Direct evidence of this possibility comes from a survey of the informal labor market by Lemieux et al. (1994). They have data on wages and hours of work in regular employment, as well as in the illegal underground economy in Canada. Workers in the underground economy are not paying income tax, and hence their labor is by definition illegitimate "criminal" labor supply. Table (1) reports the results for the effect of wages on hours of work for this sample of workers (standard errors are in brackets). The two stage least squares estimates (2SLS) control for correlation between observed wages and the error term to correct for potential biases in estimation (and hence can be interpreted as the "causal" effect of wages on labor supply). The striking fact is that a wage increase has a consistently negative effect for the underground/illegitimate labor supply, while the labor supply to the regular sector has the expected positive sign. This is direct evidence that individuals view illegitimate labor as an inferior form of labor.

This paper's contribution is to provide a simple model of labor supply that captures this effect in a parsimonious way utilizing the variation of a single parameter capturing a person's level of need. Barzel and McDonald (1973) have pointed out that adding need to the classical model of labor supply leads to a downward sloping labor supply curve. The neoclassical labor supply model typically assumes that consumption and leisure enter multiplicatively, which in turn results in a complex condition for an increase in wages to reduce labor supply. In contrast, King et al. (1988) preferences assume the utility from consumption is additively separable from the cost of labor, an assumption that is standard in agency theory (**?**). In those models labor costs are independent of consumption and increase with labor supply.[10] This formulation results in a sharp distinction between the case of upward and downward labor supply based upon a single measure of economic need. When a minimum consumption level, c^0, is added to King et al. (1988) preferences, then the

[10]The traditional neo-classical model assumes that the worked chooses how much leisure to consume, as opposed to how much labor to supply. That approach, and the one used here based upon agency theory provide similar predictions. The choice of model depends upon which one more elegantly illustrates the point at hand. The agency approach results in a model in which a single parameter determines whether labor supply is upward or downward sloping.

individual experiences extreme disutility when personal consumption falls towards c^0. This in turn implies that if a person has only criminal labor available to earn income, then they must engage in crime to meet this basic consumption level.

A person's *need* is defined the difference between necessary consumption and the amount of resources other than labor income that a person can access. Technically, need is given by $c^0 - t^0$, where t^0 are non-labor resources available to the individual. This might be their own savings, resources supplied by family members or social services in the community in which they reside. When this need is positive, criminal labor is like a Giffen good and crime increases with deterrence. Conversely, a person is called *affluent* if their need is negative, namely they have sufficient access to resources to maintain consumption above the minimum level: $t^0 > c^0$. For affluent individuals labor is a normal good, and the level of crime decreases with increases in deterrence. The details of the model leading to these results are outlined in the next section.

The second part of the analysis addresses the question of optimal policy. Regardless of a person's need, the income effect implies that transfers to an individual always reduce crime. Hence, optimal crime policy has at least two instruments for crime reduction - deterrence and transfers.[11] It shown that the optimal policy entails reducing the need for all individuals to some level. Optimal deterrence is a function of the sensitivity of crime to deterrence, that in turn is shown to depend upon the distribution of need in the population. The effectiveness of deterrence increases with the affluence of the population.

Section (3) discusses the growing body of evidence showing the relationship between transfers to individuals and crime reduction. I begin with an outline of the analytic details of the argument. After the discussion section, the paper concludes with some open questions for future research.

2 Analytical Framework

This section provides a model of criminal labor supply that highlights the relationship between an individual's income, and the extent to which their behavior responds to incentives provided by the legal system. The model illustrates that even with stable preferences, variation in a person's need can lead to large variation in their response to deterrence. The approach follows Becker (1968) and Ehrlich (1973) in viewing crime as a labor supply problem, with the added twist that individuals vary in their needs. From this perspective the focus is upon activity that is mainly remunerative in nature, such as theft, fraud or drug dealing.

The extent to which a person allocates time to criminal activities depends upon the return. It is assumed that such activity earns a return of ω per unit of time. The activity is illegitimate because

[11] See Demougin and Schwager (2000) and Tabbach (2008) for papers that also make the point that income transfers reduce criminal labor supply via the income effect. The new point in this paper, is that in some cases this may be the only effective intervention.

the social cost per unit of time, w^c is greater than the benefit, ω, to the individual. Hence, we simply call such activity "criminal activity". The introduction of deterrence reduces the return to crime, formally given by $w = \omega - \tau$, where τ is the level of deterrence. We shall show presently that τ can be computed from the standard model of deterrence as used in Becker (1968). The level of crime is denoted by l. It is assumed that crime is the only labor activity available to individuals. This is a key assumption because it focuses attention on how the *absence* of alternative sources of work can affect rational choice in unexpected ways.

It is assumed that an individual has King et al. (1988) preferences. These preferences are widely used in macro-economics because they capture the fact that aggregate level labor supply is often wage inelastic. More precisely it is assumed:

$$\begin{aligned} U &= \text{Utility-from-Income} - \text{Cost-of-Effort}, \\ &= \log\left(c - c^0\right) - V\left(l\right), \end{aligned} \tag{1}$$

where l is criminal labor supply, the cost of effort satisfies $V'\left(l\right), V''\left(l\right) > 0$ for $l > 0$, and c is consumption. A person's need is given by c^0. In principle, it can vary by individual and over time, but for this discussion it is assumed fixed. The choice of $\log\left(c - c^0\right)$ for utility is not arbitrary. It captures the notion that there is a minimum level of consumption that a person views at "necessary", and has the feature that $\lim_{c \to c_i} \log\left(c - c_i\right) = -\infty$. Second, it turns out that this functional form is unique among those that generate what economists call "inelastic labor supply" (shown formally in MacLeod and Rivera (2024)).

It is also the case that one can use these preferences to capture variation in sensitivity of criminal labor supply to the "wage", w, the return per hour from criminal labor. Thus consumption takes the form:

$$c = w \times l + t.$$

Total labor income is given by $w \times l$, and t is non-labor income, such as transfers from savings or family. We define a person's net need as the amount of labor income needed to meet minimum consumption:

$$n^0 = c^0 - t^0.$$

This is the difference between their minimum consumption need and the amount of non-labor income a person is receiving. We say a person is "affluent" when need is negative, $n^0 < 0$ (income is greater than the basic consumption need). The superscript 0 indicates need before government transfers, while government or other third party transfers are simply denoted by t^g.

Finally, it is assumed that criminal activity leads to a potential fine, punishment or tax, τ, satisfying $\omega \geq \tau \geq 0$, where ω be the wage from criminal activity, and hence a person's net "wage"

is:

$$w = \omega - \tau.$$

Ehrlich (1973) observes that individuals are not involved in crime at all times. Rather, they choose daily how much time to allocate to crime. In the appendix it is shown that in a Shapiro and Stiglitz (1984) continuous time model one can transform the standard deterrence model of Becker, as generally used in the literature (Polinsky and Shavell (2000)), into one where punishment is effectively a tax.

The standard deterrence model supposes that a person committing a crime faces a probability of detection P, followed by the implementation of a sanction f. The probability that a person is detected depends upon the length of time engaged in the criminal activity. Letting $P = p \times l$ be the flow probability of detection then, as we show in the appendix, the effective "tax" on criminal activity is:

$$\tau \times l = f \times P = f \times p \times l.$$

In this model deterrence, $\tau = f \times p$, reduces the person's criminal wage w.

In order to have convenient closed form solutions it is assumed that $V(l) = l^2/2$. The qualitative features of this model will be the same as with a more general convex cost of effort function. Criminal labor supply is the level of activity that maximizes the individual's payoff as a function of the net wage, w, and need, n:

$$l^S(w, n) = \arg\max_{l \geq 0} \log(wl - n) - l^2/2. \tag{2}$$

In the appendix we show that the solution to this problem is a decreasing function of the ratio of transfers to the wage that is called *real need,* $N = \frac{n}{w}$:

$$l^S(w, n) = L\left(\frac{n}{w}\right) = L(N),$$

where labor supply as a function of real need can be shown to take the form:

$$L(N) = \left(N + \sqrt{N^2 + 4}\right) \Big/ 2.$$

As is standard in labor economics, elasticities are used to measure how the policy affects the level of illegitimate or criminal activity. The elasticity of criminal activity with respect to the criminal

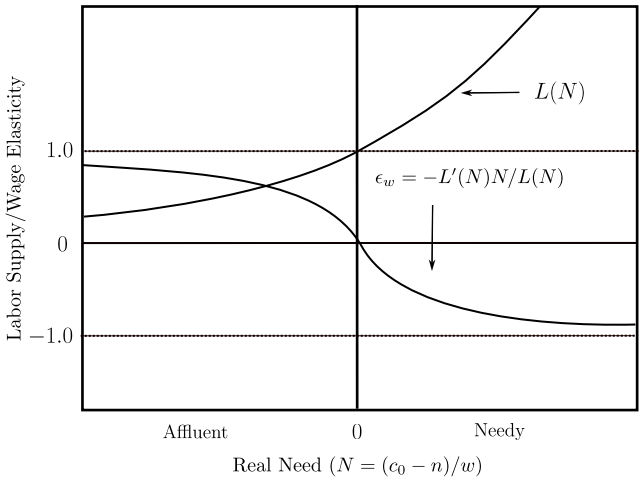

Figure 1: Illegitimate Labor/Crime as a Function of Need

wage is:

$$\begin{aligned}\epsilon_w(N) &= \frac{L'(N)}{L(N)}\frac{dN}{dw} \times w, \\ &= -\frac{L'(N)}{L(N)}N\end{aligned}$$

Both labor supply and this elasticity are illustrated in figure (1). Notice that the elasticity is positive for affluent individuals but negative for needy persons.

Elasticities are widely used in labor economics because they provide a unit free measure of how changes in the wage result in a change in labor supply. The percentage change in illegitimate labor is equal to the elasticity of labor supply as a function of deterrence times the percentage change in deterrence:

$$\%\Delta l \approx \epsilon_w \times \%\Delta w,$$

where ϵ_w is the elasticity of labor supply with respect to the criminal wage w. Notice that a deterrence $\Delta\tau$ corresponds a change $-\Delta w$ in the wage. This implies that the impact of deterrence on illegitimate labor is given by:

$$\%\Delta l \approx -\epsilon_w \times \Delta\tau/w$$

where $w = \omega - \tau$ is the individual's net wage from criminal activity. The net income from criminal activity l is

$$w \times l = (\omega - \tau) \times l.$$

The sign of the elasticity ϵ_w depends upon whether or not the individual is needy, namely whether

or not $c^0 - t^0$ is positive or negative.

In particular, for needy individuals, increasing deterrence *increases* the supply of illegitimate or criminal labor. The elasticity computed here is known as the Marshallian elasticity - it combines both the substitution effect and the income effect. The substitution effect is the extent to which a person changes labor supply given the wage, holding utility fixed. This is always positive - an increase in the wage, or decrease in deterrence always increases the incentive to shift from leisure to labor. In contrast, the income effect is always negative - increasing income holding the wage fixed reduces labor supply. When the size of the income effect is greater than the substitution effect this gives rise to what is known as the backward bending labor supply curve. What is convenient about King et al. (1988) utility is that need, $n^0 = c^0 - t^0$, completely determines whether or not the income effect dominates the substitution effect.[12]

In addition to deterrence, transfers that affect need are an alternative policy instrument that can affect the level of illegitimate activity. When the government provides a transfer t^g this has the following effect on labor supply:

$$\%\Delta l \approx \epsilon_t \times \%\Delta t = \epsilon_t \times \Delta t^g / t,$$

where:

$$\begin{aligned} \epsilon_t &= \frac{\partial l}{\partial t} \frac{t}{\bar{l}}, \\ &= -t \times \frac{L'(N)}{I(w, N)} < 0, \end{aligned}$$

$t = t^0 + t^g$ is the total transfer, and $I(w, N) = L(N) \times w$ is the total income from illegitimate or criminal labor. In this case $\epsilon_t < 0$, and hence increasing transfers *always* decreases the level of crime. In contrast, if a person is needy, then deterrence simply exacerbates their needs, leading to more criminal behavior. In particular, holding need constant, a person with a lower wage will be more responsive to a transfer.

2.1 Optimal Policy

This section derives the optimal level of deterrence and transfer for an individual. The transfers are assumed to occur *ex ante,* before any crime is committed, while deterrence is an uncertain event that occurs once the individual begins criminal labor supply. It is assumed that the social cost of

[12] See Barzel and McDonald (1973) for a discussion of need in the context of a constant elasticity of substitution model, given by equation (11) in their paper.

criminal labor is given by:

$$\mathscr{C}(\tau, t^g) = MC(\tau)\, l\left(\tau, t^0 + t^g\right) + \lambda t^g, \tag{3}$$

where the marginal cost of crime per unit of criminal activity is:

$$MC(\tau) = \left(w^c - (\omega - \tau) + D(\tau)\right).$$

The social cost of illegitimate labor is w^c. Increasing deterrence reduces the individual's income and hence imposes a social cost that is measured by the income loss due to deterrence, $(\omega - \tau)\, l(\tau, t)$. Government transfers, t^g, are socially costly at the rate $\lambda > 0$, which in the public finance literature typically assumed to be approximately 0.3.[13] Finally, following Becker (1968), it is assumed that increasing deterrence is costly and this cost is given by $D(\tau)$, which is assumed to be differentiable and satisfy:

$$D(0) = D'(0) = 0, D'' > 0, \lim_{\tau \to \omega} D(\tau) = \infty. \tag{4}$$

This cost implies that perfect deterrence is impossible, and hence, as in Becker (1968), there will always be some criminal activity. Following Polinsky and Shavell (2000), I proceed by asking what interventions minimize the social cost of crime. More precisely, it is assumed that government chooses a policy $P = (\tau, t)$, the level of deterrence and transfers to the individual, that minimize costs:

$$\min_{\tau \in [0,\omega], t^g \geq 0} \mathscr{C}(\tau, t^g)$$

where:

$$\mathscr{C}(\tau, t^g) = MC(\tau)\, L\left(\frac{n^0 - t^g}{\omega - \tau}\right) + \lambda t^g,$$

and $L\left(\frac{n^0 - t^g}{\omega - \tau}\right)$ is labor supply as a function of real need, and $n^0 = c^0 - t^0$. The assumption that lump taxation is not possible is represented by the requirement $t^g \geq 0$. Finally, the individual's utility as a function of the choice variables is given by:

$$\begin{aligned} u(\tau, t^g) &= \log\left(w\left(L(N) - N\right)\right) - V\left(L(N)\right), \\ &= \log(w) + \log\left(L(N) - N\right) - V\left(L(N)\right), \end{aligned}$$

where, as above, the net criminal wage is $w = \omega - \tau$, and real need is given by $N = \frac{n^0 - t^g}{\omega - \tau}$.

In the appendix the first order condition for optimal deterrence are derived. The first result

[13] See Laffont and Tirole (1993).

is that when person is needy, the wage elasticity is negative, $\epsilon_w < 0$, which in turn implies that increasing deterrence (lowering the wage from crime) *increases* crime. Hence, in that case it is optimal to have *no deterrence:* $\tau^* = 0$. In other words, some crime by needy individuals is tolerated. When a person is affluent, the wage elasticity is positive and the first order condition for deterrence is:

$$\tau^* = \omega \frac{\epsilon_{MC}(\tau^*)}{\epsilon_w(\tau^*) + \epsilon_{MC}(\tau^*)}, \tag{5}$$

where the elasticity of social cost with respect to deterrence is:

$$\epsilon_{MC}(\tau^*) = \frac{dMC(\tau)}{d\tau} \times \frac{\tau}{MC(\tau)}.$$

If individuals are very wage elastic (ϵ_w is large), then a small amount of deterrence has a large effect on crime. Thus, τ^* is correspondingly smaller. Holding the cost of crime fixed, this implies that it is optimal to have less deterrence for more affluent individuals (whose wage elasticity is higher - see figure 1).

The first order condition for the optimal transfer is:

$$L'\left(\frac{n^0 - t^*}{\omega - \tau^*}\right) = \lambda \times \frac{\omega - \tau^*}{MC(\tau^*)}.$$

Since $L' > 0$, when the social cost of funds is sufficiently low, then regardless of need this implies that is optimal to have a positive transfer. More precisely, let

$$\bar{\lambda}(\tau^*) = MC(\tau^*) L'\left(\frac{n^0}{\omega - \tau^*}\right) \frac{1}{\omega - \tau^*} > 0.$$

Whenever $\lambda < \bar{\lambda}(\tau^*)$ it is optimal to have a transfer $t^g > 0$.

2.2 Aggregate Policy

The analysis of the previous section highlights the point that optimal compliance entails the use of both deterrence and transfers. It also requires the policy to be tailored to the characteristics of the individual. In practice the characteristics of the individual are typically observed imperfectly. Consistent with the public finance literature, it is assumed that transfer policies can be means tested. In contrast, consistent with the norm in criminal law, it is assumed that while criminal penalties can vary with the crime, they do not normally vary with the characteristics of the person (all individuals are equal before the law).[14]

The aggregate analysis begins with a population of individuals who vary by their need, $n^0 \in \Re$, given by a distribution $f\left(n^0\right) > 0$. It is assumed that one can tailor transfer policy to a person's

[14] Repeat offenders can receive more severe punishments, and case we put aside for the current discussion.

need. Hence, authorities choose a transfer function $t\left(n^0\right) \geq 0$. It is further assumed that deterrence τ is chosen to be independent of type. The available policy choices are formally given by $P = \left\{\tau, t\left(n^0\right)\right\} \in \mathscr{P} = [0, \omega] \times \mathscr{N}$, where $\mathscr{N}$ is the set of functions determining need with positive transfers:

$$\mathscr{N} = \left\{t : \Re \to \Re_+\right\}.$$

The optimal policy is the solution to:

$$\min_{P \in \mathscr{P}} \mathscr{C}(P) = \min_{P \in \mathscr{P}} \int_{-\infty}^{\infty} \left\{ MC(\tau) L\left(\frac{n^0 - t\left(n^0\right)}{\omega - \tau}\right) + \lambda t\left(n^0\right) \right\} f\left(n^0\right) dn^0 \tag{6}$$

The fact that the cost function is convex in the transfer, continuous and bounded above ensures that there is a cost minimizing solution. The solution is detailed in the appendix. I proceed with the determination of the optimal transfer, $t\left(\tau, n^0\right)$, given a level of deterrence τ, and then derive the optimal level of deterrence.

The first order condition for optimal need is found by differentiating the interior of (6), to get:

$$L'\left(\frac{n^0 - t\left(n^0\right)}{\omega - \tau}\right) = \frac{\lambda(\omega - \tau)}{MC(\tau)}. \tag{7}$$

We know that $L' < 1$, hence if the social cost of funds is too high $\left(\lambda \geq \frac{MC(\tau)}{\omega - \tau}\right)$, it is not optimal to have government transfers. When the social cost w^c of the illegitimate activity is sufficiently high, then it is always optimal have some transfer. Letting $n^*(\tau) = n^0 - t\left(n^0\right)$, then (7) implies:

$$L'\left(\frac{n^*(\tau)}{\omega - \tau}\right) = \frac{\lambda(\omega - \tau)}{MC(\tau)}.$$

This is the optimal level of total need for individual that receive a government transfer. When an individual has need less than $n^*(\tau)$ then achieving this would require a lump sum tax that is not allowed. Hence, the optimal level of need corresponding to the optimal transfer $t\left(\tau, n^0\right) = n^0 - n^*(\tau)$ is:

$$n^*\left(\tau, n^0\right) = \begin{cases} n^*(\tau), & n^0 \geq n^*(\tau), \\ n^0, & n^0 \leq n^*(\tau). \end{cases} \tag{8}$$

For those individuals with need less than $n^*(\tau)$ there is no transfer. Hence, when there are individuals that are involved in costly criminal activities, it may be optimal, as a matter of optimal enforcement of legal rules, to transfer resources to these persons! This illustrates the point that one cannot cleanly distinguish equity policy from the optimal crime policy.

The next step is to determine how the transfer affects optimal deterrence. From (8) we can

compute labor supply at the optimal transfer:

$$L^S(\tau) = \int_{-\infty}^{n^*(\tau)} L\left(n^0/(\omega-\tau)\right) f\left(n^0\right) dn^0 + L\left(n^*(\tau)/(\omega-\tau)\right)\left(1-F\left(n^*(\tau)\right)\right). \tag{9}$$

The first term is labor supply from affluent individuals who do not receive a transfer, while the second term term is the labor supply from needy individuals who have the same level of need after transfers. In the appendix the average elasticity of criminal labor supply is derived:

$$\hat{\epsilon}_w(\tau) \equiv \left\{\int_{-\infty}^{n^*(\tau)} \epsilon_w\left(\tau, n^0\right) h\left(n^0\right) dn^0 - G(\tau) L\left(\frac{n^*(\tau)}{\omega-\tau}\right) \epsilon_w\left(\tau, n^*(\tau)\right)\right\} \Big/ L^S(\tau).$$

This is the mean elasticity of labor supply for each level of need weighted by the total criminal activity (number of individuals times labor supply), and then divided by total criminal labor supply. This in turn results in exactly the same expression for optimal deterrence for one person, except we now use average elasticity:

$$\tau^* = \omega \frac{\epsilon_{MC}(\tau^*)}{\hat{\epsilon}_w(\tau^*) + \epsilon_{MC}(\tau^*)}. \tag{10}$$

As before, when the wage elasticity is negative ($\hat{\epsilon}_w(\tau^*) < 0$) then it is optimal to have no deterrence ($\tau^* = 0$). It is assumed that there are both needy and affluent individuals. Hence whether or not there should be deterrence depends upon the relative proportions of needy and affluent individuals in the economy.[15]

Any activity for which the social cost is higher than the private return ($w^c > \omega$) is illegitimate. We call an illegitimate activity a *crime* whenever it is optimal to have strictly positive deterrence ($\tau^* > 0$). Thus, this simple model provides conditions under which an activity should be deemed a crime, along with the level of resources to be allocated to reduce crime:

Proposition 1. *Assuming a unique solution to the optimal deterrence policy, an illegitimate activity ($w^c > \omega$) should be criminalized with a positive level of deterrence if:*

$$\hat{\epsilon}_w(0) > \left(\frac{1}{w^c/\omega - 1}\right) > 0. \tag{11}$$

A necessary condition for criminalizing an activity is that the average wage elasticity of criminal labor supply is positive. An interesting implication of this result is that even though it may be optimal to have deterrence, in jurisdictions where individuals are very needy, the policy may be ineffective, in which case we observe informal non-enforcement of the law. It is also the case that when the social cost of an illegitimate activity is sufficiently high and the labor elasticity is

[15] This might seem to be an extreme case. However, most human societies, until relatively recently, did not have formal police. Rather affluent individuals use personal protection, and lived in secure accommodation with walls, and inner courtyards - castles in medieval Europe, walled houses in towns around the Mediterranean.

positive, then condition (11) will be satisfied. In this case a positive level of deterrence is optimal. Presumably, jaywalking in New York City (a crime punishable by two weeks in jail) is not enforced because the private benefit is large relative to the social cost of jay walking![16]

3 Discussion

The model introduced above is, by design, very simple. The goal is to add the notion of a consumption need to the basic Becker (1968) model. A need is a good for which a person will work harder to obtain. This in turn causes the income effect to be larger than the substitution effect - criminal labor supply becomes an inferior good with the feature that an increase in deterrence increases criminal labor supply. In this case crime is an example of a Giffen good. This section discusses how the interaction of need and deterrence may provide a way to organize some of the themes in the vast literature on criminal deterrence in economics, sociology and law and economics.

3.1 Implications for Economics

The first result uses the Shapiro and Stiglitz (1984) model to re-frame the Becker-Erhlich deterrence model as a tax on wages. This is a standard approach in finance economics where future risks can be priced (see section 3.3 of MacLeod (2022)). The main technical contribution is to illustrate how the notion of need can be introduced to King et al. (1988) preferences to provide clear predictions on the conditions under which criminal labor supply will rise with an increase in deterrence. These preferences are additive in the utility of consumption and cost of effort, as in standard agency theory (Hart and Holmström (1987)). Their inclusion illustrates how the standard agency model provides a convenient way to capture this effect relative to the labor supply model where labor is viewed as negative leisure, as in Barzel and McDonald (1973).

When a person is needy, then deterrence behaves much like an inefficient income tax - an increase in the tax leads to an inefficient increase in crime. In that case, as we know from optimal tax theory, it may be efficient to use transfers rather than deterrence (Feldstein (1999) and Slemrod and Kopczuk (2002)). The introduction discusses some evidence consistent with the hypothesis that labor supply can fall with an increase in the wage. The question is whether we have evidence of this phenomena in the crime literature?

There are several papers that use aggregate crime statistics to estimate the effect of changes in deterrence on crime. Figure (2) reports elasticities for property crime with respect to deterrence from a number of important studies. For the most part, the point estimates are negative, consistent with the standard assumption in the deterrence literature. However, even though the point estimates

[16]Section 1152 of New York's Vehicle & Traffic Laws makes jay walking illegal with a penalty of a fine of not less than $200 nor more than $500. A term of imprisonment of not more than 30 days. Both such fine and imprisonment may be imposed.

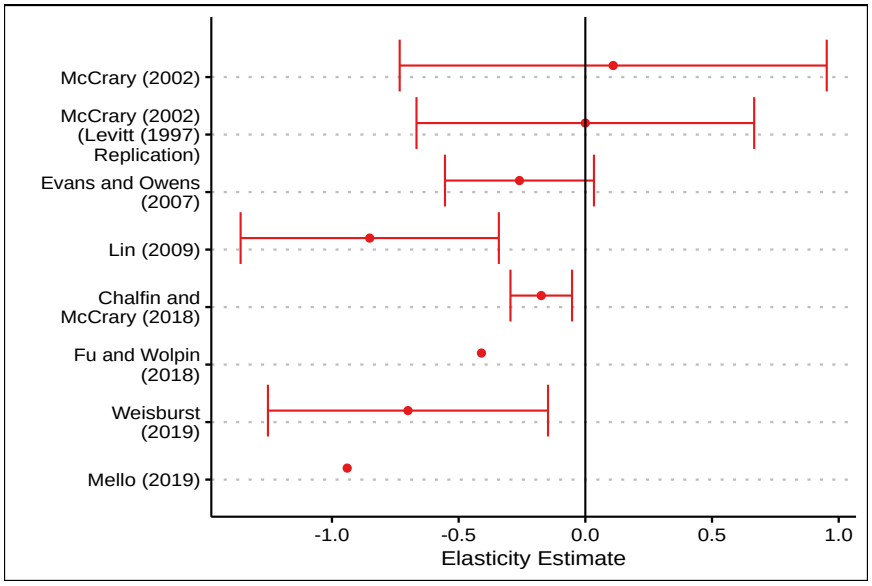

Figure 2: Effect of Deterrence on Crime
Sources: Levitt (1997); McCrary (2002); Chalfin and McCrary (2018); Evans and Owens (2007); Fu and Wolpin (2017); Lin (2009); Weisburst (2019); Mello (2019)

are generally negative, they have large error bars.[17] Note, that these papers report the *average* elasticity in the population ($\hat{\epsilon}$ in the formal model), not the elasticity at an individual level.

It is a feature of the evidence from the literature illustrated in figure (2) that one is typically measuring crime in terms of reported crime, as found in the *Uniform Crime Reports* issued by the Federal Bureau of Investigation (FBI). As Levitt (1997) points out, this data under reports crime since it depends upon crimes reported to the police, which is less than all crimes. Moreover, when multiple crimes are committed at the same time, only the more serious crime is reported. Finally, these statistics measure the outcome of criminal activity, and not the amount of time allocated to crime. For example, increased policing is known to lower crime as an outcome, but it is an open question of what effect this has on the total time individuals are allocating to criminal activity, including efforts to avoid detection. Increase policing may result in individuals working harder to avoid detection, without necessarily decreasing measured crime.

Another source of evidence comes from the growing literature on how need affects crime. In a fascinating historical study, Melander and Miotto (2023) find that the New Poor Law of 1824 resulted in large changes in welfare spending in English and Welsh communities. They find that in areas where generosity is reduced there is more non-violent crime, particularly during periods of high unemployment. Using high quality data in Finland, Aaltonen et al. (2016) find that when

[17] This paper deals with mainly with property crime. It is worth noting that in the case of violent crime, there is little evidence that strong deterrence, such as the death penalty, has a significant deterrence effect (Donohue and Wolfers (2005)).

individuals are in debt, and there is aggressive debt collection, then this leads to more crime by the affected person. Palmer et al. (2019) link the availability of housing assistance to Chicago police records, and find that the provision of housing reduces crime, particularly violent crime.

Papers by He and Barkowski (2020) and Jácome (2020) show that access to health services reduces crime. Deshpande and Meuller-Smith (2021) find that individuals loosing access to Supplemental Security Income (SSI) at age 18 commit more crime. Moreover, the cost of this increase in criminal activity is greater than the cost of continuing SSI coverage. Aslim et al. (2020) also find that providing medical services to released prisoners reduces recidivism, and provides a cost effective way to reduce crime.

It is also worthwhile pointing out that there is a literature that emphasizes the human costs of increased deterrence via incarceration. The time spent incarcerated results in a loss of legitimate employment experience. As Hart and Holmström (1987) documents, labor market experience when young results in large wage increases, and hence the incarceration of young offenders is particularly costly since it delays their entry into the formal labor market. Thisin turn reduces future income in legitimate activities.

Moreover, incarceration results in a criminal record that can reduce post incarceration employment opportunities (Aizer and Doyle (2015), Agan and Starr (2018), Doleac and Hansen (2020)).[18] Finally, it is not clear that deterrence, as measured by incarceration length is effective. Ouss (2020) finds that when the cost of incarceration is moved from a US state to the counties, this results in a sharp reduction of in sentence length. Yet, this does not result in an increase in arrests, suggesting that incarceration policy in these states is not be optimal - they can reduce sentence length without increasing crime.

In addition to the labor market implications, the theory here can also be viewed through the lenses of behavioral economics. For example, individuals are likely to vary in their needs over time, that in turn is predicted to lead to variation in crime. This can be captured by making both consumption need, c^0, and transfers, t^0, time varying. As we know from Becker and Murphy (1988), a person's preference over drugs can vary with time and with their current level of consumption. A drug addiction generates a need, that may require criminal activity to satisfy. This is consistent with the finding by Levitt (2004) that the crack cocaine crises during the 1980s and 1990s explains in part the rise and fall of crime. Even if one holds the level of deterrence fixed, a person's perception of τ can vary between individuals and over time (Lochner (2004), Ouss and Peysakhovich (2015)).

Understanding a person's need, particularly for individuals in poverty, is central to the large sociology literature on crime. Let us turn to a brief discussion of that literature and its connection with the notion of need in this model.

[18] See also the interesting work by Sviatschi (2022a) who finds that children working on coca farms have a greater propensity to enter into the drug business in Peru, which in turn leads to increased chances for incarceration.

3.2 Implications for Sociology

Beginning with the seminal work of Merton (1938) on crime, there is a rich and extensive literature in sociology exploring the reasons for criminal activity. For the most part, the economics literature discussed above focuses upon estimating the causal effect of policy interventions on crime. In order to have statistical significance, this requires both a sufficient number of observations, and the aggregation of evidence from a heterogeneous population of individuals.

In contrast, the sociology literature focuses upon fine-grained evidence of the relationship between individuals, their environment and crime. Merton (1938) initiated the concept of "strain" in order to understand the factors that lead an individual to commit crime. That theory, and its later development (Agnew et al. (2009); Agnew (1992)), illustrates the many factors that can cause a person to offend. This has led to a consensus in the sociology literature that deterrence is not the most important determinant of crime (Pratt and Cullen (2005)). Rather, variation in the the environment and context are more important. These views are consistent with more recent evidence discussed by Chalfin and Tahamont (2018).

The simple model introduced here captures this approach via the notion of "necessity". Though necessity is modeled as a consumption need, the concept is quite general. It is any factor increasing a consumption need that in turn causes the individual to commit crime, despite the fact that they may face a punishment.

The high marginal utility from consumption in the model can be identified with Merton (1938)'s notion of "strain". As discussed above, addiction is another source of "strain" that Levitt (2004) finds explains some of the increase in crime during the 1980s. Taking crack cocaine leads to a distortion in preferences, and a need to obtain funds to support one's addiction. There is an extensive empirical literature linking drug use to criminal behavior (see DeBeck et al. (2007) and Long et al. (2014)). Allen (2005) documents cases where the criminal behavior of drug addicts are the result of once off acts of desperation to satisfy their addiction.

The economic model developed here also highlights the point that "strain" is not the only precondition for crime. Becker's model predicts that choice is shaped by both preferences and the environment as represented by a person's budget constraint. If individuals have sufficient resources to satisfy their basic needs then this not only reduces the propensity to engage in crime, but also increases the effectiveness of sanctions - in effect the person has "skin in the game". Economic theory does not require needs to be satisfied via the private production and consumption of goods. The budget constraint typically focuses upon these factors because they are often the only factors that can be measured. More generally, the budget constraint can also include public goods, which in turn shape the local environment in which an individual lives (Oakland (1987)).

The importance of environment for understanding observed crime level is highlighted by Sampson et al. (1997). This approach has become a central ingredient in explaining crime over space and time

(Sharkey et al. (2016)). The notion of a transfer in the model introduced in this paper can represent any local condition that allows a transfer of resources to the individuals that reduces their need to commit crime. This may include the available employment opportunities, legitimate or not, as well as social needs. Individuals who are socially better connected tend to be healthier, better adjusted and have better employment opportunities. What the model emphasizes is that there should be specific and measurable resources being supplied by community services, such as food, shelter and health services. Sharkey et al. (2017) provides evidence on the importance of these services for reducing crime, and shows that the introduction of nonprofits into a community can significantly reduce property crime.

Another way to think about context is in terms of the legal notion of "necessity" that can be used as a defense in court against some criminal acts. Posner (2014) discusses the case in which a person happens to be lost in the wilderness and comes upon an empty cabin with food that the person steals in order to survive.[19] This is of course a crime, but given the situation the person might be exonerated because otherwise they would have starved.

Posner (2014) goes on to point out that if the individual was starving in a city, and grabbed food from a passerby they would not be exonerated. At this point one is reminded of Victor Hugo's *Les Misérables*, where the hero, Jean Valjean, is imprisoned for 19 years for stealing bread to feed his starving sister and her children. It is unlikely that any level of deterrence would have altered Jean Valjean's choices. Yet, today, as then, a person's theft of bread from a grocery store to feed their children can lead to arrest and punishment. Why does the law treat these this situations differently?

3.3 Implications for Law and Economics

A goal of law and economics is to use price theory to explain and organize many of the complex features of modern legal systems (Posner (2014)). Legal rules allocate both decision rights, and guide judges on how to set transfers, damages and criminal penalties. Parties are assumed to choose whether to comply with the law or to be sanctioned (Polinsky and Shavell (2000)). Posner (2014) has shown that a surprisingly large number of legal rules in common law jurisdictions can be viewed as solutions to the problem of maximizing social well being as measured by total wealth. This section discusses some of the implications of the results in this paper when one views legal rules as solutions to the question of how best to maximize social well-being. The main result is that the design of optimal legal rules depends upon the social policies set by government. Moreover, recognizing that the income effect can affect deterrence implies that optimal policy depends upon the joint determination of social policy and criminal deterrence.

An attractive feature of Posner's approach to explaining legal rules is that the basic structure of

[19] See section 7.2 of Posner (2014).

the law can be explained with little reference to social policy. Kaplow and Shavell (1994) provide a nice formalization of this point. They show that it is efficient for the legal system to set damages at the optimal level for deterrence, while the job of redistribution is allocated to the tax system. A point that is missing from their discussion is the role of time and information. A generic feature of the law is that enforcement is *ex post,* after the an individual has violated the law or has caused harm to others. Another way to think about this point is that formal legal systems are a backstop mechanism to address issues of social control that have not been or cannot be adequately addressed *ex ante.*

The Kaplow and Shavell (1994) analysis supposes that the optimal legal rule is *independent* of existing institutions. They are able to do this because it is assumed that individuals are risk neutral and not judgment proof.[20] In that case, strict liability is optimal, with the level of damages equal to the harm caused by a tortious action. An essential feature of tort law is that individuals are not barred from actions that harm others, whether this includes reckless driving or producing smelly gases that harm neighbors. However, when a person harms another this entails a social harm that tort law corrects by requiring the tortfeasor to pay damages equal to the harm. For example, the person may be speeding due to the need to bring a person to the hospital or to reach an important meeting on time. By setting damages equal to harm, individuals choose to harm others only if the benefit from their actions is greater than the harm caused to others.

Tort law can be viewed as an addendum to regulation. It is impossible for regulators to anticipate all situations where individuals may harm others, and in turn it is not always possible to fix the appropriate level for damages *ex ante.* Tort law provides an effective *ex post* solution. Each case before the courts is evaluated individually, resulting in decisions that are context specific in a way that regulation could not hope to achieve. There are number of conditions that need to be satisfied in order for tort law to be an efficient solution. Prominent among these is the requirement that tortfeasors are able to pay the damages assessed against them (Shavell (1986)).

There are number of solutions to the problem of judgment proof agents. One of these is based upon the observation that many torts are committed by individuals as part of their work, and hence at the time the tort is committed, they are employed by a larger entity. In these cases the judgment proof problem is solved with the law of vicarious liability. It holds the employer liable for the torts committed by their employees (Kornhauser (1982), Sykes (1984)). This in turn creates an incentive to firms to engage in better monitoring and reward of their employees (Arlen and MacLeod (2005)).

An important caveat to this is that firms can engage is strategic judgment proofing. In some cases this can be solved by giving tort victims priority in bankruptcy (Che and Spier (2008)). However, a successful tort suit also requires knowledge of the individuals responsible for committing the tortuous acts. Arlen (1994) and Arlen and Kraakman (1997) show that firms can use strategic non-

[20] Expression A1, Kaplow and Shavell (1994).

collection of information to deny the courts information that would lead to the successful collection of damages from the firm.

The problem of judgment proof agents is particularly severe in the cases of theft and violence committed by individuals. In principle, these acts can be viewed as torts, but since many of these actions are carried out needy individuals outside the employment relationship, the individuals are in general judgment proof. Hence, as Posner (1985) observes, criminal law has evolved to address harms caused by judgment proof individuals through the use of incarceration.

In addition to the use of incarceration, criminal law can also be viewed as a "regulatory" regime. Under tort law, each case can be viewed as an idiosyncratic event for which the courts can imposed tailored damages, that in turn allows individuals the right to "choose" to commit a tort, and then pay for the consequences of their choice. In contrast, crimes are actions for which no level of activity is considered efficient. The law specifies what actions are deemed to be crimes, along with a range of punishments to be used in those cases. These sanctions are correlated with severity of the crime, but are not necessarily related to precise measures of the economic cost of the criminal act.

In the necessity case discussed above, a feature of the interaction between the wealthy holder of bread and the needy person grabbing it is that the identity of offender is easy to observe. This implies that the cost of apprehending the offender is relatively low. This "hard hearted" rule implies that a needy person taking bread in a market context has committed a criminal act. If the defense of necessity were allowed, the courts may be overwhelmed with cases of individuals stealing and using the defence of necessity. This in turn would place a heavy fact finding burden on courts..

Rather, the solution observed in practice effectively gives the police and the prosecution some flexibility in whether to pursue a case or not. Both individuals and stores that deal with shop lifting have the option of not pressing charges against an individual who commits theft. For some cases the police or the victim may choose to not to proceed with a case. I have observed exactly this solution used in Italy, where pick pocketing is common and often done by children. I went to the police station with a colleague whose wallet was stolen. The police were able to recover the wallet, without the cash, which they returned to my colleague. From their perspective they had completed their job. They told me that it was simply impossible for them to process the large number of poor individuals involved in pick pocketing in the city, and hence the perpetrator was freed, and no charges were made. This behavior could be viewed as implementation of the doctrine of necessity!

The example highlights the important role played by context and information.[21] The optimal rule derived in section (2.2) uses the fact that the government has information on the economic status of an individual that can be used to set transfers. The evidence shows that these transfers in turn not only reduce crime, but also increases the effectiveness of sanctions. Hence, optimal sanctions are likely to be a complex function of government policy, the quality of information available to

[21] See Baird et al. (1994) for a beautiful discussion of the role of information and game theory for understanding legal rule.

government, and how individuals respond to sanctions. This analysis is consistent with Kaplow and Shavell (1994)'s point that damages set *ex post* by the legal system should not be used to achieve distributional goals since this is more efficiently carried out by the entity with the superior information, normally the tax collection authority. However, the extent to which the government pursues distributional goals determines in part the effectiveness of sanctions. Hence the optimal level of sanctions are affected by the equity goals pursed by government. Finally, if wealth maximization is the only goal of society, the analysis shows that optimal policy can entail some redistribution of resources, even in the absence of a preference for equity.

4 Directions for Future Research

The primary goal of this paper has been to highlight the role of economic need in determining the effectiveness of criminal sanctions. In the context of a simple labor supply model, if a person must choose between leisure and crime, the amount of time allocated to crime is increasing in their need. I begin by showing that one can view optimal deterrence as an optimal tax problem, that in turn allows us to integrate crime policy with the large public finance literature on labor supply. Daniel Nagin observes that one can view the Becker model as capturing the behavior of a person who thinks one step ahead - what will happen if the crime is detected.[22] This paper considers the situation where crime in an ongoing economic activity, in which case the individual views deterrence as a tax on their criminal labor supply. This perspective suggests a number of questions that would benefit from further research.

The first, is the empirical question of how much time individuals allocate to criminal activities. Most data on crime measures the incidence of crime, but does not measure the time allocated to criminal activity. This time has an opportunity cost, particularly when the individual could be engaged in productive work. This implies, as Levitt (2004) points out, that crime statistics are likely to be an underestimate of the cost of crime. Better measures of the cost of crime would hopefully lead to better policy.

Even if one were able to measure the time allocated to criminal activity, that would still be a lower bound on the cost of crime. The reason is that humans are very creative. When need drives individuals into crime this leads to innovation to find better ways to avoid detection and more efficiently execute criminal activity. There is plenty of evidence today of such innovation, including internet scams, and the development of techniques to circumvent crime prevention technology. For example, in many countries criminals have evolved kidnapping as an effective income generating activity.[23] Moreover, crime and kidnapping are two of the frequently cited reasons that the state

[22] Private correspondence on 2024-07-29.

[23] There are about 2 kidnappings per 100,000 population world wide (`https://dataunodc.un.org/data/crime/kidnapping`).

departments uses to recommend that individuals do not travel to a country. Currently there 47 countries with travel advisories at level 3 or above.[24] Finding interventions to improve this situation would be of great benefit.

Another example of criminal activity that has an element of desperation is illegal immigration to the US. Keefe (2010) provides a striking description of lengths to which individuals are will to suffer in order to go from China to the US occurs. A particularly interesting open question is the role of learning and crime. Mungan (2010) points out that this is important in understanding incentives for repeat offenders. In important work, Sviatschi (2022b) shows that increasing criminal deportations to El Salvador has resulted in an increase in homicide rates and gang activity. These are individuals who have made specific investments into criminal activity, and hence require more effective deterrence policies.

These examples illustrate that criminal activity is a complex phenomena that cannot be reduced by simply increasing in the severity of punishment, as postulated by Becker (1962) and Stigler (1970). More work is needed to understand the interaction between social policies that reduce the need to commit crime, and deterrence policies that reduce the return from crime (see the discussion in Nagin (2013)).

Galenianos et al. (2012)'s model of the drug trade illustrates how enforcement policy interacts with the strategies used by drug dealers. Dobbie et al. (2018) show that while pretrial detention has little effect upon future crime, it has a significant impact upon future income and employment. This work highlights the fact that crime is a complex dynamic process, and that optimal policy is likely to require coordination of several policy instruments. Since policies take time to have an effect, while there is always political pressure to reduce crime in the short run. The purpose of this paper is to provide a simple framework that can motivate the development of an integrated approach to improving the rule of law.

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[24] This changes regularly. This number is from 2024-02-27. See `https://travel.state.gov/content/travel/en/traveladvisories/traveladvisories.html`.

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A Appendix

A.1 Notation

Here is list of notation for reference. We will use these identities when convenient to reduce notation. In particular $N = \frac{n^0 - t}{\omega - \tau}$, where t is the government transfer is used frequently.

- Criminal activity: l
- Criminal wage: ω
- Marginal social cost of crime: $w^c > \omega$.
- Need: $n = c^0 - t$
- Return from crime: ω
- Deterrence: $\tau = w - \omega$
- Net return from crime: $w = \omega - \tau$
- Non-labor income: t^0 (initial endowment) and t^g (government)
- Real need is need in labor hours: $N = \frac{n}{\omega - \tau} = \frac{n}{w}$, where need $n^0 = c^0 - t^0$,$n = c^0 - t^0 - t^g$.

- Utility is:

$$\begin{aligned} U &= \log\left((\omega-\tau)\,l - n^0\right) - V(l), \\ &= \log\left((\omega-\tau)\left(l - \frac{n^0}{\omega-\tau}\right)\right) - V(l), \\ &= \log\left((\omega-\tau)\left(l - N^0\right)\right) - V(l). \end{aligned}$$

- Cost of effort: $V(l) = l^2/2$

- Criminal labor supply as function of real need: $L(N) = \arg\max_{l\geq 0}\left(\log\left((\omega-\tau)(l-N)\right) - V(l)\right)$

- Wage elasticity of labor supply: $\epsilon_w(\tau,t) = -L'\left(\frac{n^0-t}{\omega-\tau}\right)\frac{n^0-t}{(\omega-\tau)L} \in (-1,1)$

- Marginal social cost of crime: $MC(\tau) = (w^c - (\omega-\tau) + D(\tau))$

- Elasticity of marginal social cost with respect to deterrence: $\epsilon_{MC}(\tau) = \frac{dMC(\tau)/d\tau}{MC(\tau)} \times \tau = \frac{(1+D'(\tau))\times\tau}{(w^c-(\omega-\tau)+D(\tau))} \geq 0$

A.2 Deterrence as a Tax

The purpose of this section is to show that the penalty in the standard deterrence model is equivalent to a tax on the criminal market wage. In the Becker model of deterrence, when an individual chooses to offend she faces a probability P of a sanction f (see footnote 16 of Becker (1968)). We can translate this into a flow of offenses using the Shapiro and Stiglitz (1984) model. We also discuss the conditions under which further incarceration can result in ineffective deterrence when a person is very needy.

Suppose that the individual has a single illegitimate activity and that effort in that activity is given by a constant l per unit of time, resulting in illegitimate income of $\omega \times l$ per unit of time. Time is divided into small intervals of length $\Delta > 0$. During a period Δ, we can suppose that the probability of detection is given by $P = p \times l$. This is a Poisson parameter, so with an higher level of activity the individual faces a higher probability of detection. When caught, a penalty f per unit of time is paid. Let us suppose that the individual's discount rate is r and that the process is stationary. Thus, individual utility solves the following dynamic program:

$$U_t = \Delta\left(p \times l \times u(\omega l - f - n) + (1 - p \times l)\,u(\omega l - n) - V(l)\right) + e^{\Delta r}U_{t+\Delta}. \tag{12}$$

The stationary process assumption implies $U_{t+\Delta} = U_t$, and we have:

$$\begin{aligned}\frac{1-e^{-\Delta r}}{\Delta}U_t &= u(\omega l - n) - V(l) + pl\left(u(\omega l - f - n) - u(\omega l - n)\right), \\ &\approx u(\omega l - n) - plfu'(\omega l - n) - V(l), \\ &\approx u(\omega l - plf - n) - V(l) \\ &= u((\omega - pf)l - n) - V(l).\end{aligned}$$

We can now let $\tau = pf$ define the flow level of deterrence, or the tax on crime. Letting $\Delta \to 0$ then we get:

$$\begin{aligned}rU_t &= u((\omega - pf)l - n) - V(l) \\ &= u((\omega - \tau)l - n) - V(l).\end{aligned}$$

Since multiplying utility by a constant does not change preferences, this expression corresponds to the static model 1 with wage $w = \omega - \tau$ and flow utility given by log consumption less effort costs.

Since f is per unit of time in the dynamic programming problem, it corresponds approximately to a stock (one time) penalty of $F = f/r$, where r is the individuals discount rate. For example, a standard discount rate of 2% implies that F is 50 times larger than f.

The key ingredient is that this is a perceived cost on the part of the individual. We might not expect that the individual correctly evaluates the cost of their action. However, the fact that crime may rise with the punishment may seem odd, but it is the consequence of need.

Incarceration

This section illustrates the interaction between incarceration and need. Let U^* be the lifetime utility of a person who had not yet been apprehended for crime, and let U^0 be the utility if apprehended and incarcerated. The notion of need implies that for very needy individuals their utility will be lower than the utility from incarceration. To see this let:

$$rU^*(n) = \max_{l \geq 0}\left(\log(wl - n) - V(l)\right),$$

be the optimal level of utility given need n. Notice that $\lim_{n\to\infty} rU^*(n) = -\infty$. In other words, for any level of utility from incarceration, say U^0, if the person is sufficiently needy, then incarceration is preferred in utility terms. Let $\Delta\gamma l$ be the probability that a person is apprehended in any period of length Δ, and let U^* be the discounted payoff before apprehension, including the potential for

incarceration. Then we have:

$$U^* = (1 - \Delta pl)\,\Delta\left\{u\left(wl - n\right) - V\left(l\right) + U^*\right\} + \Delta plU^0.$$

The dynamic programming algorithm (Bertsekas (2012)) combined with the fact that we can ignore the higher order terms, Δ^2 implies that:

$$0 = \frac{dU^*}{dl} = \Delta\left(u'\left(wl^* - n\right)w - V'\left(l^*\right)\right) + p\Delta\left(U^* - U^0\right),$$

and hence:

$$u'\left(wl^* - n\right) = V'\left(l^*\right) - p\left(U^0 - U^*\right).$$

Notice that if a person is sufficiently needy, then $\left(U^0 - U^*\right) > 0$, that turn implies that criminal labor supply with deterrence is higher than with no deterrence. Moreover, an increase in the probability of detection, p, leads to more rather than less crime. This formulation again makes the point that if a person is sufficiently needy, then an increase in deterrence may have perverse effects. In the text we use the tax formulation because it provides a sharper distinction between the cases where labor supply is upward and downward sloping.

A.3 Optimal Labor Supply

Problem (2) is concave and hence interior solutions are characterized by the first order condition:

$$\frac{w}{\left(wl - n\right)} = l,$$

from which it follows:

$$\begin{aligned} l\left(l - n/w\right) - 1 &= 0, \\ l^2 - \frac{n}{w}l - 1 &= 0. \end{aligned} \tag{13}$$

The solution to this begins by defining *real need* as $N = \frac{n}{w}$, that can be positive or negative. This allows us to write labor supply as:

$$L\left(N\right) = \frac{N \pm \sqrt{N^2 + 4}}{2}.$$

Since $l \geq 0$ and the square root term is larger than N it follows that the unique solution is:

$$L\left(N\right) = \left(N + \sqrt{N^2 + 4}\right) \Big/ 2.$$

Observe that $L(0)=1$, $\lim_{N\to-\infty} L(N)=0$, $\lim_{N\to\infty} L(N)=\infty$.

Taking into account that N can be negative or positive implies that the derivative is given by:

$$\begin{aligned}\frac{dL}{dN} &= \left(1+\frac{N}{\sqrt{N^2+4}}\right)\Big/ 2 \\ &= \begin{cases} \left(1+\left(1+4/N^2\right)^{-1/2}\right)\Big/ 2, & N>0 \\ 1/2, & N=0 \\ \left(1-\left(1+4/N^2\right)^{-1/2}\right)\Big/ 2, & N<0 \end{cases}\end{aligned}$$

Thus:

$$\lim_{N\to\infty}\frac{dL}{dN}=1 \tag{14}$$

$$\lim_{N\to 0}\frac{dL}{dN}=\frac{1}{2}$$

$$\lim_{N\to-\infty}\frac{dL}{dN}=0 \tag{15}$$

The second derivative is given by:

$$L''(N)=\frac{2}{\left(N^2+4\right)^{3/2}}>0.$$

The elasticity of labor supply with respect to real need is:

$$\begin{aligned}\epsilon_N(N) &= \frac{L'(N)N}{L} \\ &= \frac{\left(1+\frac{N}{\sqrt{N^2+4}}\right)}{\left(N+\sqrt{N^2+4}\right)}\times N \\ &= \frac{\left(N+\frac{N^2}{\sqrt{N^2+4}}\right)}{\left(N+\sqrt{N^2+4}\right)}.\end{aligned} \tag{16}$$

From the last line is follows that:

Proposition 2. *The elasticity of labor with respect to wage is $\epsilon_w = -\epsilon_N$. It satisfies:*

$$\begin{aligned}\lim_{w\to\infty} \epsilon_N(w) &= -1,\\ \lim_{w\to 0} \epsilon_N(0) &= 0,\\ \lim_{w\to-\infty} \epsilon_N(w) &= 1.\end{aligned}$$

Proof. Observe:

$$\begin{aligned}\epsilon_w &= \frac{dl}{dw}\frac{w}{L}\\ &= L'(N)\frac{dN}{dw}\frac{w}{L}\\ &= -L'(N)\frac{n}{w^2}\frac{w}{L},\\ &= -L'(N)\frac{N}{L}\\ &= -\epsilon_N \lesseqgtr 0.\end{aligned}$$

When $N = 0$ (16) is zero. Next, when $N > 0$ we have:

$$\begin{aligned}\epsilon_N(N) &= \frac{N\left(1+\frac{N}{\sqrt{N^2+4}}\right)}{N\left(1+\sqrt{1+4/N^2}\right)}.\\ &= \frac{\left(1+\frac{N}{\sqrt{N^2+4}}\right)}{\left(1+\sqrt{1+4/N^2}\right)}.\end{aligned}$$

From this it follows that $\lim_{N\to\infty}\epsilon_N(N) = \frac{1+1}{1+1} = 1$. For $N < 0$, we can let $x = -N > 0$ and let $x \to \infty$. Thus we have:

$$\begin{aligned}\epsilon_N(x) &= \frac{\left(-x+\frac{x^2}{\sqrt{x^2+4}}\right)}{\left(-x+\sqrt{x^2+4}\right)}\\ &= \frac{\left(-1+\frac{x}{\sqrt{x^2+4}}\right)}{\left(-1+\sqrt{1+4/x^2}\right)}.\end{aligned}$$

Notice that the term on top is negative for $x > 0$ ($\frac{x}{\sqrt{x^2+4}} < 1$), while the term on the bottom is positive, and hence $\lim_{x\to\infty}\epsilon_N(x) = -1$. From this we obtain the limits in the proposition. For

the rest of the appendix, we define elasticity in terms of deterrence and need. We set:

$$\epsilon(\tau, n) \equiv -\frac{dl}{dw}\frac{n}{\omega - \tau}$$

□

A.4 Cost Minimizing Problem

The optimal social cost of reducing illegitimate labor is the solution to:

$$\begin{aligned}\min_{\tau\in[0,\omega],t^g\geq 0} \mathscr{C}(\tau, t^g) &= \min_{\tau\in[0,\omega],t^g\geq 0} (w^c - \omega + \tau + D(\tau)) L\left(\frac{n^0 - t^g}{\omega - \tau}\right) + \lambda t^g, \\ &= \min_{\tau\in[0,\omega],t^g\geq 0} MC(\tau) L\left(\frac{n^0 - t^g}{\omega - \tau}\right) + \lambda t^g\end{aligned}$$

where $w^c > 0$ is the marginal social cost of illegitimate labor, and

$$MC(\tau) = (w^c - \omega + \tau + D(\tau)),$$

is the total marginal cost of the illegitimate activity that takes into account individual welfare and cost of deterrence. The cost of deterrence is assumed to be differentiable with $D(0) = D'(0) = 0, D'' > 0$. It is further assumed that perfect deterrence is very costly, namely:

$$\lim_{\tau\to\omega} D(\tau) = \infty$$

We proceed by considering optimal deterrence in the absence of transfers and then we address the general case.

Optimal Deterrence with No Transfers $(t = 0)$**:**

The first order condition is:

$$\frac{d\mathscr{C}}{d\tau} = MC(\tau) L'\left(\frac{n^0}{\omega - \tau}\right)\frac{n^0}{(\omega - \tau)^2} + L\left(\frac{n^0}{\omega - \tau}\right) \times \frac{dMC(\tau)}{d\tau} = 0. \tag{17}$$

We can use the expression for the wage elasticity of labor and the elasticity of MC with respect to deterrence:

$$\begin{aligned}\epsilon_{MC}(\tau) &= \frac{\frac{dMC(\tau)}{d\tau}}{MC(\tau)}\tau, \\ &= \frac{(1 + D'(\tau))}{(w^c - (\omega - \tau) + D(\tau))} \times \tau > 0.\end{aligned}$$

We suppose that this elasticity is increasing with deterrence (since $D(\tau) \to \infty$ as $\tau \to \omega$). We can rewrite the first order condition (17) as:

$$-\epsilon_w(\tau)/(\omega-\tau) + \epsilon_{MC}(\tau)/\tau = 0. \tag{18}$$

Hence if the optimal level of deterrence satisfies $\omega > \tau > 0$ then:

$$\frac{\epsilon_w(\tau^*)}{\epsilon_{MC}(\tau^*)} = \left(\frac{\omega}{\tau^*} - 1\right) \geq 0.$$

Since $\epsilon_{MC}(\tau^*) \geq 0$, a necessary condition for positive deterrence is that $\epsilon_w > 0$, namely that the person be affluent. Rearranging we get:

$$\tau^* = \omega \frac{\epsilon_{MC}(\tau^*)}{\epsilon_w(\tau^*) + \epsilon_{MC}(\tau^*)} \in [0, \omega] \tag{19}$$

Thus we have:

Proposition 3. *If a person is needy, then it is never optimal to have a positive level of deterrence ($\tau^* = 0$). A positive level of deterrence is cost minimizing if and only if the marginal social cost of criminal labor satisfies $w^c > \bar{w}^c > \omega$, where:*

$$\bar{w}^c = \omega\left(1 + \frac{1}{\epsilon_w(0)}\right).$$

Moreover, for affluent persons, the optimal level of deterrence rises with the social marginal cost of illegitimate labor w^c.

Proof. When a person is needy then the elasticity of labor supply is negative. Hence (17) cannot be satisfied and some deterrence in not optimal. Increasing w^c decreases the elasticity of MC without affecting labor supply. This combined with the monotonicity of elasticity with respect to deterrence implies τ^* increases with w^c. Expression (19) can be written as follows:

$$\begin{aligned}
\tau^* \frac{\epsilon_w(\tau^*)}{\epsilon_{MC}(\tau^*)} &= \omega - \tau^*, \\
\epsilon_w(\tau^*) \times \frac{(w^c - (\omega - \tau) + D(\tau))}{(1 + D'(\tau))} &= \omega - \tau^*.
\end{aligned}$$

Setting $\tau^* = 0$ in this expression defines $\bar{w}^c$ via:

$$\epsilon_w(0) \times (\bar{w}^c - \omega) = \omega,$$

yielding the desired result. Notice that for needy persons $\epsilon_w(0) < 0$, and hence $\bar{w}^c > \omega$ is a necessary condition for positive deterrence. □

Optimal Transfers

Consider the optimal provision of transfers given that the government is choosing an optimal level of deterrence τ^*. By the envelope theorem we can ignore the effect of transfers on the optimal τ^*. The first order condition for the optimum transfer is:

$$\frac{d\mathscr{C}}{dt^g}(\tau^*, t^g) = -MC(\tau^*) L'\left(\frac{n^0 - t^g}{\omega - \tau^*}\right)\frac{1}{\omega - \tau^*} + \lambda.$$

Thus the first order condition is given by:

$$L'\left(\frac{n^0 - t^{g*}}{\omega - \tau^*}\right) = \lambda \times \frac{\omega - \tau^*}{MC(\tau^*)}. \tag{20}$$

The second term is the cost of funds times the return to crime over the marginal social harm of crime. Since $L' > 0$ for all levels of real need we have:

Proposition 4. *If the cost of funds satisfies:*

$$\lambda \geq \bar{\lambda}(\tau^*) = MC(\tau^*) L'\left(\frac{n^0}{\omega - \tau^*}\right)\frac{1}{\omega - \tau^*},$$

then no transfer is optimal. However if $\lambda < \bar{\lambda}(\tau^*)$ then it is optimal to provide a transfer to the individual to lower crime.

Proof. Observe that the left hand side of (20) is strictly monotonic in t since $L'' > 0$, from which the result follows. □

A.5 Aggregate Policy

We begin with a population of individuals who only vary by their need, $n^0 \in \Re$, with distribution $f\left(n^0\right) > 0$. It is assumed the one can tailor transfer policy to a person's need. Hence, it is assumed that the authorities choose transfers $t\left(n^0\right) \geq 0$ Given that all individuals are equal before the law, it is further assumed that deterrence, and hence the net wage, $w = \omega - \tau$, is chosen independent of type. As assumed above, lump sum taxation ($t < 0$) is not possible. The optimal policy is thus the solution to:

$$\min_{\{\tau \in [0,\omega], t^g(n^0) \geq 0\}} \mathscr{C}\left(\tau, t^g\left(n^0\right)\right) = \min_{\{\tau \in [0,\omega], t^g(n^0) \geq 0\}} \int_{-\infty}^{\infty} MC(\tau) L\left(\frac{n^0 - t^g\left(n^0\right)}{\omega - \tau}\right) + \lambda t^g\left(n^0\right) f\left(n^0\right) dn^0. \tag{21}$$

where the first term is the integral of social cost of crime with respect to need, and the second term is the social cost of the transfers to the needy. The fact that the cost function is continuous and bounded above ensures that there is a cost minimizing solution. We proceed by first fixing the level of deterrence, τ, and determining the optimal transfer, $t\left(n^0, \tau\right)$, as a function of a person's need.

Step 1- Optimal transfer given τ:

Ignoring for the moment the non-negativity contraint on t, one has the first order condition:

$$MC\left(\tau\right) L'\left(\frac{n^0 - t^g\left(n^0\right)}{\omega - \tau}\right) / \left(\omega - \tau\right) + \lambda = 0 \tag{22}$$

Thus in the absence of constraints, real need $\frac{n^0 - t\left(n^0\right)}{\omega - \tau}$ is *independent* of individual need, n^0. Let $n^*\left(\tau\right)$ be the unique solution (when it exists) to:

$$L'\left(\frac{n^*\left(\tau\right)}{\omega - \tau}\right) = \frac{\lambda\left(\omega - \tau\right)}{MC\left(\tau\right)} \tag{23}$$

The solution has the follow properties.

Proposition 5. *There is a unique solution to (23), $n^*\left(\tau\right)$, that is need independent if an only if:*

$$MC\left(\tau\right) / \left(\omega - \tau\right) > \lambda. \tag{24}$$

If this is not satisfied, no transfer is optimal given deterrence τ. When it is satisfied, then the unique optimal transfer that solves equation (6), $t\left(n^0\right)$, satisfies:

$$t^g\left(n^0\right) = \begin{cases} n^0 - n^*\left(\tau\right), & \text{if } n^0 \geq n^*\left(\tau\right), \\ 0, & \text{if not.} \end{cases}$$

Proof. The proof is straightforward and follows from the uniqueness of the cutoff $n^*\left(\tau\right)$ when it exists. □

Step 2:

The next step is to determine the optimal level of deterrence, assuming that transfers are set optimally. Given optimal transfer policy, the optimal cost of deterrence as a function of deterrence τ is given by:

$$\mathscr{C}\left(\tau, t^{g*}\left(\tau\right)\right) = MC\left(\tau\right) L^{S*}\left(\tau\right) + \lambda T^{g*}\left(\tau\right), \tag{25}$$

where

$$L^{S*}(\tau) = \int_{-\infty}^{n^*(\tau)} L\left(n^0/(\omega-\tau)\right) f\left(n^0\right) dn^0 + G(\tau) L\left(\frac{n^*(\tau)}{\omega-\tau}\right),$$

is the labor supply given deterrence τ under the optimal transfer policy. The number of individuals receiving a transfer is

$$G(\tau) \equiv (1 - F(n^*(\tau))),$$

where $F\left(n^0\right)$ is the cumulative distribution function for the density $f\left(n^0\right)$. Post-transfer all the individuals receiving a transfer choose the same level of crime, $L\left(\frac{n^*(\tau)}{\omega-\tau}\right)$. The second term in (25) is the total cost of the transfers to needy individuals under the optimal transfer policy:

$$\begin{aligned} T^g(\tau) &= \int_{n^*(\tau)}^{\infty} \left\{n^0 - n^*(\tau)\right\} f\left(n^0\right) dn^0 \\ &= \int_{n^*(\tau)}^{\infty} n^0 f\left(n^0\right) dn^0 - n^*(\tau) G(\tau), \\ &= Need^{expost} - Need^{exante}. \end{aligned}$$

Under the hypothesis that transfers are chosen optimally, the envelope theorem implies that first order condition is found by taking the partial derivative with respect to deterrence:

$$\frac{\partial MC(\tau)}{\partial \tau} L^{S*}(\tau) + MC(\tau) \frac{\partial L^{S*}(\tau)}{\partial \tau} + \lambda \frac{\partial T^g(\tau)}{\partial \tau} = 0. \tag{26}$$

The envelope theorem implies that the derivative with respect to real need, $\bar{N}$, will be zero, and hence we can ignore the effect of deterrence on the cutoff when evaluating the first order conditions. Thus we have:

$$\begin{aligned} \frac{\partial MC(\tau)}{\partial \tau} &= \left(1 + D'(\tau)\right) > 1, \\ \frac{\partial L^{S*}(\tau)}{\partial \tau} &= \int_{-\infty}^{n^*(\tau)} L'\left(n^0/(\omega-\tau)\right) \frac{n^0}{(\omega-\tau)^2} f\left(n^0\right) dn^0 + G(\tau) L'\left(\frac{n^*(\tau)}{\omega-\tau}\right) \frac{n(\tau)}{(\omega-\tau)^2}, \\ \frac{\partial T^g(\tau)}{\partial \tau} &= 0, \end{aligned}$$

where we have abused notation somewhat to suppose that the partial derivatives indicate a derivative that ignores the effect of deterrence on the transfer via $n^*(\tau)$.

The effect of deterrence on labor supply can be written in the form:

$$\begin{aligned}
\frac{\partial L^{S*}(\tau)}{\partial \tau} &= \frac{1}{(\omega-\tau)}\int_{-\infty}^{n^*(\tau)} \frac{L'\left(n^0/(\omega-\tau)\right)}{L\left(n^0/(\omega-\tau)\right)}\frac{n^0}{(\omega-\tau)} L\left(n^0/w\right) f\left(n^0\right) dn^0 \\
&\quad + L\left(\frac{n^*(\tau)}{\omega-\tau}\right) G(\tau) \frac{L'\left(\frac{n^*(\tau)}{\omega-\tau}\right)}{L\left(\frac{n^*(\tau)}{\omega-\tau}\right)} \frac{n^*(\tau)}{(\omega-\tau)^2} \\
&= -\frac{1}{(\omega-\tau)}\int_{-\infty}^{\bar{n}(w)} \epsilon_w\left(\tau, n^0\right) h\left(n^0\right) dn^0 - \frac{L\left(\frac{n^*(\tau)}{\omega-\tau}\right)}{\omega-\tau}\epsilon_w\left(\tau, n^*(\tau)\right) \\
&= \left\{\int_{-\infty}^{\bar{n}(w)} \epsilon_w\left(\tau, n^0\right) h\left(n^0\right) dn^0 - G(\tau) L\left(\frac{n^*(\tau)}{\omega-\tau}\right)\epsilon_w\left(\tau, n^*(\tau)\right)\right\} / (\omega-\tau) \\
&= -\hat{\epsilon}_w(\tau)/(\omega-\tau),
\end{aligned}$$

where $h\left(n^0\right) = L\left(n^0/(\omega-\tau)\right) f\left(n^0\right)$ is the density of criminal activity by individuals with need n^0. The term in brackets is the The elasticity $\hat{\epsilon}_w(\tau)$ is the average elasticity over the distribution of distribution of criminal activity weighted by the total crime carried out at each level of need $n^*(\tau)$.

We can normalize by the total crime and set:

$$\hat{\epsilon}_w(\tau) \equiv \left\{\int_{-\infty}^{\bar{n}(w)} \epsilon_w\left(\tau, n^0\right) h\left(n^0\right) dn^0 - G(\tau) L\left(\frac{n^*(\tau)}{\omega-\tau}\right)\epsilon_w\left(\tau, n^*(\tau)\right)\right\} \Big/ L^{S*}(\tau).$$

If there is an interior solution, the first order conditions imply that the optimal level of deterrence τ^* will satisfy:

$$\frac{\partial MC(\tau)}{\partial \tau^*} - MC(\tau)\hat{\epsilon}_w(\tau^*)/(\omega-\tau^*) = 0. \tag{27}$$

Following a similar argument to the single person case, we get an equation for the optimal deterrence that is the same formula as the one above, except now we are using the population mean elasticity:

$$\tau^* = \omega\frac{\epsilon_{MC}(\tau^*)}{\hat{\epsilon}_w(\tau^*) + \epsilon_{MC}(\tau^*)} \in [0, \omega]. \tag{28}$$

An application of this analysis is to delineate which activities should be criminalized:

Proposition 6. *Assuming a unique solution to the optimal deterrence policy, an illegitimate activity* $(w^c > \omega)$ *should be criminalized with a positive level of deterrence if:*

$$\hat{\epsilon}_w(0) > \left(\frac{1}{w^c/w - 1}\right) > 0. \tag{29}$$

Proof. An activity should not be deterred if increasing deterrence above zero decreases social costs.

This will occur if:

$$\frac{\partial MC\left(0\right)}{\partial \tau}L^{S*}\left(0\right)+MC\left(0\right)\frac{\partial L^{S*}\left(\tau\right)}{\partial \tau}+\lambda\frac{\partial T^{g}\left(0\right)}{\partial \tau}<0.$$

This implies:

$$\frac{\frac{\partial MC(0)}{\partial \tau}}{MC\left(0\right)}-\frac{\hat{\epsilon}_{w}\left(0\right)}{\omega}<0,$$

or:

$$\frac{1}{w^{c}-\omega}-\frac{\hat{\epsilon}_{w}\left(0\right)}{\omega}<0,$$

which implies the result. □

This implies two corollaries:

Corollary 7. *If the wage elasticity is negative with optimal transfers, then it is optimal to set* $\tau^{*}=0$.

Transfers have the effect of reducing need and hence increasing the wage elasticity. However, even with transfers if the number of individuals in need after transfers is sufficiently large, then the wage elasticity can be negative. In that case no deterrence is optimal.

Corollary 8. *With a sufficiently high social cost, it will be optimal to have some deterrence.*

This results follows from the fact that as social cost rises, so does the benefit of a transfer. Eventually, the wage elasticity will be positive at $\tau=0$, and with a sufficient high social cost of crime, (29) will be satisfied.