NBER WORKING PAPER SERIES

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THE INCOME EFFECT AND THE OPTIMAL REGULATION OF CRIME

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Working Paper 32805
http://www.nber.org/papers/w32805

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2024

We thanks Ronen Avraham, Bocar Ba, Janet Curre, Ben Enke, Jeff Grogger, Murat Mungan, Nicola Persico, Mitchell Polinsky, Emmanuel Saez and the participants at the 2021 Theoretical Law and Economics Conference, Northwestern University and session participants at the 2022 Society of Labor Economics Annual meeting for helpful comments and discussions. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 32805
August 2024
JEL No. D6,H20,J20,K14

ABSTRACT

Theories of crime in economics focus on the roles of deterrence and incapacitation in reducing criminal activity. In addition to deterrence, a growing body of empirical evidence has shown that both income support and employment subsidies can play a role in crime reduction. This paper extends the Becker-Ehrlich model to a standard labor supply model that includes the notion of a consumption need (Barzel and McDonald (1973)) highlights the role of substitution vs income effects when an individual chooses to engage in crime. Second, we show that whether the production of criminal activity is a substitute or a complement with the production of legitimate activity is central to the design of optimal policy. We find that both individual responsiveness to deterrence and optimal policy vary considerably with context, which is consistent with the large variation in the effect of deterrence on crime. Hence, optimal policy is a combination of deterrence, work subsidies and direct income transfers to the individual that vary with both income and location.

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1. Introduction

The seminal works of Becker (1968) and Ehrlich (1973) model criminal (or illegitimate) activity as a market phenomena, wherein individuals commit crime while weighing the benefits and the costs — the risk of being caught and punished (deterrence), as well as the opportunity cost.[1] The rational choice model has been proven to provide a very useful approach to thinking about crime, and suggesting policies to reduce crime. However, as Chalfin and McCrary (2017) observe, the relationship between deterrence and crime is very unstable and variable.[2] The purpose of this paper is to introduce a simple extension of the Becker (1968)-Ehrlich (1973) model that predicts large variation in the elasticity of response to deterrence as function individual need and observable characteristics of employment opportunities available to individuals. We find that even in the presence of legitimate employment, the impact of deterrence on crime depends upon the extent to which employment is a substitute or complement to criminal activity.

We begin with Ehrlich (1973)'s observation that crime is the consequence of a time allocation decision - how does an individual allocate time between between leisure, income-earning criminal activity and legitimate work.[3] To this model we add two features. First, rather than follow the standard Becker (1968) model to suppose that the primitives of the model are the probability of detection and the size of the fine, we use the Shapiro and Stiglitz (1984) model to transform deterrence into a *tax* on income from crime.

This, in turn, allows the use of a standard labor supply model to focus on the interaction between the income effect and the substitution effects between leisure, crime and legitimate work. In this framework, the elasticity of response to deterrence is the negative of the wage elasticity of criminal labor supply. Next, we follow Barzel and McDonald (1973) and introduce the notion of *consumption need* into otherwise standard King et al. (1988) preferences. Variation in need, in turn, generates large variation in the wage elasticity of labor, from negative (backward bending) to positive.

This simple model provides a framework that ties together a number of results in the literature. It predicts why low-income individuals are particularly susceptible to crime, as Machin and Meghir (2004) find. Second, it is consistent with the findings of Levitt (2004) who finds that incarceration rather than deterrence is a major factor in explaining crime

[1]By "crime" we mean activities that are typically illegitimate (but not necessarily so), and that are socially sanctioned. Here, we follow Ehrlich (1973), and use the term "illegitimate" to mean any activity whose return to the individual is lower than the social return, where the social return is discounted by the utility of the person.

[2]See in particular table 4 of Lee and McCrary (2017).

[3]See for example Lemieux et al. (1994), Grogger (1998), and Williams and Sickles (2002) viewing crime as a labor supply question. Dahl and DellaVigna (2009) provide some direct evidence on how the allocation of time affects crime. They find that violent crime falls when potential offenders are in movie theaters..

reduction. In terms of individual behavior, he also finds that the crack epidemic was a significant factor in explaining variation in crime over time. This is direct evidence of the role of "need" for low-income individuals, and, in that case, a need for income to support an addiction.

We show that this need can be formally captured with a standard labor supply model. When need is introduced into King et al. (1988) preferences, labor supply is backward bending if a person's short run consumption needs must be met via labor income. In other words labor is an inferior commodity or Giffen good. There is a general skepticism that this case is of empirical importance (see Posner (2003), page 5). Yet, "crimes of necessity" are widely recognized in popular culture, politics, and empirical work (Allen (2005); Fishback et al. (2010)).

A possible reason for this view is the lack of data on individuals that face very low returns from labor. Pencavel (2021) shows that early in the 20th century, when real wages for labor were very low, labor supply per year fell as wages rose. As Pencavel (2021) observes, this result is consistent with a negative Marshalian wage elasticity. The fieldwork of Levitt and Venkatesh (2000) shows that the income for criminal work is low. Moreover, drug gangs tend to work in very disadvantaged neighborhoods with poor employment opportunities (see their Table I).

Lemieux et al. (1994) provide some direct evidence the elasticity of criminal labor supply using data from the underground economy in Quebec, Canada. This is labor that avoids paying income tax, and hence is by definition illegal, or criminal. For example, workers in construction might be paid "under the table" for work on house renovations. The elasticities of labor supply from their study are reported in Table (1). Observe that for the low-wage underground economy work, the elasticity of labor supply is *negative* – an increase in the underground wage results in a reduction in labor supply.

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).

Observe that if underground labor has a negative elasticity while the regular sector has a positive elasticity, then this suggests that there is an intermediate case for which the elasticity of labor supply is zero. Keane (2011), in a review of the literature on labor supply elasticities, finds that the Mashallian elasticity of labor supply varies from -0.2 to 0.89 (table 7, Keane (2011)).

We show that if labor supply has zero elasticity over a small range, then it must take the form of King et al. (1988) preferences that assumes utility is log consumption less the cost of labor hours. One can add need to these preferences by supposing individuals have a minimum consumption need $c^0 > 0$, and hence preferences are of the form:

$$U(c,l) = log\left(c - c^0\right) - V(l). \tag{1}$$

where $c^0 > 0$ represents a person's consumption *need* and $V(l)$ is the cost of supplying l units of labor to income earning activities.

Need is a level of consumption that a person believes that they must obtain, either to meet basic consumption needs or fulfill obligations, such as rent or debt payments. In particular, it is a model of *behavior* and not physical need, as in the early efficiency wage models (Lewis (1954)). When a person's consumption is close to their need, they will be willing to work hard to increase their consumption. This can capture the behavior of poor individuals, but it can also capture the behavior of wealthier individuals who have a target consumption need, and hence the model may also provide insights into the behavior of white collar criminals.

Suppose an individual relies only upon criminal income that earns a positive wage $w > 0$ from criminal labor supply l. Then a utility maximizing person will choose labor supply that ensure they satisfy their need, namely $w \times l > c^0$. If an increase in deterrence results in a criminal wage $w^0 < w$ such that they can longer afford to pay for their basic needs ($w^0 \times l < c^0$), then a utility maximizing person will increase their participation in crime.

In this case, the only policy that would reduce criminal labor supply is a transfer t^0 such that $w^0 \times l + t^0 > w \times l$. More generally, an increase in transfers to an individual will always, via the income effect, reduce crime. This result is consistent with a growing body of evidence on the negative relationship between income and crime such as Tuttle (2019) and Deshpande and Mueller-Smith (2022). In this framework, a person is needy if they do not have the resources to cover need ($t^0 - c^0 < 0$), and affluent if they do ($t^0 - c^0 > 0$). With King-Plosser preferences, needy individuals have a negative (backward bending) labor supply elasticity, while affluent individuals have a positive labor supply elasticity.

The model in (1) is extended to case in which the individual chooses to allocate labor time between criminal/illegitimate activity, legitimate work and leisure. A new insight of this framework is that the effect of deterrence on crime depends upon the degree of substitution between criminal and legitimate work, which, in turn, has an impact on optimal crime policy. In some cases crime and legitimate labor are complements. For example, in the Netherlands it is legal (a legitimate activity) to open a cafe where individuals can purchase marijuana.

However, the sourcing of the marijuana is illegal (an illegitimate activity), such that the same distributors distribute other illegal drugs, with the consequence that organized crime has expanded operations in the Netherlands. When the complements effect is sufficiently large, then optimal policy may entail taxing or restricting legitimate activity due to the effect it has on criminal labor supply.

When criminal labor supply is a substitution for legitimate labor, then the other available instruments are wage subsidies and make work programs. It has long been recognized by policy makers that improving employment opportunities is crime reducing (Soares (2004)). Our contribution is to place this policy into a simple integrated framework for crime policy that highlights the trade-off between income support programs, employment support programs and deterrence as a function of the relative returns to these activities.

The agenda for the paper is as follows. The next subsection provides a brief discussion of the literature. Section 2 outlines the labor supply model and how the level of crime varies with deterrence, income transfers and wage subsidies. Optimal crime policy is derived in Section 3. The final section summarizes the results and how they can be used to understand the disparate results in the large literature on crime and incentives.

1.1. **Literature.** This paper builds on the theoretical models of deterrence stemming from Becker (1968) and Ehrlich (1973), which focus on the effect of deterrence (probability and size of punishment) and the attractiveness of legitimate labor as a substitute for criminal activity. The core elements of the Becker-Ehrlich framework are highlighted in reviews of the literature by Machin and Meghir (2004), Nagin (2013), Draca and Machin (2015), Chalfin and McCrary (2017) and Lee and McCrary (2017). They discuss the many theoretical modifications and empirical results in the last five decades. In particular, labor economists have incorporated taxes (Lemieux et al. (1994)), leisure (Grogger (1998)), human capital (Williams and Sickles (2002), Lochner (2004), Deming (2011)), and networks (Calvo-Armengol et al. 2007) into models of criminal choice and deterrence. There is broad evidence for economic conditions and wages influencing crime (Kelly (2000); Raphael and Winter-Ebmer (2001); Yang (2017); Agan and Makowsky (2021)). Additional advancements include incorporating extralegal consequences and social stigma (Nagin and Pogarsky (2001); Durlauf and Nagin (2011)), distinguishing between the probability of arrest and the probability of punishment (Nagin (2013)), incorporating dynamics (Lee and McCrary (2017)), and incorporating the incapacitation effect of arrest (Nagin et al. (2015)).

A notable feature of this large literature is a lack of a consensus regarding the elasticity of crime with respect to deterrence as shown in Figure 1.

This paper puts aside the important role of incarceration, in order to focus upon the labor supply effects of criminal deterrence. While incarceration policy is extremely important,

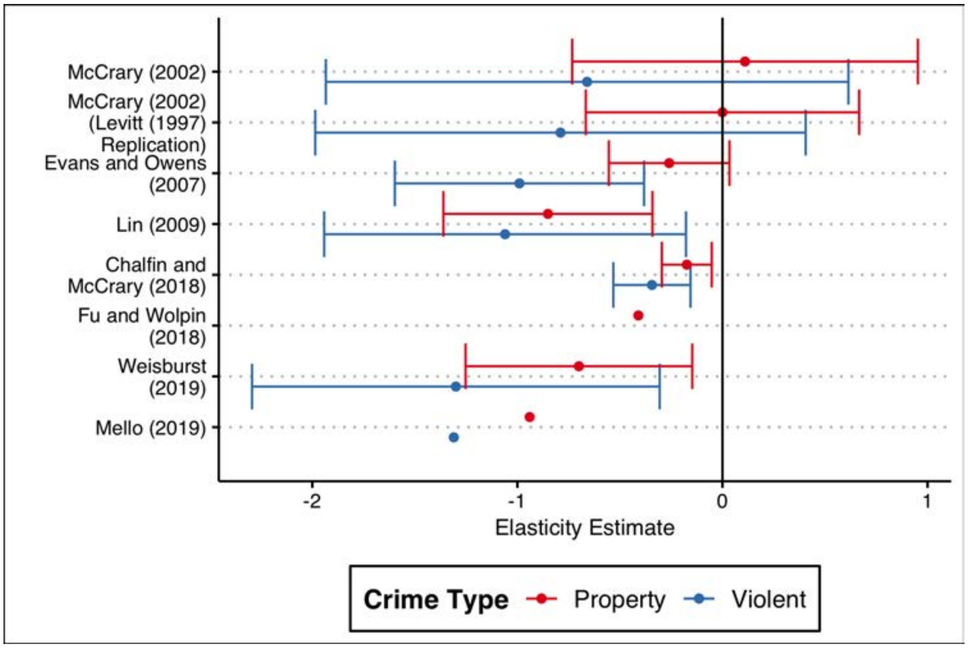

FIGURE 1. Estimates of the Elasticity of Crime with Respect to Police (Deterrence)

even in the US, the relative number of individuals who have contact with the criminal justice system is significantly larger than the number of individuals who are incapacitated in prison for a significant duration: 3% of all adults have been to prison, 8% have a felony conviction (Shannon et al. (2017)), and more than 77 million people in the US have criminal histories (Fields and Emshwiller (2014)), with about 40% of white and 50% of Black men in the US experience an arrest by the age of 23 (Brame et al. (2014)). Our focus, therefore, is on the deterrent effect of sanctions and their effectiveness relative to the alternative policies of income support and employment subsidies.

2. Labor Supply

This section introduces a model of labor supply that incorporates the notion of need and views deterrence as a tax on criminal labor supply. The analysis proceeds in two steps. We begin with the analysis of the leisure/crime trade-off. Then, this model is extended to allow for substitution between illegitimate criminal labor and legitimate labor.

2.1. **Crime versus Leisure.** Consider an individual, i, who chooses how much time, l_i, to supply to the illegitimate criminal labor market — in this subsection, "labor supply" will solely refer to illegitimate labor supply. Labor supply, l_i, need not only be the amount of illegitimate labor (crime), it can also be viewed as the individual's effort applied to such activity (time planning or preparing) or the severity of the activity (e.g., stealing a bag of chips vs. car-jacking).

The individual is assumed to earn w_i from criminal labor that corresponds to the wage after deterrence. In order to have expressions that can be related to the standard elasticity of labor supply, it is assumed that deterrence is a proportional reduction of the wage:

$$w^\tau = \frac{w}{\tau},$$

where $\tau \geq 1$. Observe that one normally uses log wage in regressions, and, with this formulation, we have $\log w^\tau = \log w - \log \tau$. Hence, an increase in deterrence corresponds to a decrease in the intercept in a wage regression and n the individual receiving a smaller share of their ill gotten gains. As shown in the appendix equation (27), this implies that:

$$\epsilon^\tau = -\epsilon^w,$$

the elasticity of deterrence is the negative of the elasticity of labor supply.

Much of the literature follows Becker's original model such that criminal activity affects the probability of detection. When detected, the individual faces a penalty P. In appendix (A), we show that one can use a standard agency model, as in Shapiro and Stiglitz (1984), to model criminal activity over time. The Becker model is equivalent to a labor supply choice in continuous time, with a Poisson arrival rate of detection γ, followed by punishment P. In this case, deterrence is given by:

$$\tau = \frac{w - \gamma P}{w}.$$

Our formulation of deterrence corresponds to any sanction that reduces consumption. For example, being arrested and held in jail reduces consumption as one loses income (legitimate or criminal) while incapacitated or dealing with the legal system. This highlights the fundamental point that the goal of deterrence is to reduce the time that a person allocates to criminal activity.[4]

Hence, individual i's consumption is given by:

$$c_i = w^\tau l_i + t_i, \tag{2}$$

where t_i is the income stream that is independent of labor supply from wealth, the state or the family. For now, we restrict our model to the case of an individual who either cannot obtain a wage from legitimate labor (or additional hours of legitimate work) or whose illegitimate wage is strictly higher than their legitimate wage at any reasonable level of deterrence. In this sense, legitimate work can be subsumed by the initial income stream (t_i). Allowing legitimate labor and wages to change is discussed in section 3. Given the budget constraint in equation

[4] This is consistent with Ehrlich (1973)'s approach to modeling crime. Aneja and Avenancio-Leon (2021) provides direct empirical evidence on the relationship between deterrence and consumption and finds that incarceration reduces access for credit leading to increased crime.

(2), the individual chooses labor supply to maximize utility that takes the following form:

$$U_i(c_i, l_i) = u_i(c_i) - V_i(l_i), \tag{3}$$

where $c_i \geq 0$ represents consumption and total labor supply is given by $l_i \geq 0$. The utility from consumption, with $c \in (c_i^0, \infty)$, is assumed to be twice differentiable, with $u' > 0$ and $u'' \leq 0$ on (c_i^0, ∞). The consumption $c_i^0 \geq 0$ represents the lower bound on a person's acceptable consumption. The cost of effort function, $V(l) \geq 0$, is assumed to be twice differentiable and strictly convex, with $V''(l) > 0$, $V'''(l) \leq 0$ for $l \geq 0$, and $V(0) = V'(0) = 0$.[5]

It is worth observing that the functional form in equation (3) is not only consistent with King et al. (1988) preferences used in macroeconomics, but is also the ubiquitous functional form used in agency theory (Hart and Holmström (1987)). In our context, this functional form results in a single condition that allows one to separate the case where labor supply is upward sloping, or when it is backward bending.

The fixed transfer t_i can be income from wealth, but it is also a potential policy instrument that can be changed by the government through lump sum transfers or taxes. Given a wage w_i and transfer t_i, the individual chooses labor supply. In order for this to be a well defined problem, it must be feasible in the sense that total income is sufficient to pay the minimum consumption need c_i^0. This can be captured in a utility framework with the following definition:

Definition 1. A person has a consumption need c_i^0 if:

$$\lim_{c_i \downarrow c_i^0} u(c_i) = -\infty.$$

We have defined need as a minimal consumption level, and when $c_i > c_i^0$ then the person has sufficient resources to survive, and hence utility is finite. It is natural to think about a need as a level of consumption for which utility becomes unbounded from below as $c_i \to c_i^0$. Accordingly, we define a person's *need* or *neediness* by $n_i = c_i^0 - t_i$, the amount by which a transfer (and legitimate income) falls below minimum consumption. Conversely, a person's affluence is the negative of need, $a_i = -n_i$. We assume that a person's affluence in the absence of government transfers is observable and given by:

$$a_i = t_i^0 - c_i^0.$$

This parameter plays a key role in the subsequent development.

[5]The third derivative is needed to sign the second derivative of labor demand. Note that $V(l) = l^a, a \in (1, 2]$ satisfies this condition. This implies that the function is minimized when $l = 0$. The existence of well defined labor supply does not depend upon V''', but ensuring it is positive implies a unique social optimum. It can be relaxed at the cost of increasing the complexity of the analysis. If $V(l) = al^v$, these conditions are satisfied for $a > 0$ and $v \geq 2$.

Given that utility is increasing in consumption, then consumption is equal to labor income plus transfers, and hence the optimal labor supply is the solution to

$$\max_{l\geq 0} U_i\left(l\right), \tag{4}$$

where

$$U_i\left(l\right) = u_i\left(w^\tau l + t_i\right) - V_i\left(l\right). \tag{5}$$

The assumptions regarding the utility from consumption and cost of labor imply:

Proposition 2. *There is a well defined labor supply function, $l_i^*\left(w^\tau\right)$ solving (4) for $w^\tau > 0$.*

The proofs for this and subsequent propositions are in the appendix. We begin by characterizing preferences that are wage inelastic. It turns out that these preferences have a simple structure that allows for a simple characterization of cases with either upward (increasing with wage) or downward (decreasing with wage) labor supply curves.

Proposition 3. *Labor supply is wage inelastic on an open set of wages not containing the zero wage if and only if it has the form:*

$$u_i\left(c\right) = log\left(c - t_i^0\right). \tag{6}$$

One can easily verify the sufficient condition. Given labor supply l_i, a person's consumption is $c = w^\tau l_i + t_i^0$, hence the utility of the individual is given by:

$$U\left(l_i\right) = log\left(\left(w^\tau l_i + t_i^0\right) - t_i^0\right) - V\left(l_i\right).$$

The optimal labor supply, l_i^0, solves $U'\left(l_i^0\right) = 0$, and it is the unique solution to:

$$\frac{1}{l_i^0} = V_i'\left(l_i^0\right) > 0. \tag{7}$$

Since this solution is independent of the wage, then labor supply is wage inelastic. These are the King et al. (1988) preferences that are widely used in macroeconomics.[6] This result motivates the following specification that allows one to provide a clean condition under which labor supply is either upward or backward bending:

Definition 4. The preference of individual i with need c_i^0 is given by:

$$u_i\left(c\right) = \log\left(c - c_i^0\right).$$

This satisfies the criteria of need since $lim_{c\to c_i^0} u_i\left(c\right) = -\infty$. With these preferences and given affluence $a_i = t_i^0 - c_i^0 - t_i$, or $t_i^0 = a_i - c_i^0$, then labor demand is inelastic if and only

[6] Kimball and Shapiro (2008) provide an alternative axiomatization of these preferences via an assumption they call *scale symmetry*. Their concern is with inter-temporal labor supply, while our focus is upon deterrence and inequality within the period.

if affluence/need satisfies $a_i = n_i = 0$. A person is said to be needy if $a_i < 0$ and affluent otherwise. What is nice about this specification is that whether or not labor supply is upward sloping is completely determined by the level of affluence. When a person is needy, we show that decreasing the wage *increases* labor supply, and hence the Marshallian elasticity is negative. Conversely, when a person is affluent, decreasing the wage *decreases* labor supply.

More precisely, given a wage $w^\tau > 0$, and affluence $a_i = t_i^0 - c_i^0$ the person's utility as a function of labor supply l_i is given by:

$$U(l_i | w^\tau, a_i) = \log(w^\tau l_i + a_i) - V(l_i).$$

What is nice about this specification is that a single parameter, the level of affluence, a_i, determines the elasticity of labor supply and the effectiveness of deterrence. The analysis of the labor supply problem can be simplified if we derive labor supply as a function of *real affluence:*

$$A_i = \frac{a_i}{w^\tau} = \frac{t_i^0 - c_i^0}{w^\tau}.$$

When a person is needy ($n_i > 0$), then $A_i < 0$, and $-A_i$ is the amount of labor hours (or effort) needed to meet basic needs. When a person is affluent ($a_i > 0$), then real affluence is $A_i \geq 0$. It measures how may labor hours the person can purchase at their going wage. In particular, notice that as deterrence increases without limit, the wage approaches zero, and the needy individual becomes increasingly desperate because the amount labor required to meet needs becomes infinite ($\lim_{\tau \to \infty} \frac{n_i}{w^\tau} = \infty$). These effects are captured by the labor supply function:

Proposition 5. *Given a wage $w^\tau > 0$, labor supply can be written as a function of real affluence:*

$$l_i(w^\tau) = l(A_i),$$

where $A_i = \frac{a_i}{w^\tau}$, and the function $l(A_i) > 0$ is the unique solution to:

$$A_i = \frac{1}{V_i'(l(A_i))} - l(A_i). \tag{8}$$

The solution satisfies $l(A) > 0$, $l_A(A) < 0$, $l_{AA}(A) > 0$. The wage elasticity of labor supply with respect to deterrence is equal to the elasticity of labor supply with respect to affluence, and the negative of the wage elasticity:

$$\epsilon^\tau = \epsilon^A = -\epsilon^w. \tag{9}$$

The details of the proof are in Appendix (A.1). The individual's optimal labor supply is found by differentiating equation (4) with respect to the wage, w^τ, and rearranging to get equation (8). The nice feature of this result is that the shape of labor supply is a fixed function of the level of affluence. This relationship is illustrated in figure (2). Given that the marginal cost of effort is zero with zero effort, this implies that for any positive wage there is some labor supply. When a person is not needy ($A_i \geq 0$), then increasing the wage (w_i) decreases affluence ($A_i = \frac{a_i}{w_i}$) and labor supply increases.

Conversely, if the person is needy ($-a_i = n_i = c_i^0 - t_i > 0$), then as the wage decreases and approaches zero, the person becomes less affluent ($A_i = -\frac{n_i}{w_i} \to -\infty$), and labor supply increases without bound. When $a_i = A_i = 0$, then labor supply is independent of the wage hence inelastic since $A_i = 0$. In this case labor supply, $\bar{l}_i$, is the unique solution to $\bar{l}_i = 1/V'\left(\bar{l}_i\right)$.

The figure also illustrates the corresponding wage elasticity of labor supply as a function of affluence.[7]

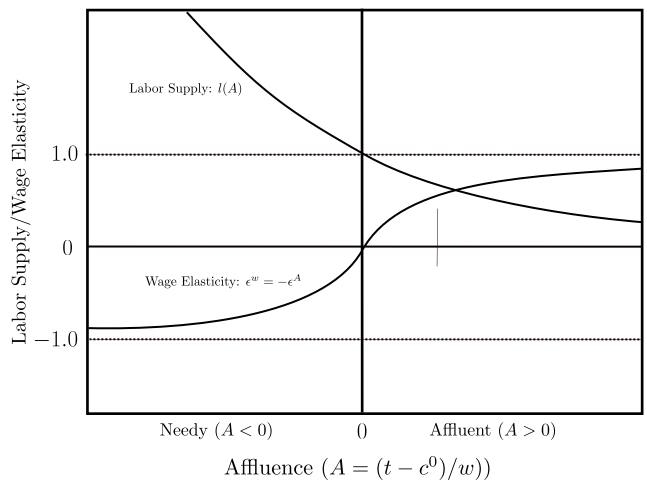

FIGURE 2. Criminal Labor Supply and Wage Elasticity as a Function of Affluence

When viewed as a function of real affluence, labor supply is a smooth, continuous decreasing function of affluence. It captures the *income* effect - increasing the transfer t_i to an individual increases their affluence and hence reduces crime regardless of their original neediness.

The monotonic income effect does not hold for the effect of deterrence. This is illustrated in figure (3). When need is zero, then labor supply is inelastic and fixed at $\bar{l}_i$, that in turn implies that deterrence has no effect on crime. When a person is affluent ($a_i > 0$), labor supply is given by the lower curve. In this case, the elasticity of labor supply is positive, and it becomes increasingly inelastic as the wage rises. Labor supply increases with the wage and asymptotically approaches $\bar{l}_i$, the maximum labor supply for an affluent individual. This is because as the wage increases, $w_i \to \infty$, then affluence approaches zero, $A_i \to 0$, and hence labor supply approaches $\bar{l}_i$.

[7]The figure is draw using $V(l) = l^2/2$. The details for this example are found in MacLeod (2023).

Conversely, for a needy person ($n_i = -a_i > 0$), labor supply has a negative elasticity. An increase in deterrence lowers the wage from crime, resulting in the needy person engaging in more crime to cover their basic needs. This corresponds to a backward bending labor supply curve (as the wages rise, then labor supply falls).[8]

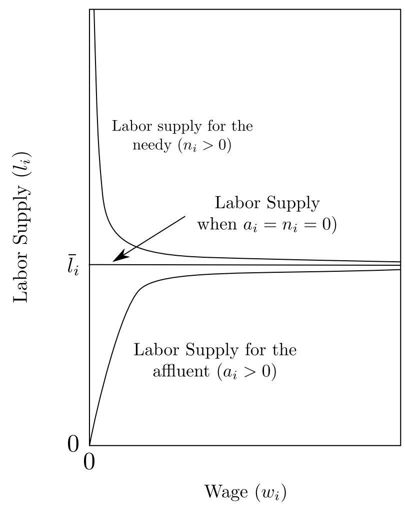

FIGURE 3. Criminal Labor Supply

2.2. **Substitution Effects.** Low unemployment, high wages, and good economic conditions are consistently found to be crime-reducing. This follows from the fact that legitimate labor can be a substitute for crime (Ehrlich (1973)). In this section, we show that the level of criminal activity depends not only on the payoff from both legitimate and criminal labor, but, importantly, whether or not legitimate and illegitimate criminal labor are substitutes or complements.

Let L_i denote a legitimate activity, and let l_i continue to represent the level of the crime. While traditionally viewed as substitutes (one either chooses employment or crime), a feature of many criminal activities is that they may be complementary with legitimate activity, as with the example of marijuana sales in the Netherlands or with legal alcohol sales and illegal drunk driving. Let W_i be the wage for the legitimate activity, and w_i the wage from criminal activity, while a_i is a person's endowment in flow terms. Preferences are given by:

$$u_i\left(\vec{w}_i, \vec{l}_i\right) = \log\left(W_i \times L_i + w_i \times l_i + t_i + a_i\right) - V_i\left(\left(L_i^{\theta} + l_i^{\theta}\right)^{1/\theta}\right), \tag{10}$$

where $\vec{w}_i = \{W_i, w_i\}$ $\vec{l}_i = \{L_i, l_i\}$. Let:

$$f_{\theta}\left(\vec{l}\right) = \left(L^{\theta} + l^{\theta}\right)^{1/\theta},$$

[8]Barzel and McDonald (1973) were the first to point out the fact that need implies a backward bending labor supply curve.

be a CES production function, where $\theta \geq 1$ measures the degree of substitution between activities. We study in detail the cases where the activities are perfect substitutes ($\theta \to 1$) or perfect complements ($\theta \to \infty$).[9] If $\theta = 1$ then $f_1\left(\vec{l}\right) = L + l$, and the model is linear. In that case, it is optimal for the individual to allocate all effort to the activity with the highest wage (perfect substitutes). An increase in θ increases the return to spreading labor between the two activities. When $\theta \to \infty$ this results in the Leontief preferences $f_{\theta=\infty}\left(\vec{l}\right) = \max\{L, l\}$. In that case, the individual allocates effort equally between the two activities, regardless of the relative wages (perfect complements).

In addition to capturing the full range of substitution possibilities between legitimate and criminal activities, the CES production function allows us to aggregate activity levels and wages into a single index. The aggregate measure allows us to distinguish the effect of policy on overall economic activity, separate from the allocation between legitimate and criminal activities.

The labor supply, $\vec{l}^*$,that maximizes utility (10) satisfies (see appendix (A.2) for details of the computations):

$$\left(\frac{l_i^*}{L_i^*}\right) = \left(\frac{w_i}{W_i}\right)^{1/(\theta-1)}. \tag{11}$$

Thus, the ratio of legitimate to criminal activity does not depend upon the shape of the cost of labor function, V_i. For this specification, we can define an aggregate measure of "activity," denoted by $\hat{l}_i$:, and a corresponding wage index $\hat{w}_i$ by:

$$\hat{l}_i = f_\theta\left(\vec{l}\right) = \left(L_i^\theta + l_i^\theta\right)^{1/\theta}. \tag{12}$$

This allows us to view the choice as a two step procedure. In the first step, the individual chooses how to allocate labor between two activities, with a bound on aggregate activity to solve:

$$\max_{\vec{l}_i \geq \vec{0}} \log\left(W_i \times L_i + w_i \times l_i + t_i - c_i^0\right)$$

$$\text{subject to:}$$

$$f_\theta\left(\vec{l}_i\right) \leq \hat{l}_i.$$

[9]Notice that this is a bit different from Arrow et al. (1961), where the CES is used for production. In their case $\theta < 1$. The difference is that labor is a cost in the CES function in our case, while it is an element of productivity in Arrow et al. (1961).

Proposition 6. *The supply of legitimate and criminal labor is given by:*

$$L_i = \gamma^\theta \left(\frac{W_i}{w_i}\right) \hat{l}_i, \tag{13}$$

$$l_i = \gamma^\theta \left(\frac{w_i}{W_i}\right) \hat{l}_i, \tag{14}$$

where $\gamma^\theta(r) = \left[1 + \left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}}$.

This function plays an important role in the subsequent analysis. Notice that $\gamma(r)$ is increasing in r since $\theta > 1$, with:

$$\lim_{r\to 0} \gamma^\theta(r) = 0,$$
$$\lim_{r\to \infty} \gamma^\theta(r) = 1.$$

See Appendix (A.2.1) for additional results.

The next step is to determine the optimal level of aggregate activity $\hat{l}_i$. In order to do this, we need to define a corresponding aggregate "wage", denoted by $\hat{w}_i$ for $\hat{l}_i$ that satisfies the budget constraint:.

$$\begin{aligned}
\text{Labor Income} &= W_i \times L_i + w_i \times l_i, && (15)\\
&= W_i \times \gamma^\theta \left(\frac{W_i}{w_i}\right) \hat{l}_i + w_i \times \gamma^\theta \left(\frac{w_i}{W_i}\right) \hat{l}_i, \\
&= \left(W_i \times \gamma^\theta \left(\frac{W_i}{w_i}\right) + w_i \times \gamma^\theta \left(\frac{w_i}{W_i}\right)\right) \hat{l}_i && (16)\\
&= \hat{w}_i^\theta \times \hat{l}_i, && (17)
\end{aligned}$$

where $\hat{w}_i^\theta$ represents the aggregate wage for activity $\hat{l}_i$.

In other words, when the ratio of legitimate to criminal activity is optimal, then $\hat{w}_i^\theta$ is the return in dollars from engaging in an aggregate activity level given by $\hat{l}_i$. This implies that the optimal activity level can be modeled as a one-dimensional labor supply problem, as studied in section (2). The solution solves:

$$\hat{l}^*\left(\hat{w}^\theta\right) = \arg\max_{\hat{l}_i \geq 0} \log\left(\hat{w}^\theta \times \hat{l}_i + t_i - c_i^0\right) - V_i\left(\hat{l}_i\right).$$

This is formally identical to the one activity problem solved in the previous section. As before, we can define *aggregate* affluence as $\hat{A}_i = \frac{a_i}{\hat{w}_i} = \frac{t_i - c_i^0}{\hat{w}_i}$, and thus we have:

$$\hat{l}^*\left(\hat{w}_i\right) = l\left(\hat{A}_i\right) = l\left(\frac{a_i}{\hat{w}_i}\right). \tag{18}$$

Equations (13-14) imply that, holding total activity fixed, increasing deterrence reduces the relative return of the criminal activity and hence decreases the relative allocation of time to that activity. However, this is only a partial effect. Increasing deterrence also affects total activity. As we can see from equation (18), when a person is needy, decreasing the aggregate wage, $\hat{w}_i$, *increases* total activity. Thus, for needy persons, more deterrence increases the ratio of legitimate to criminal labor via equation (11). The net effect upon crime or criminal activity depends upon the relative size of the substitution effect versus the effect on overall activity. Thus, for needy individuals the net effect of deterrence is *indeterminate*. This can be made more precise in terms of the elasticities of the components of labor supply.

Proposition 7. *The elasticity of crime with respect to deterrence is given by:*

$$\begin{aligned} \epsilon^{\tau} &= -\epsilon^{w}, \\ &= -\left\{\hat{\epsilon}^{\hat{w}} \times \epsilon^{w}\left(\hat{w}^{\theta}\right) + \epsilon^{w/W}\left(\gamma^{\theta}\right)\right\}, \end{aligned}$$

where:

(1) *The elasticity of aggregate labor with respect to aggregate wage is* $\hat{\epsilon}^{\hat{w}} = \frac{d\hat{l}}{d\hat{w}} \times \frac{\hat{w}}{\hat{l}}$.
(2) *The elasticity of aggregate wage with respect to criminal wage is:* $\epsilon^{w}\left(\hat{w}^{\theta}\right) = \frac{d\hat{w}}{dw} \times \frac{w}{\hat{w}} \geq 0$.
(3) *The elasticity of the ratio of crime to legitimate labor with respect to criminal wage is:* $\epsilon^{w}\left(\gamma^{\theta}\right) = \frac{\gamma^{\theta}}{\gamma^{\theta}} \times \frac{w}{W} \geq 0$

This result illustrates ways in which deterrence affects crime. When deterrence increases, then the aggregate wage at the optimal allocation of labor between crime and legitimate activity decreases, and hence $\epsilon^{w}\left(\hat{w}^{\theta}\right)$ is positive. It can be zero in the case of perfect substitutes discussed below. An increase in deterrence makes legitimate labor more attractive, and hence this is also a factor in reducing crime. This is captured via the elasticity $\epsilon^{w/W}\left(\gamma^{\theta}\right)$.

Finally, an increase in deterrence has an ambiguous effect on total activity. The results from section 2.1 apply in this case. When a person is affluent, then an increase in deterrence leads to a fall in the aggregate wage and hence a decrease in crime. However, if a person is needy, then a fall in the aggregate wage leads to an increase in total activity and hence an increase in crime. Deterrence can decrease crime when a person is needy, but this requires the substitution effect towards legitimate work to be larger than the income effect. The point is empirically relevant because it highlights the point that the type of legitimate work that is available can determine the effectiveness of deterrence. We illustrate this point by comparing the case of perfect substitutions to perfect complements.

2.3. **Perfect Substitutes and Complements.** Consider first the case of perfect substitutes. Take wages as fixed and let $\theta \to 1$. In this case the cost of labor supply is $V(l_i + L_i)$ and hence a person allocates all labor to crime if and only if $w_i > W_i$. This immediately implies that:

$$l_i(\vec{w}) = \begin{cases} 0, & w^\tau \leq W, \\ l\left(\frac{t_i^0 + t_i - c_i^0}{w^\tau}\right), & w^\tau > W. \end{cases}$$

This implies that crime is a discontinuous function of deterrence - whenever deterrence satisfies $\tau \geq -W/w$, then there will be no crime.[10]

In the case of perfect complements ($\theta \to \infty$), it is always optimal to set $l_i = L_i$- the level of crime is equal to the level of legitimate activity. The aggregate wage satisfies $\hat{w}_i = \lim_{\theta \to \infty} \hat{w}(w^\tau, W_i) = w^\tau + W_i$, and thus criminal labor supply is given by:

$$l_i(\vec{w}) = \hat{l}_i = l\left(\frac{a_i}{w^\tau + W_i}\right) = l\left(\hat{A}_i\right).$$

The elasticity of crime with respect to deterrence is:

$$\begin{aligned} \epsilon_\tau &= -\epsilon_w \\ &= l'\left(\hat{A}_i\right) \frac{\hat{A}}{w^\tau + W_i}. \end{aligned}$$

Thus, for affluent individuals, $\hat{A} > 0$ and hence $\frac{\partial l}{\partial \tau} < 0$, implying that increasing deterrence reduces total activity, $\hat{l}_i$, including criminal activity. Conversely, for needy individuals, $\frac{\partial l}{\partial \tau} > 0$, and hence an increase in deterrence increases both legitimate and criminal activity.

The implicit assumption in the classic Becker (1968) model is that an increase in deterrence always reduces crime since individuals have access to a legitimate labor market. However, when criminal activity is a complement to legitimate work, then an increase in deterrence can lead to an increase in both crime and legitimate activity for needy individuals.

3. Optimal Policy

In this section we use the labor supply model to derive optimal crime policy that operates via the three instruments: deterrence, transfers to individuals and wage subsidies/make work programs. We consider two cases. First, the case where the individual chooses between leisure and criminal activity. A paradigm example of this is illegal immigration where individuals exert a great deal of effort to migrate, and they work in the underground economy once they arrive. Since they are undocumented then they have no access to legal employment, and hence all labor supply is necessarily "criminal".

We then discuss optimal policy when individuals have available to them legitimate employment opportunities. Here we contrast the policies for the case of perfect substitutes and perfect complements between illegal and legitimate labor supply. In both cases the goal of

[10] As is assumed in the principal-agent literature, when the individual is indifferent legitimate work and crime, they choose legitimate work.

policy makers is to minimize social cost. It is assumed that costs are in dollar terms and that the benefit to individuals is measured in terms of their total income, a variable that is, in principle, measurable. Utility is not directly observable, and hence we measure costs and benefits in dollar terms. If the individual loses a dollar as a result of a policy change, this increases social cost by one dollar.

The policy instruments are summarized by $\pi = \{\tau, s, t\} \in \Pi$, where $\tau > 1$ is deterrence, the employment subsidy is $s \in (0, 1)$ and the transfer is $t \geq 0$. This policy results in a criminal wage of $w^{\tau} = w/\tau$ and a wage from legitimate work of $W^s = W/s$. A person with affluence a_i has affluence $a_i + t$ after the implementation of the policy. Given this policy the individual choose $l_i(\pi)$ hours of criminal activity and $L_i(\pi)$ hours of legitimate work. The social cost function has the following components.

(1) It is assumed that crime creates a cost of w^{sc}. This is the fundamental reason for crime reduction policy:
$$SC_i^{sc} = w^{sc} \times l_i(\pi).$$

(2) The cost of implementing deterrence policy $\tau > 0$ is:
$$SC_i^{\tau}(\pi) = \tau k \times l_i(\pi).$$
As the level of crime increases, this increases deterrence costs in proportion to the amount of deterrence τ.

(3) The cost of a \$1 of transfer to an individual from the government is $1 + \lambda$,where it is typically assumed that $\lambda \cong 0.3$. Individuals receive both direct transfers ($t \geq 0$) and possibly income support (s). This results in a cost:
$$SC_i^{ts}(\pi) = (1 + \lambda)\left(t + \left(\frac{W}{s} - W\right) L_i\right).$$

(4) Individuals earn income from both crime and legitimate activity. Since social welfare values all individuals, including criminals, the total income that is subtracted from social cost:
$$I_i(\pi) = \frac{w}{\tau} l_i(\pi) + \frac{W}{s} L_i(\pi) + t.$$

The goal of policy is to minimize social cost, and we assume there is a policy π that satisfies:

$$\min_{\pi \in \Pi} SC_i(\pi) = \min_{\pi \in \Pi} \left\{ SC_i^{sc} + SC_i^{\tau}(\pi) + SC_i^{ts} - I_i(\pi) \right\}. \tag{19}$$

In the absence of any policy, denoted by $\pi^0 = \{1, 1, 0\}$, if there is some crime, $l_i(\pi^0) > 0$, then it is assumed that the cost of crime, w^c, is sufficiently high then it will also pay to have some crime reducing policy. In the following discussion, it is assumed that this is the case, so that optimal policy will have the feature $\pi^* \neq \pi^0$.

3.1. **Optimal Policy with Weak Labor Market.** Consider first the case where there is no attractive legitimate work available for the individual. There are a number of reasons that this might be the case. For example, the person might be an undocumented non-citizen, a low-skilled felon, or simply live in a area with very little work. The first order conditions for the social cost minimizing deterrence imply:

Proposition 8. *When it is efficient to have deterrence τ^*, then it satisfies:*

$$\epsilon^w\left(\tau^*\right) = \frac{\tau \times MC_\tau\left(\tau^*\right)}{MC\left(\tau^*\right)}, \tag{20}$$

where $\epsilon^w(\tau)$ is the wage elasticity of criminal labor supply, the marginal cost of crime is $MC(\tau) = (w^{sc} - w^\tau) + \tau k$. If $\epsilon^w(0) \leq \frac{k+w}{w^{sc}-w+k}$ then it is not efficient to deter crime.

The right hand side of (20) is always positive under the hypothesis that crime is not socially efficient ($w^{sc} > w$), hence it can never be satisfied for needy persons for whom the elasticity of criminal labor supply is negative. In particular, if the wage elasticity is not greater than the relative benefit, $\frac{\tau \times MC_\tau(\tau^*)}{MC(\tau^*)}$, then no deterrence is optimal. The solution is illustrated in Figure (4). Since it is the norm in labor economics to focus on log wage, we plot the elasticities against log deterrence. As one can see, when the social cost of crime (w^{sc}) rises or the cost of deterrence (k) falls, this increases the relative benefit of deterrence, resulting in deterrence going from τ^{*L} to τ^{*H}.

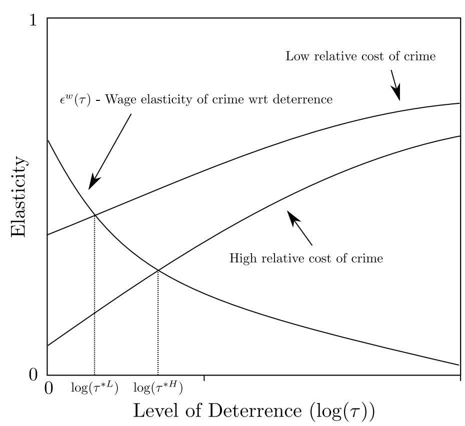

FIGURE 4. Optimal Level of Deterrence when $\epsilon^w > 0$

When individuals are needy, increased deterrence is counter-productive. In the absence of labor market opportunities, optimal policy is restricted to income transfers. Since the income effect always has a negative employment effect then increasing transfers decreases crime, regardless of need. In practice, deterrence is always positive and significant. Let us suppose that deterrence τ is given and that transfers are chosen optimally. Since transfer are typically made via the income tax system, we suppose that the authorities observe affluence a_i, and set transfers as a function of a person's affluence, given by $t(a_i)$.

The optimal transfer as a function of a person's affluence is given by the following proposition:

Proposition 9. *Given deterrence τ,the optimal transfer is:*

$$t^{\tau *}(a_i) = \max\left\{0, A^*(\tau) \times w^{\tau} - a^0\right\}, \tag{21}$$

where optimal real affluence $A^*(\tau)$ is the unique solution to:

$$l'(A^*(\tau)) = -\frac{\lambda w^{\tau}}{(w^{sc} - w^{\tau} + \tau k)}. \tag{22}$$

Moreover, optimal affluence is increasing in deterrence ($dA^*(\tau)/d\tau > 0$), and hence if there are positive transfers, $t^* > 0$, an increase in deterrence results in an increase in the optimal transfer. Similarly, an increase in the cost of crime, w^{sc}, leads to an increase in optimal affluence A^*, and hence an increase in transfers.[11]

There are two useful implications of this result. The first is that transfers and deterrence are *complements.* If policy makers wish to reduce overall crime by increasing deterrence, then at the same time it is optimal increase income support programs. Second, we use this result to derive optimal policy for a population of individuals with different levels of affluence, $a_i = t_i^0 - c_i^0$ that is distributed $a_i \sim f(a_i)$. Proposition 9 implies that optimal transfers would bring all individuals up to some minimum level of affluence. We suppose that feasible policy takes the form of deterrence and a means-tested transfer: $\pi = \{\tau, t(a_i)\}$. We now derive the population level optimal policy that solves:

$$\min_{\pi} E\{SC_i(\pi)\} = \min_{\pi} \int_{-\infty}^{\infty} SC_i(\tau, t(a_i)) f(a_i) \, da_i.$$

where person i gets a transfer $t^{\tau}(a_i)$ given by proposition 9.

Proposition 10. *The first order condition for optimal deterrence (τ^*) with optimal transfer policy ($t^{\tau *}(a_i)$) is given by:*

$$\hat{\epsilon}^w = \frac{\tau^* \times MC_{\tau}(\tau^*)}{MC(\tau^*)},$$

where is the average wage elasticity of criminal labor supply, weighted by the fraction of crime committed by individuals with affluence a_i is $\hat{\epsilon}^w$.

The definition of $\hat{\epsilon}^w$ is given by appendix equation (48). The optimal transfer and deterrence policy satisfies a generalized version of the single person optimal policy (20). The

[11]Note that this cutoff can be positive or negative. Countries with large social support programs tend to have low crime, such as Scandinavian countries. See Soares (2004) for some evidence on cross-country differences in crime.

solution has a number of features worth highlighting. The first is that optimal transfers ensure that all individual achieve a minimum level of real affluence $A(\tau*)$. This result implies that optimal crime policy leads to lower inequality without requiring an explicit equity goal.

Second, even though there are transfers to the most needy, crime is still most highly concentrated among the most needy persons. If the cost of crime, w^{sc}, rises, then this would lead to higher optimal deterrence and more equality. The latter follows from the fact that deterrence and the level of optimal real affluence, $A^*(\tau)$ are complements. Another policy to address crime among the most needy is to improve legitimate employment opportunities for this group. The next section addresses this question.

3.2. **Optimal Policy when Legitimate Employment is Available.** In this section, we turn to the role that legitimate labor plays in crime policy. We put aside the issue of transfers under the hypothesis that optimal transfers are being supplied, which in turn allows us to consider the trade-off between deterrence, τ, and legitimate wage subsidies, s, that result in a legitimate wage $W^s = W/s$. It turns out that the degree of substitution, θ, between criminal and legitimate and criminal labor supply plays a crucial role in determining optimal policy. We consider optimal policy for the two extremes, perfect substitutes and perfect complements. Intermediate levels of substitution are simply combinations of these extreme policies.

Perfect Substitutes. When crime and legitimate work are perfect substitutes, the individual will allocate all labor to the activity with the highest wage. Let us suppose that in the absence of an intervention individual i specializes in crime ($w > W$). Further suppose that the cost of crime is sufficiently high that deterring crime is optimal. This case corresponds to the observation in Becker and Stigler (1974) that perfect enforcement can be implemented. This is achieved with deterrence $\tau^* = w/W$. In this case, the individual is indifferent between crime and legitimate labor, and we can suppose that deterrence is set slightly higher so that there is no crime. In the absence of crime, the marginal enforcement cost is zero, and the social cost is given by the income lost individual i suffers due to deterrence:

$$SC^{\tau*} = (w - W)\, l\left(\frac{a_i}{W}\right),$$

where a_i is individual $i's$ affluence. A wage subsidy can achieve the same outcome by setting $s^* = W/w$, so that the individual chooses legitimate work over criminal work. In this case the individual's income is unchanged, and thus the social cost is given by the social cost of government funds:

$$SC^{s^*} = \lambda\,(w - W)\, l\left(\frac{a_i}{w}\right).$$

Observe that a wage subsidy is optimal if and only if $SC^{s^*}/SC^{\tau^*} < 1$, from which the following proposition is immediate:

Proposition 11. *When crime and legitimate work are perfect substitutions, then a wage subsidy is strictly preferred to deterrence if and only if:*

$$\lambda < \frac{l\left(\frac{a_i}{W}\right)}{l\left(\frac{a_i}{w}\right)}. \tag{23}$$

It is normally supposed that the social cost of funds $(\lambda) \cong 0.3$, and hence when a person is needy $(a_i < 0)$, the fact that $w > W$ implies:

$$l\left(\frac{a_i^*}{W}\right) > l\left(\frac{a_i^*}{w}\right) > 0,$$

hence (23) is satisfied, and a wage subsidy is the preferred policy. In particular, as in the one activity case, deterrence can only be optimal for affluent individuals Suppose a_i^* satisfies $\lambda = \frac{l\left(\frac{a_i^*}{W}\right)}{l\left(\frac{a_i^*}{w}\right)}$, then for $a_i > a_i$ it is efficient to use deterrence. Thus the perfect substitutes case provides a policy recommendation that has a similar solution as the case with no legitimate labor: for needy individuals transfer programs are the more efficient crime reducing policy. Deterrence remains an effective policy for sufficiently affluent individuals.

Perfect Complements. The case of perfect complements is quite different. In this case, even if the legitimate wage, W, is less than the criminal wage, w, the individual chooses to allocate equal amounts of time to criminal and legitimate labor. As shown above, the aggregate wage is given by $\hat{w} = w + W$, while criminal labor supply from an individual with affluence a_i is:

$$l_i = l\left(\frac{a_i}{w + W}\right).$$

In this case, we can let the policy variables be the return from crime, $w^\tau \leq w$, and a subsidy for legitimate work, $W^s \geq W$. Using the fact that the level of legitimate and criminal labor is the same, the social cost of crime can now be written as:

$$SC_i = \left(w^{sc} + \tau k + (1+\lambda)\left(\frac{W}{s} - W\right) - w^\tau - W^s\right) l\left(\frac{a_i}{w^\tau + W^s}\right)$$

The question we now ask is: starting with no intervention, $\tau = s = 1$, does the social cost fall if one increases deterrence or the wage subsidy? This is found by evaluating the sign of the effect of policy on social cost. In the appendix, we show:

Proposition 12. *Let $MC^0 = (w^{sc} + k - (w + W)) > 0$ be the marginal cost of crime in the absence of deterrence or a wage subsidy. It efficient to increase deterrence if a person is sufficiently affluent with wage elasticity satisfying:*

$$\epsilon_i^{\hat{w}} > \frac{\hat{w}}{MC^0}\left(k/w + 1\right). \tag{24}$$

It is efficient to subsidize legitimate labor if a person is sufficiently needy with a wage elasticity satisfying:

$$\epsilon_i^{\hat{w}} < -\frac{\lambda \hat{w}}{MC^0} \tag{25}$$

In the case of perfect complements, authorities can only control total activity. When individuals are affluent, if crime is sufficiently expensive, it is efficient to reduce both crime and legitimate activity. This is achieved with deterrence that solves (10).

However, the wage elasticity of labor supply is negative for needy individuals, which implies that (24) cannot hold, and hence optimal policy may include an employment subsidy when (25) is satisfied. In this case, the employment subsidy will total activity and hence crime.

4. Discussion and Conclusion

This paper builds upon Ehrlich (1973)'s point that crime is the result of a time allocation decision by individuals. The goal of deterrence is to decrease a person's time spent in criminal labor supply. We show that whether or not this is an effective policy depends upon both a person's affluence, as measured by their disposable income less consumption need, and the degree of substitution between crime and legitimate labor.

Our goal is to highlight how variation in an individual's situation can lead to very different optimal crime policies. We add two ingredients to the canonical crime model: consumption need and the elasticity of substitution between crime and legitimate activity. The consequence is a simple model that highlights the role that these two factors play in explaining the large observed variation in crime to policy changes.

4.1. **Why Deterrence Can Be Ineffective.** Becker and Stigler (1974) made the point that enforcement is expensive, hence the problem of crime and malfeasance can be addressed by increasing the efficiency of the enforcement system through higher punishments and higher rewards to enforcers. Our first point is that there are situations where deterrence is simply ineffective. A paradigm example is drug addiction that can lead to street crime through "one-off 'acts of desperation'" (Allen (2005)). Levitt (2004) shows that much of the variation in crime in the 1980s is due to the crack epidemic. Stam et al. (2024) provides direct evidence on income and crime, showing that a welfare recipient's propensity to commit crime increases as they approach their next welfare payment as the money from the previous payment starts to run out.

A related example is the policy of coca eradication, through which governments destroy large swaths of coca farms in South America, such as Colombia, in order to reduce cocaine supply. ICG (2021) find that this policy was largely a failure. The policy destroyed coca farmers' income without a corresponding alternative income stream or transfer. It simply drove them into desperation and increased the ability of cartels to pressure them. Reyes (2014) finds that coca eradication *increased* coca cultivation with an elasticity close to 1; Mejia et al. (2017) shows eradication via aerial spraying to be highly destructive but have a relatively small effect on cultivation and massive costs relative to benefits.[12]

4.2. **Dysfunctional Employment Policies.** A reason that deterrence can be ineffective is that individuals do not have attractive alternatives to pursue. Our second point is that both deterrence and legitimate work policies need to be coordinated. When legitimate work is a complement to criminal activity, then deterrence may not be effective. Additionally, since transfers reduce both legitimate and illegitimate activity among the affluent, higher transfers to the affluent may mean less crime but also less labor, consistent with the evidence of cash transfers on employment (see Vivalt et al. (2024)).

Schnepel (2018) finds that employment opportunities in higher wage industries like construction and manufacturing, where there is limited opportunity for crime, significantly reduce recidivism, while opportunities for lower wage jobs retail and food service do not. Similarly, Davis and Heller (2020) show that some youth summer employment increases future property crime, which the authors ascribe to employment increasing opportunities for some forms of criminal activity.

Financial advisor misconduct is another prime example of complementarities between legitimate and criminal work. Egan et al. (2019) find that over 7% of financial advisors have at least one reported disclosure of misconduct. Yet, they also find that advisors who commit misconduct are fired and re-hired by other firms which seemingly specialize in misconduct.

Shipping is an industry for which crime in the form of theft of products being transported has long been an issue. The innovation of containers has greatly reduced theft, but it has introduced other activities that are complementary with crime. Russo (2014) shows that increases in legitimate shipping without increased enforcement or inspections likely led to an increase in cocaine smuggling, as the activities are complementary. Increasing inspections would deter smuggling but would also raise costs for the legitimate activity, thereby reducing legitimate shipping. Furthermore, transfers would decrease the legal and illegal shipping activity – though transfers to suppliers may reduce supply (as discussed above with respect to cocoa eradication). Figure (5) illustrates this complementarity, displaying the negative relationship between the price of cocaine in cocaine importing countries and the country's ratio of imports to GDP.

[12]A growing literature focusing on Mexico and Brazil has found heavy-handed and aggressive anti-crime initiatives to actually increase violent crime (Calderón et al. (2015); Flores-Macías (2018)). Bullock (2021), for example, finds that a reduction in police raids in Brazil reduced violent crime because unpredictable and highly violent raids forced criminals to be more violent and on-edge for self-protection.

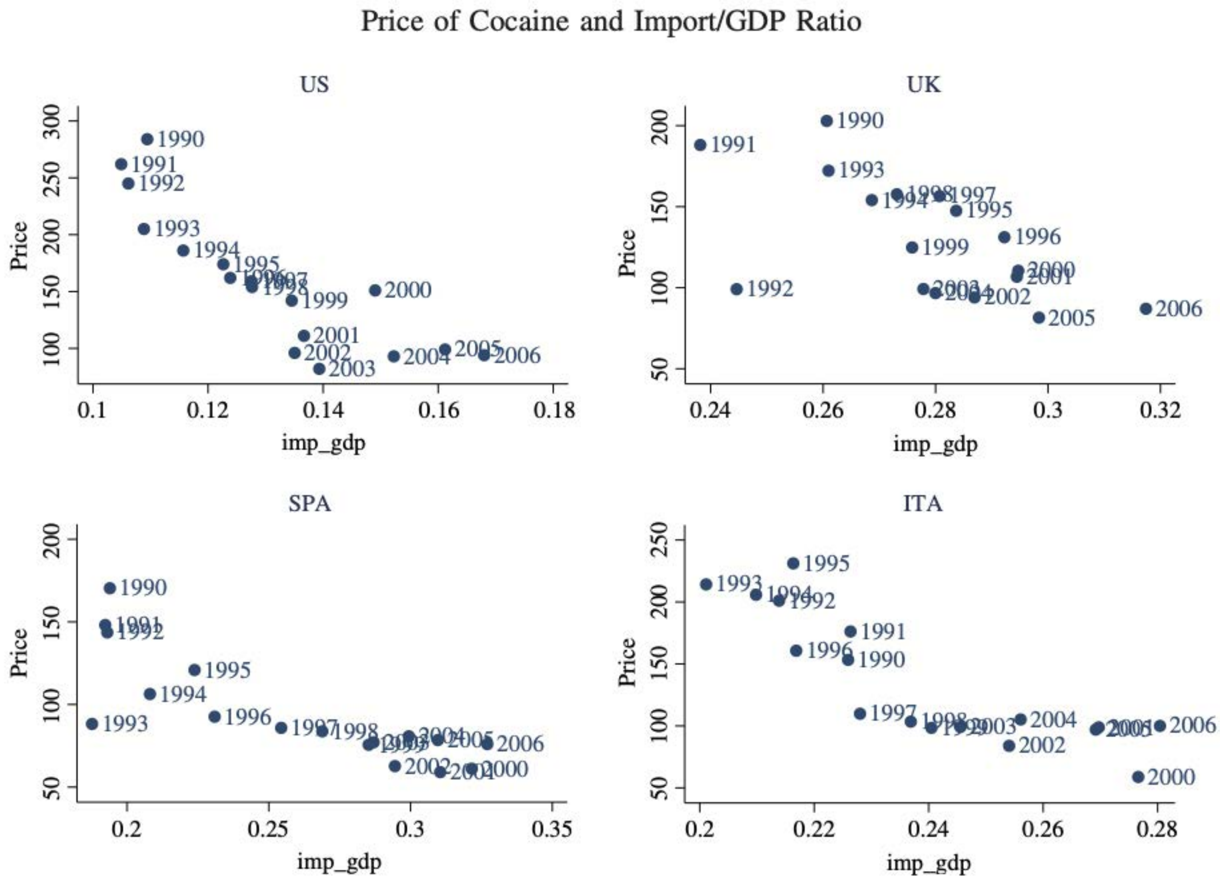

FIGURE 5. Price of Cocaine and Import/GDP Ratio
Source: Russo (2014)

As mentioned above, in the Netherlands, the consumption and sale of soft drugs, such as marijuana and hashish, is not legal but tolerated ("gedoogbeleid"). In principal, this half-way policy seems like an enlightened approach to drugs with little social and individual harm.[13] However, it introduces perverse results due to complementarities. Because the 'coffee shops', which sell soft drugs, are legal, but obtaining the drugs is illegal (i.e., production, transportation, etc.), this means that the policy induces strong complementarities between the legitimate activity (demand) and the criminal activity (supply). As a result, all supply is performed by criminal enterprise, who then invest in criminal production and shipping networks and violence to protect territory and influence critics and officials.[14] This has contributed to the Netherlands being a hub for cocaine production and shipment for international drug trafficking and the site of an increasingly dire situation with powerful drug gangs — who

[13] https://www.politico.eu/article/the-dark-dangerous-side-of-dutch-tolerance/
[14] See https://www.france24.com/en/europe/20211002-dutch-pm-under-protection-as-the-mocro-mafia-drug-cartel-sows-fear-in-the-netherlands and https://youtu.be/Ig5uP2R_9bg

have assassinated lawyers, informants, and in 2021 caused the prime minister to be put under special guard.[15] Either making consumption illegal or supply legal would significantly damage this criminal enterprise as they would remove the complementarity between criminal enterprise and legitimate activity.

4.3. **Making Deterrence More Effective.** The analysis highlights two types of policies that are effective at reducing crime. Our starting point is to show that in a standard labor supply model the elasticity of crime with respect to deterrence varies greatly with a person's affluence. Moreover, the income effect is always negative: transfers to individuals always reduces activity levels and crime. This result is consistent with the evidence on targeted income support program such as SNAP (Tuttle (2019)) and SSI (Deshpande and Mueller-Smith (2022)). They show transfers significantly reduce income generating crime, while cash transfers to the relatively affluent have no such effect (Watson et al. (2020)). Beyond direct monetary transfers, welfare in the form of healthcare can also reduce criminal activity (Jácome (2020); He and Barkowski (2020); Aslim et al. (2020)).

The importance of compensation has long been recognized as an ingredient to reduce bureaucratic corruption (Flatters and Macleod (1995)). Van Rijckeghem and Weder (2001) find that there is a negative relationship between pay and bureaucratic corruption in a large sample of low income countries. More generally, deterrence is more effective if individuals have attractive and feasible alternatives, consistent with the large literature that has shown that improved employment opportunities reduces crime (Grogger (1998); Raphael and Winter-Ebmer (2001); Yang (2017); Rose (2018); Dell et al. (2019); Rege et al. (2019); Kelly (2000); Agan and Makowsky (2021)).

4.4. **Providing Attractive Alternatives.** Finally, we discussed the role that improving alternatives can play in reducing crime. The challenge is that employment opportunities are more limited for the least skilled individuals, who are also the population most likely to be engaged in crime. After the Great Depression in the 1930s, Fishback et al. (2010) shows that New Deal work relief programs reduced property crime. At the time there were many unskilled workers for whom manual work was an attractive option. Today, the challenge is to provide attractive alternatives that are feasible.

This can be very difficult due to the high cost of accumulating the appropriate human capital. Sviatschi (2022) shows that in Peru, early childhood exposure to working in coca production later led to a higher likelihood that a person would choose a life of crime. Similarly Lochner (2004, 2011) shows that more education leads to less crime. In both cases, human capital investments increase the opportunities for individuals to engage in attractive

[15]https://www.nytimes.com/2021/09/30/world/europe/netherlands-prime-minister-threats.html

legitimate employment. Conversely, the use of incarceration for deterrence results in individuals investing in human capital that is complementary with time in prison. Such investments increase the cost of providing legitimate skills for released individuals so that they can find attractive legitimate work.

More generally, we need better dynamic models of crime. Mungan (2010) highlights the role of learning by offenders. Galenianos et al. (2012)'s search model of the drug trade illustrates how enforcement policy interacts with the strategies used by buyers as they learn about drug dealers. Lee and McCrary (2017) emphasize the impact that incareration has on the re-entry into the labor market and hence the incentive to offend. Dobbie et al. (2018) show that pretrail detention has a significant impact upon future income and employment. In general, these dynamics are complex - some 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 it to provide a simple framework that can motivate an approach that integrates a number of policy levers to improving the rule of law.

Finally, one of the core features of optimal crime policy is income transfers that ensure all individuals achieve a minimum level of affluence. Thus optimal crime policy alone implies that there is a returns from reduced inequality. A related topic we did not address is the incentives for crime provided by high inequality. The existence of many wealthy individuals creates many employment opportunities for criminals. Individuals who live in poor regions, particularly needy individuals, have an incentive to allocate time and effort to acquiring access to this wealth, either through online scams, or migration. The experiences of Chinese immigrants documented in Keefe (2010) illustrate that needy individuals are willing to exert extra-ordinary amounts of effort to migrate to the United States. This paper highlights the point that optimal policy entails the coordination of a number of instruments and that simple prescriptions, such as increasing deterrence, will not by themselves be successful. Our results suggest that more work is needed to measure the causal effect of different interventions and develop ways for more highly coordinated policies to address crime.

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Appendix A. Propositions, Proofs and Derivations Model of Jean Valjean Effect

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 market wage. In the Becker model of deterrence, if an individual chooses to offend, then she faces a probability p of a punishment f (see footnote 16 of Becker (1968)). We can translate this into a flow of offenses using the Shapiro and Stiglitz (1984) model.

Suppose that the individual has a single criminal activity, and that effort in that activity is given by l_i per unit of time, resulting in criminal income of $w \times l_i$ per unit of time. Time is divided into small intervals of length $\Delta > 0$. During a period Δ, the probability of detection is given by $\Delta\gamma l_i$, where γ is the Poisson parameter. A higher level of activity results in the individual facing a higher probability of detection. When caught, a penalty P is paid that is proportional to time allocated to crime. This model is appropriate to habitual criminal activity, such as prostitution or shop lifting, where individuals pay a penalty, either a fine or short time in jail, and then continue with the activity. Suppose that the individual's discount rate is r, and that the process is stationary. The utility from criminal labor supply is the solution to the following dynamic program:

$$U_t = \Delta \left(\gamma l_i u \left(w l_i - P - n_i\right) + \left(1 - \gamma l_i\right) u \left(w l_i - n_i\right)\right) + e^{\Delta r} U_{t+\Delta}. \tag{26}$$

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

$$\begin{aligned}
\frac{1-e^{-\Delta r}}{\Delta} U_t &= u\left(wl_i - n_i\right) + \gamma l_i \left(u\left(wl_i - P - n_i\right) - u\left(wl_i - n_i\right)\right), \\
&\cong u\left(wl_i - n_i\right) - \gamma l_i P \frac{du\left(wl_i - n_i\right)}{dc}, \\
&\cong u\left(wl_i - \gamma l_i P - n_i\right) \\
&= u\left(w_i l_i - n_i\right),
\end{aligned}$$

where $w_i = w - \gamma P$ is the net return from criminal effort. If we let $\Delta \rightarrow 0$ then we get:

$$\begin{aligned}
rU_t &= u\left(\left(w - \gamma P\right) l_i - n_i\right) - V_i\left(l_i\right), \\
&= u\left(w_i l_i - n_i\right) - V_i\left(l_i\right).
\end{aligned}$$

Since multiplying utility by a constant does not change preferences, which expression corresponds to the static model given by equation (5).

Without loss we do a change of variables and let deterrence be defined by\tau

$$\begin{aligned}
\tau &= \frac{w_i}{w}. \\
&= \frac{w - \gamma P}{w}
\end{aligned}$$

When $\tau = 1$ there is no deterrence, while $\tau > 1$ implied positive deterrence, while $\tau < 1$ is a subsidy to individuals. This formulation is convenient because it allow us to relate the elasticity of deterrence to the elasticity of labor with respect to wage:

$$\epsilon^w = \frac{dl_i\left(w\right)}{dw} \times \frac{w}{l_i}.$$

The corresponding elasticity with respect to deterrence is:

$$\begin{aligned}
\epsilon^\tau &= \frac{dl_i\left(w_i\right)}{d\tau} \frac{\tau}{l_i} \\
&= \frac{dl_i\left(w_i\right)}{dw_i} \times \frac{dw_i}{d\tau} \times \frac{\tau}{l_i} \\
&= \frac{dl_i\left(w_i\right)}{dw_i} \times -\frac{w}{\tau^2} \times \frac{\tau}{l_i} \\
&= -\epsilon^w.
\end{aligned} \tag{27}$$

This allows us to relate the elasticity of deterrence to the wage elasticity. In the literature one will also report the elasticity of deterrence, as measured by γP. Using this fact and

$\frac{w}{\tau} = w - \gamma P$ we have:

$$\begin{aligned}
\epsilon^{\gamma P} &= \frac{dl_i(w_i)}{d\gamma P}\frac{\gamma P}{l_i}, \\
&= \frac{dl_i(w_i)}{dw_i} \times -\frac{\gamma P}{l_i} \\
&= -\epsilon^{w} \times \frac{l_i}{w_i} \times \frac{\gamma P}{l_i} \\
&= \epsilon^{\tau} \times \frac{\gamma P}{w_i}, \\
&= \epsilon^{\tau}(\tau - 1).
\end{aligned}$$

Thus the elasticity of response to punishment γP is the elasticity wrt τ times $(\tau - 1)$.

A.1. **Derivations for Section 2.**

> **Proposition-2:** There is a well defined labor supply function, $l_i^*(w_i)$. solving (4) for $w_i > 0$.

Proof. Let $\bar{l}$ be any labor supply choice resulting in feasible consumption $c = w_i\bar{l} + t_i > c_i^0$. Next, define the set of labor supply choice providing utility at least as great as at l:

$$G_i(\vec{x}_i, \bar{l}) = \left\{\hat{l}|U_i\left(\hat{l}\right) \geq U_i(\bar{l})\right\},$$

where:

$$U_i(l) = u_i(w_i l + t_i) - V_i(l).$$

The fact that V_i is unbounded and continuous, while u_i is strictly concave, implies that $G(\vec{x}_i, \bar{l})$ is a compact set. Hence, the the optimal labor supply is given b

$$l_i^*(w_i, t_i) = \arg \max_{l \in G_i(\vec{x}_i, l)} U_i(l).$$

If it happens that $\bar{l} = l_i^*(w_i, t_i)$, then the strict concavity of U_i implies that G_i is a single point. In that case the fact that the set of feasible allocations is open, means that one can find a new $\bar{l}$ in the neighborhood of the old choice, resulting in a set G_i such that $l_i^*(w_i, t_i)$ is in the interior for G_i. Since $V'(0) = 0$ then $l_i^* \neq 0$ for $w_i \neq 0$. From this and an inspection of the first order conditions for the optimum implies that labor supply is a continuous function of the wage. If $t_i = 0$, then $l_i = l_i^0$ is the optimal solution as defined by (7). ☐

The next proposition is a formal statement and proof of the necessary conditions for proposition (3).

> **Proposition-3:** Let W be an open subset of $\Re_{++}$ Suppose the labor supply function is inelastic ($\frac{dl_i^*(w)}{dw} = 0$) on this set then the preference for consumption is represented

by:

$$u_i(c) = log(c - t_i). \tag{28}$$

Proof. The first derivative of (5) with respect to the wage implies that for $w \in W$ labor supply satisfies:

$$u_i'(wl_i^*(w) + t_i)w_i - V'(l_i^*(w)) = 0.$$

The assumption that labor supply is wage inelastic implies we can take the derivative of the first order condition to get:

$$0 = u_i'(wl_i^*(w) + t_i) + u_i''(wl_i^*(w) + t_i)l_i^*(w)w.$$

Letting $c = l_i^*(w)w$, and then we have:

$$u_i''(c + t_i)c + u_i'(c + t_i) = 0,$$

and thus:

$$\frac{d\log(u_i'(c + t_i))}{dc} = -\frac{1}{c}.$$

The solution to this implies for some constant α':

$$\log(u_i'(c + t_i)) = -\log(c) + \alpha' = \log\left(\frac{1}{c}\right) + \alpha'.$$

Take this expression to the power e and let $\alpha = \exp(\alpha') > 0$:

$$u_i'(c + t_i) = \frac{\alpha}{c}.$$

Let $\tilde{c} = c + t_i$ and hence:

$$u_i'(\tilde{c}) = \frac{\alpha}{\tilde{c} - t_i},$$

and for some $\beta \in \Re$ then:

$$u_i(\tilde{c}) = \alpha\log(\tilde{c} - t_i) + \beta.$$

However, von Neumann-Morgenstern preferences are invariant under positive affine transformations, so this is equivalent to:

$$u_i(\tilde{c}) = \log(\tilde{c} - t_i).$$

□

The next proposition is a general version of proposition (5) where $l^+(w_i)$ corresponds to solution for (5).

Proposition-: Labor supply can be written in the form:

$$l_i(w_i) = l(A_i),$$

where $A_i = -\frac{n_i}{w_i}$, and the function $l(A_i) > 0$ is the unique, decreasing solution to:

$$A_i = \frac{1}{V_i'(l(A_i))} - l(A_i).$$

The wage elasticity of labor supply is equal to the negative elasticity of labor supply with respect to affluence

$$\epsilon^w = -\epsilon^A.$$

Proof. The first order condition for labor supply satisfies:

$$\frac{1}{(w_i l_i - n_i)} w_i - V'(l_i) = 0. \tag{29}$$

$$\frac{n_i}{w_i} = -A_i = l_i - \frac{1}{V'(l_i)} \equiv g(l_i). \tag{30}$$

Since $V'(0) = 0$ then we have $\lim_{l \to 0+} g(l) = -\infty$ For $l_i > 0$ the strict concavity of V_i implies that $g' > 0$,(details below) while $lim_{l_i \to \infty} g(l_i) = \infty$. This ensures that g is invertible for $l_i > 0$ and hence $l(A_i)$ is well defined for $A_i \in \Re$ and strictly decreasing.

Next, observe:

$$g'(l) = 1 + \frac{V''(l)}{(V'(l))^2} > 0$$
$$g''(l) = -2\frac{V''(l)V'(l)}{(V'(l))^3} + \frac{V'''(l)}{(V'(l))^2}.$$

Since $V''' \leq 0$, then we have $g'' < 0$. We can compute the consequence for the derivatives of $l(A)$. Hence from (30):

$$-1 = g'(l(A))\, l_A(A),$$

from which it follows that $l_A < 0$. Next we have:

$$0 = g'(l(A))\, l_{AA}(A) + g''(l(A))\, l_A(A),$$

and thus since $g'' < 0$:

$$l_{AA}(A) = -g''(l(A))\, l_A(A) / g'(l(A)) > 0.$$

The wage elasticity is given by:

$$\begin{aligned}
\epsilon^{w} &= \frac{dl_i}{dw} \times \frac{w}{l_i} \\
&= \frac{dl\left(A\right)}{dw} \times \frac{w}{l} \\
&= \frac{dl\left(A\right)}{dA} \times \frac{dA}{dw} \times \frac{w}{l} \\
&= \frac{dl\left(A\right)}{dA} \times -\frac{n_i}{w^2} \times \frac{w}{l} \\
&= -\epsilon^{A}
\end{aligned}$$

Hence is also follows that from above that $\epsilon^{\tau} = \epsilon^{A}$- the elasticity of crime with respect to deterrence is equality to the elasticity of crime with respect to real affluence. □

A.2. **Derivations for Section 2.2.** Preferences are given by:

$$u\left(\vec{w}_i, \vec{l}_i, T_i\right) = log\left(W_i \times L_i + w_i \times l_i + T_i - c_i^0\right) - V\left(f_\theta\left(\vec{l}_i\right)\right). \tag{31}$$

where $f_\theta\left(\vec{l}\right) = \left(L^\theta + l^\theta\right)^{1/\theta}, \theta \geq 1$. Notice that this is a bit different from the standard CES function from Arrow et al. (1961) that normally requires $\theta \leq 1$. The reason for the difference is that we are aggregating costly effort, rather than output. When $\theta \to \infty$ this corresponds to the case of perfect complements, with the cost of effort given by $(\max(L, l))$. Hence the individual can increase the lower effort at no cost, and which in general increases utility. Hence, at the optimal it will always be the case that $L_i = l_i$ for the CES production function when $\theta \to \infty$.

For the rest of the discussion the index i is dropped to reduce notational clutter.

The first order condition for the level of criminal work, $u_l = 0$, is given by:

$$\begin{aligned}
\frac{du}{dl} &= \frac{1}{\left(W \times L + w \times l + T - c^0\right)} w_i - V'\left(f_\theta\left(\vec{l}\right)\right) \frac{df_\theta}{dl}, \\
&= \frac{1}{\left(W \times L + w \times l + T - c^0\right)} w_i - V'\left(f_\theta\left(\vec{l}\right)\right) f_\theta\left(\vec{l}\right)^{1-\theta} l^{\theta-1} \\
&= 0.
\end{aligned}$$

Hence:

$$w = \left(W \times L + w \times l + T - c^0\right) \times V'\left(f_\theta\left(\vec{l}\right)\right) f_\theta\left(\vec{l}\right)^{1-\theta} l^{\theta-1}$$

With a similar expressions for L_i, we have at an optimal allocation of labor supply:

$$\frac{W}{w} = \left(\frac{L}{l}\right)^{(\theta-1)},$$

$$\left(\frac{L}{l}\right) = \left(\frac{W}{w}\right)^{1/(\theta-1)} = \left(\frac{W}{w}\right)^{\sigma}, \tag{32}$$

where $\sigma = \frac{1}{\theta-1}$ is the elasticity of substitution for the CES production function. This implies that the ratio of labor allocated to each activity is constant regardless of the scale. Let $\hat{l}$ define the scale of activity and thus we can set:

$$L_i = \hat{l}_i \times \gamma^L(\vec{w}_i)$$
$$l_i = \hat{l}_i \times \gamma^l(\vec{w}_i)$$

and using the fact that f_θ is homogeneous of degree 1, and the property $f_\theta(L, l) = \hat{l} f_\theta\left(\gamma^L(\vec{w}), \gamma^l(\vec{w})\right) = \hat{l}$, to conclude:

$$f_\theta\left(\gamma^L(\vec{w}), \gamma^l(\vec{w})\right) = 1 \tag{33}$$

for all $\vec{w}$. Combine this with the ratio condition (32) we get:

$$\gamma^L(\vec{w}) = \frac{W^\sigma}{f_\theta(W^\sigma, w^\sigma)} = \frac{1}{f_\theta\left(1, \left(\frac{w}{W}\right)^\sigma\right)}, \tag{34}$$

$$\gamma^l(\vec{w}) = \frac{w^\sigma}{f_\theta(W^\sigma, w^\sigma)} = \frac{1}{f_\theta\left(1, \left(\frac{W}{w}\right)^\sigma\right)}. \tag{35}$$

Finally, we would like to aggregate wages so that the solution can be viewed as two step problem. In step one determine the aggregate activity, $\hat{l}$ as a function of an aggregate wage $\hat{w}$. This is fixed by the budget constraint:

$$\begin{aligned} \hat{w}\hat{l} &= W \times L + w \times l, \\ &= W \times \gamma^L(\vec{w}) \times \hat{l} + w \times \gamma^l(\vec{w}) \times \hat{l}. \end{aligned}$$

Thus, we construct an aggregate wage index that ensures the budget constraint is always satisfied for all wages at the optimal allocation between tasks:

$$\hat{w}(\vec{w}) \equiv W \times \gamma^L(\vec{w}) + w \times \gamma^l(\vec{w}), \tag{36}$$

$$= \frac{W^{\sigma+1} + w^{\sigma+1}}{f_\theta(W^\sigma, w^\sigma)} \tag{37}$$

$$= f_{\theta\sigma}(W, w)^{-1}. \tag{38}$$

We can simplify the expressions a bit. Observe that from (34) we get:

$$\gamma^{L}\left(\vec{w}\right)=\left[1+\left(\frac{w}{W}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}}=\gamma\left(\frac{W}{w}\right)$$

where $\gamma\left(r\right)=\left[1+\left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}}$. Thus, the fraction of the aggregate activity allocated to legitimate labor depends only upon the ratio of legitimate to criminal labor. Similarly, we have:

$$\gamma^{l}\left(\vec{w}\right)=\left[\left(\frac{W}{w}\right)^{\frac{\theta}{\theta-1}}+1\right]^{-\frac{1}{\theta}}=\gamma\left(\frac{w}{W}\right) \tag{39}$$

From these results we get 13 and 14. With these definitions we can view labor supply as a two step procedure. In the first step, the aggregate wage $\hat{w}\left(\vec{w}\right)$ given by (37) is the dollar value measurement of activity level, and the payoff of the individual can be written in the following form:

$$u=log\left(\hat{w}\hat{l}+T-c^{0}\right)-V\left(\hat{l}\right)$$

Given the activity level $\hat{l}$, the expressions (13-14) determine the optimal allocation of labor between the two activities given the wages $\vec{w}$. The optimal level of activity can be found by applying the results of section 2 to this context. Thus the equilibrium activity level when $\hat{w}>0$ is given by:

$$\begin{aligned}\hat{l}^{*}\left(\hat{w},T\right)&=l\left(\frac{T-c^{0}}{\hat{w}}\right),\\&=l\left(\hat{A}\right)\end{aligned}$$

and $\hat{A}\equiv\frac{T-c^{0}}{\hat{w}}$ is the level of affluence in terms of the aggregate wage $\hat{w}$.

Once the optimal activity level,$\hat{l}^{*}$, has been determined, then labor supply can be derived from (13-14) and we have:

Proposition-6: Given preferences (10) with substitution parameter $\theta>1$ and strictly positive wages, then the labor supplied to legitimate (at wage W_i) and criminal (at wage w_i) activities by individual i is given by

$$\begin{aligned}L_{i}^{*}&=\hat{l}_{i}^{*}\gamma\left(\frac{W_{i}}{w_{i}}\right),\\l_{i}^{*}&=\hat{l}_{i}^{*}\gamma\left(\frac{w_{i}}{W_{i}}\right),\end{aligned}$$

as defined by (34) and (39). The optimal aggregate activity level, $\hat{l}_i^* = l\left(\frac{t_i - c_i^0}{\hat{w}_i}\right) \geq 0$, solves:

$$\max_{\hat{l}_i \geq 0} log\left(\hat{w}_i \hat{l}_i + t_i - c_i^0\right) - V_i\left(\hat{l}_i\right),$$

where $\hat{w}_i = \hat{w}\left(\vec{w}_i\right) \equiv W_i \times \gamma\left(\frac{W_i}{w_i}\right) + w_i \times \gamma\left(\frac{w_i}{W_i}\right)$.

A.2.1. *Some Additional Results on* $\gamma(\cdot)$. The fraction of aggregate labor allocated to legitimate or criminal activity is determined by the function $\gamma(r) = \left[1 + \left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}}$. Its properties determine which type of policy is most effective. Note that for $\theta > 1$ then $\lim_{r\to 0} \gamma(r) = 0$ and $\lim_{r\to\infty} \gamma(r) = 1$. For $r \in (0, \infty)$ we have for the case of substitutes:

$$\lim_{\theta\to 1} \gamma(r) = \begin{cases} 1, & r > 1 \\ 1/2, & r = 1 \\ 0, & r < 1. \end{cases}$$

In the case of complements, we have $\lim_{\theta\to\infty} \gamma(r) = 1$.

We also have:

$$\begin{aligned}
\gamma'(r) &= \frac{d\left[1 + \left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}}}{dr} \\
&= -\frac{1}{\theta}\left[1 + \left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1}{\theta}-1} \frac{\theta}{1-\theta} r^{\frac{\theta}{1-\theta}-1}, \\
&= \frac{1}{\theta - 1}\left[1 + \left(\frac{1}{r}\right)^{\frac{\theta}{\theta-1}}\right]^{-\frac{1+\theta}{\theta}} r^{\frac{2\theta-1}{1-\theta}} \\
&> 0
\end{aligned}$$

providing a direct proof that $\gamma(\cdot)$ is an increasing function.

For small $r \to 0$ we have

$$\begin{aligned}
\gamma'(r) &= O\left(r^{-\frac{\theta}{\theta-1} \times -\frac{1+\theta}{\theta} + \frac{2\theta-1}{1-\theta}}\right) \\
&= O\left(r^{\frac{(1+\theta)-2\theta+1}{\theta-1}}\right) \\
&= O\left(r^{\frac{2-\theta}{\theta-1}}\right).
\end{aligned}$$

This implies that:

$$\lim_{r\to 0} \gamma'(r) = \lim_{r\to 0} \gamma(r)/r = \begin{cases} 0, & \theta \in (1, 2), \\ \infty, & \theta > 2. \end{cases} \tag{40}$$

Is also implies:

$$\lim_{r\to 0}\gamma'(r)/r = \begin{cases} 0, & \theta \in (1, 3/2), \\ \infty, & \theta > 3/2. \end{cases}$$

Moreover, we have:

$$\lim_{r\to 0} r\gamma'(r) = 0. \tag{41}$$

When $\theta \in (1,2)$ this corresponds to the case of substitutes, while $\theta > 2$ corresponds to complements, and hence the corresponding differences in the limits.

For large r we have $\gamma'(r) = O\left(r^{\frac{2\theta-1}{1-\theta}}\right) = O\left(\left(\frac{1}{r}\right)^{\frac{2\theta-1}{\theta-1}}\right)$ and hence converges to zero for large r for $\theta > 1$. Moreover, we have:

$$r^2\gamma'(r) = O\left(r^{\frac{1}{1-\theta}}\right), \tag{42}$$

and hence

$$\lim_{r\to\infty} r^2\gamma'(r) = 0. \tag{43}$$

A.3. **Effect of Instruments on Criminal Labor Supply.**

Proposition-7: The elasticity of crime with respect to deterrence is given by:

$$\begin{aligned}\epsilon^{\tau} &= -\epsilon^{w}, \\ &= -\left\{\hat{\epsilon}^{\hat{w}} \times \epsilon^{w}\left(\hat{w}^{\theta}\right) + \epsilon^{w/W}\left(\gamma^{\theta}\right)\right\},\end{aligned}$$

where:

(1) The elasticity of aggregate labor with respect to aggregate wage is $\hat{\epsilon}^{\hat{w}} = \frac{d\hat{l}}{d\hat{w}} \times \frac{\hat{w}}{\hat{l}}$.

(2) The elasticity of aggregate wage with respect to criminal wage is: $\epsilon^{w}\left(\hat{w}^{\theta}\right) = \frac{d\hat{w}}{dw} \times \frac{w}{\hat{w}} \geq 0$.

(3) The elasticity of the ratio of crime to legitimate labor with respect to criminal wage is: $\epsilon^{w}\left(\gamma^{\theta}\right) = \epsilon^{w}\left(\gamma^{\theta}\right) = \frac{\gamma^{\theta}}{\gamma^{\theta}} \times \frac{w}{W} \geq 0$

Proof. Criminal labor supply is given by:

$$l_i = l\left(\frac{-n_i}{\hat{w}}\right)\gamma^{\theta}\left(\frac{w}{W}\right).$$

Thus we have:

$$\begin{aligned}
\epsilon_w &= \frac{dl_i}{dw} \times \frac{w}{l_i} \\
&= \left(\frac{dl}{d\hat{w}^\theta} \times \frac{d\hat{w}_\theta}{dw} \times \gamma^\theta + l \times \gamma^\theta \left(\frac{w}{W}\right) \times \frac{1}{W}\right) \times \frac{w}{l \times \gamma^\theta} \\
&= \left(\frac{l'}{l} \times \frac{\hat{w}_\theta}{\hat{w}^\theta} \times \frac{d\hat{w}_\theta}{dw} w + \frac{\gamma^\theta}{\gamma^\theta} \times \frac{w}{W}\right) \\
&= \epsilon^{\hat{w}} \times \epsilon^w \left(\hat{w}^\theta\right) + \epsilon^w \left(\gamma^\theta\right)
\end{aligned}$$

. $\square$

The elasticity of crime with respect to a monetary transfer t for a person with need n_i is given by:

$$\begin{aligned}
\epsilon_t &= \frac{dl_i}{dt} \times \frac{t}{l_i}, \\
&= \frac{d\hat{l}\left(\frac{t-c_i^0}{\hat{w}_i}\right)}{dt} \gamma^\theta \left(\frac{w}{W}\right) \times \frac{t}{l \times \gamma^\theta} \\
&= \frac{\hat{l}'}{\hat{l}} \times \frac{t}{\hat{w}_i} < 0
\end{aligned}$$

A.4. **The Case of Perfect Substitutes.** With pure substitutes ($\theta \to 1$) the individual solves:

$$\max_{l_i \geq 0, L_i \geq 0} \log\left(W_i \times L_i + w_i \times l_i + T_i - c_i^0\right) - V_i\left(L_i + l_i\right).$$

In this case the individual views legitimate and criminal as interchangeable. Hence, all effort is allocated to the activity with the highest return. Hence, the supply of criminal activity is given by:

$$l_i = \begin{cases} 0, & W_i \geq w_i, \\ l\left(-\frac{n_i}{w_i}\right) & W_i < w_i. \end{cases}$$

In this case, the optimal level of deterrence when the return to criminal work is higher, $W > w$, is given by:

$$\tau^* = W/w.$$

At this level of deterrence there is no crime, and the social cost is zero. If there is no alternative legitimate employment, but it is possible to create a perfect substitute with wage W. This policy would be effective regardless of the person's need.

A.5. **Perfect Complements.** With perfect complements ($\theta \to \infty$) the individual solves:

$$\max_{l_i \geq 0, L_i \geq 0} \log\left(W_i \times L_i + w_i \times l_i + t_i - c_i^0\right) - V_i\left(\max\left\{L_i, l_i\right\}\right).$$

Clearly, $L_i < l_i$ or $l_i < L_i$ cannot be optimal when wages are strictly positive, thus we can let $L_i = l_i = \hat{l}_i$. Thus the solution is found by solving:

$$\max_{\hat{l} \geq 0} \log\left(\hat{w} \times \hat{l} + t_i - c_i^0\right) - V_i\left(\hat{l}\right),$$

where $\hat{w} = w + W$. Thus, the case of pure complements reduces to the one activity case with wage $\hat{w}_i$ and $L_i = l_i = \hat{l}_i$. When the wage for one activity is less than or equal to zero, and the other activity has a positive wage, then the negative wage activity can be set to zero. In that case $\hat{l}_i = max\{L_i, l_i\}$ and $\hat{w}_i = \max\{w_i, W_i\}$. If both activities have a negative wage, then $\hat{l}_i = L_i = l_i$ and $\hat{w}_i = W_i + w_i$, and we are again back into the one dimension case, with criminal labor supply given by:

$$l_i = \hat{l}_i = l\left(-\frac{n_i}{w_i + W_i}\right)$$

In this case the elasticity of crime with respect to deterrence is given by (with $s = 0$):

$$\begin{aligned}
\epsilon_\tau &= \frac{\tau}{\hat{l}} \frac{d\hat{l}}{d\tau}, \\
&= -\frac{\tau}{\hat{l}} \times l'\left(-\frac{n_i}{w_i + W_i}\right) \times \frac{n_i}{(w_i + W_i)^2}, \\
&= -\frac{\tau \times \epsilon_N^{\hat{l}}}{(w - \tau + W)}.
\end{aligned}$$

In this case there is no income effect, and the effect of deterrence depends upon the sign of the elasticity of activity with respect to real need, that if negative if and only if the individual is affluent. From this we can also compute the effect of a wage subsidy on crime:

$$\begin{aligned}
\epsilon_s &= \frac{s}{\hat{l}} \frac{d\hat{l}}{ds}, \\
&= \frac{s}{\hat{l}} \times l'\left(-\frac{n_i}{w_i + W_i}\right) \times \frac{n_i}{(w_i + W_i)^2}, \\
&= -\frac{s \times \epsilon_N^{\hat{l}}}{(w + W + s)}.
\end{aligned}$$

Notice that the sign is the opposite the case for deterrence. In other words, a wage subsidy reduces crime if and only if the individual is needy. Again, this is operating via the income effect - a wage subsidy increases income, and hence reduces activity.

Finally, consider the effect of a transfer:

$$\begin{aligned}\epsilon_t &= \frac{t}{\hat{l}}\frac{d\hat{l}}{dt},\\ &= \frac{t}{\hat{l}} \times l'\left(-\frac{n_i}{w_i + W_i}\right) \times \frac{1}{(w_i + W_i)},\\ &= -\frac{t}{c^0 - t^0 - t}\epsilon_N^{\hat{l}}.\end{aligned}$$

In this case the sign of need and the elasticity are the same, and hence it is always the case that $\epsilon_t < 0$ - transfers are a pure income effect and always lead to less crime.

A.6. **Derivations for Section (3).**

A.6.1. *Optimal Policy with a Weak Labor Market.*

Proposition-8: When it is efficient to have deterrence τ^*, then it satisfies:

$$\epsilon^w(\tau^*) = \frac{\tau \times MC_\tau(\tau^*)}{MC(\tau^*)}, \tag{44}$$

where $\epsilon^w(\tau)$ is the wage elasticity of criminal labor supply, the marginal cost of crime is $MC(\tau) = (w^{sc} - w^\tau) + \tau k$. If $\epsilon^w(0) \leq \frac{k+w}{w^{sc}-w+k}$ then it is not effective to deter crime.

Proof. First order conditions without legitimate labor supply:

$$\begin{aligned}0 =& \frac{\partial\left(SC_i^{sc} + SC_i^\tau(\pi) - I_i(\pi)\right)}{\partial\tau}\\ =& w^{sc}\frac{dl_i}{d\tau} + \left(kl_i + \tau k\frac{dl_i}{d\tau}\right) - \left(-\frac{w}{\tau^2}l_i + \frac{w}{\tau}\frac{dl_i}{d\tau}\right).\end{aligned}$$

This can be rewritten as:

$$-\left(w^{sc} + \tau k - \frac{w}{\tau}\right)\frac{dl_i}{d\tau} = kl_i + \frac{w}{\tau^2}l_i$$

$$-\left(w^{sc} + \tau k - \frac{w}{\tau}\right)\frac{dl_i}{d\tau} \times \frac{\tau}{l_i} = \left(\tau k + \frac{w}{\tau}\right)$$

$$\epsilon^w(\tau) = \frac{\left(\tau k + \frac{w}{\tau}\right)}{(w^{sc} - w^\tau) + \tau k}. \tag{45}$$

Where ϵ^w is the wage elasticity of criminal labor supply. The numerator on the right is the marginal cost due to deterrence costs and income lost to the individual. The denominator is the social benefit from crime reduction $(w^{sc} - w^\tau)$ and marginal benefit of lower deterrence costs due to less crime. Proposition (8) follows immediately. □

Proposition-9: Given deterrence τ,the optimal transfer is:

$$t^* = \max\left\{0, A^*(\tau) \times w^\tau + n^0\right\},$$

where optimal affluence A^* is the unique solution to:

$$l'(A^*(\tau)) = -\frac{\lambda w^\tau}{(w^{sc} - w^\tau + \tau k)}.$$

Moreover, optimal affluence is increasing in deterrence, and hence if there are positive transfers, $t^* > 0$, an increase in deterrence results in an increase in the optimal transfer. Similarly, an increase in the cost of crime leads to more transfers to the individual.

Proof. Next, we determine the optimal transfer given deterrence $\tau > 1$, resulting in a criminal wage $w^\tau = w^\tau$. For a given person this is not necessarily optimal. The question then is what is the optimal transfer for a given person. The first order condition for optimal t is given by:

$$\begin{aligned} 0 &= \frac{\partial \left(SC_i^{sc} + SC_i^\tau(\pi) - I_i(\pi) \right)}{\partial \tau} \\ &= w^{sc}\frac{dl_i}{dt} + \left(\tau k \frac{dl_i}{dt} \right) + (1+\lambda) - \left(w^\tau \frac{dl_i}{dt} + 1 \right). \end{aligned}$$

Rearranging we get:

$$\begin{aligned} (w^{sc} + \tau k - w^\tau)\frac{dl_i}{dt} &= -\lambda \\ \frac{dl}{dA} \times \frac{1}{w^\tau} &= -\frac{\lambda}{(w^{sc} - w^\tau + \tau k)} \\ \frac{dl(A^*)}{dA} &= -\frac{\lambda w^\tau}{(w^{sc} - w^\tau + \tau k)} \end{aligned} \tag{46}$$

This defines optimal *affluence,* $A = \frac{t - n^0}{w^\tau}$, where n^0 is the need before a transfer. Given that transfers must be non-negative It follows that the optimal transfer is $t^* = \max\{0, A^* \times w^\tau + n^0\}$.

Since $V''' \geq 0$, it follows from (8) that $l_{AA} > 0$. We can differentiate (46) to get the effect of deterrence on the optimal level of affluence:

$$\begin{aligned} l_{AA}\frac{\partial A^*}{\partial \tau} &= -\left(-\frac{\lambda w^\tau/\tau}{(w^{sc} - w^\tau + \tau k)} + \frac{\lambda w^\tau}{(w^{sc} - w^\tau + \tau k)^2}(-w^\tau/\tau + k) \right) \\ &= \frac{\lambda w^\tau/\tau}{(w^{sc} - w^\tau + \tau k)}\left(1 - \frac{(-w^\tau + \tau k)}{(w^{sc} - w^\tau + \tau k)} \right) \\ &= \frac{\lambda w^\tau/\tau}{(w^{sc} - w^\tau + \tau k)}\left(\frac{w^{sc}}{(w^{sc} - w^\tau + \tau k)} \right) > 0. \end{aligned}$$

Since the right hand side is positive, we conclude $\frac{\partial A^*}{\partial \tau} > 0$. Similarly, since $d\partial \frac{\lambda w^\tau}{(w^{sc} - w^\tau + \tau k)}/\partial w^{sc} < 0$ is follows that $\frac{\partial A^*}{\partial w^{cs}} > 0$. ☐

Proposition-10: The first order condition for optimal deterrence (τ^*) and transfer policy ($t^*(a_i)$) is given by:

$$\frac{\tau \times MC_\tau(\tau)}{MC(\tau)} = \hat{\epsilon}^w,$$

where is the average wage elasticity of criminal labor supply, weighted by the fraction of crime committed by individuals with affluence a_i.

Proof. Since transfers are optimally chosen, then $\frac{\partial SC}{\partial A^*} = 0$, and hence we can ignore the dependence of A^*on τ. One can also verify that since $t^*_\tau(a^*(\tau)) = 0$, where $a^*(\tau) = A^*(\tau) \times w^\tau$ then we also have that the effect of a^* via the margin between transfer and no transfer is zero. Also, Thus, we have:

$$\frac{\partial SC}{\partial \tau} = F(a^*(\tau))\, l(A^*(\tau))(k - \partial w^\tau/\partial\tau) + \lambda \int_{-\infty}^{a^*(\tau)} (A^*(\tau)\, \partial w^\tau/\partial\tau)\, f(a_i)\, da_i$$
$$+ \int_{a^*(\tau)}^{\infty} \left\{ l'\left(\frac{a_i}{w^\tau}\right) \frac{a_i}{w}(w^{sc} + \tau k - w^\tau) + l\left(\frac{a_i}{w^\tau}\right)(k - \partial w^\tau/\partial\tau) \right\} f(a_i)\, da_i$$

We can define the total level of crime in the population given deterrence by:

$$l^{crime}(\tau) = F(a^*(\tau))\, l(A^*(\tau)) + \int_{a^*(\tau)}^{\infty} l\left(\frac{a_i}{w^\tau}\right) f(a_i)\, da_i.$$

This allows us to rewrite the first order condition $\frac{\partial SC}{\partial \tau} = 0$ using $\partial w^\tau/\partial\tau = -w^\tau/\tau$ as:

$$l^{crime}(\tau)(k + w^\tau/\tau) = (w^{sc} + \tau k - w^\tau) \int_{a^*(\tau)}^{\infty} \left\{ -l'\left(\frac{a_i}{w^\tau}\right)\frac{a_i}{w} \right\} f(a_i)\, da_i + \lambda F(a^*(\tau))\, a^*(\tau)/\tau.$$

Multiply both sides by $\frac{\tau}{(w^{sc} + \tau k - w^\tau)}$ and use the fact that for person i we have $\epsilon_i^w = -\epsilon_i^A$, thus:

$$l^{crime}(\tau) \frac{(\tau k + w^\tau)}{(w^{sc} + \tau k - w^\tau)} = \int_{a^*(\tau)}^{\infty} \epsilon_i^w \times l_i\left(\frac{a_i}{w^\tau}\right) f(a_i)\, da_i + \lambda F(a^*(\tau)) \frac{a^*(\tau)}{(w^{sc} + \tau k - w^\tau)}.$$

Let the fraction of crime committed by individuals of affluence a_i be given by $g^{cr}(a_i, \tau) = \frac{l_i\left(\frac{a_i}{w^\tau}\right) f(a_i)}{l^{crime}(\tau)}$.

From 46 defining the optimal real affluence, A^*, we get that

$$\begin{aligned}
\frac{\lambda a^*(\tau)}{(w^{sc} + \tau k - w^\tau)} &= \frac{\lambda a^*(\tau)}{(w^{sc} + \tau k - w^\tau)} \\
&= \frac{\lambda w^\tau}{(w^{sc} + \tau k - w^\tau)} \times A^*(\tau) \\
&= -\frac{dl(A^*)}{dA} \times A^*(\tau) \\
&= l(A^*) \times \epsilon^w_{a_i^*}, \qquad (47)
\end{aligned}$$

where $\epsilon^w_{a^*_i}$ is the wage elasticity for the person with affluence $a^*_i(\tau)$. After the transfers, individuals with affluence $a^*_i(\tau)$ or less supply the same amount of criminal labor, $l(A^*)$, thus we can let $G^{cr}(a^*(\tau),\tau) = \frac{F(a^*(\tau))l(A^*)}{l^{crime}(\tau)}$ the faction of crime due to needy individuals who receive transfers. Using this expression and (47) we have:

$$\frac{\tau \times MC_\tau(\tau)}{MC(\tau)} = \int_{a^*(\tau)}^{\infty} \epsilon^w_i g^{cr}(a_i,\tau)\,da_i + \lambda G^{cr}(a^*(\tau),\tau)\,\epsilon^w_{a^*_i} \equiv \hat{\epsilon}^w. \tag{48}$$

□

A.6.2. *Optimal Policy when Legitimate Employment is Available.*

Proposition-11: When crime and legitimate work are perfect substitutes, then a wage subsidy is preferred to deterrence if and only if:

$$\lambda < \frac{l\left(\frac{a_i}{W}\right)}{l\left(\frac{a_i}{w}\right)}. \tag{49}$$

Proof. If crime is eliminated via deterrence, the social cost is given by the cost of implementing the policy. The deterrence policy reduce the wage from criminal activity to be the same as the legitimate wage. Hence the social cost of implementing this policy is:

$$\begin{aligned} SC^{\tau*} &= (w - w^{\tau*})\,l\left(\frac{a_i}{w^{\tau*}}\right), \\ &= (w - W)\,l\left(\frac{a_i}{W}\right). \end{aligned}$$

Conversely, a subsidy to legitimate work of $s^* = W/w$ is costly due to the subsidy:

$$SC^{s*} = \lambda (w - W)\,l\left(\frac{a_i}{w}\right).$$

Thus deterrence is preferred if and only if:

$$\begin{gathered} SC^{\tau*} < SC^{s*} \\ (w - W)\,l\left(\frac{a_i}{W}\right) < \lambda (w - W)\,l\left(\frac{a_i}{w}\right) \\ \frac{l\left(\frac{a_i}{W}\right)}{l\left(\frac{a_i}{w}\right)} < \lambda. \end{gathered}$$

We turn to the case of perfect complements. The social cost in this case is:

$$\begin{aligned} SC_i(\tau,s) &= (w^{sc} + \tau k + (1+\lambda)(W^s - W) - w^\tau - W^s)\,l\left(\frac{a_i}{w^\tau + W^s}\right), \\ &= MC(\tau,s)\,l\left(\frac{a_i}{w^\tau + W^s}\right). \end{aligned}$$

□

Proposition-: Let $MC^0 = (w^{sc} + k - (w + W)) > 0$ be the marginal cost of crime in the absence of deterrence or wage subsidy. It is efficient to increase deterrence if a person is sufficiently affluent with wage elasticity satisfying:

$$\epsilon_i^{\hat{w}} > \frac{\hat{w}}{MC^0} (k/w + 1) .$$

It is efficient to subsidize legitimate labor if a person is sufficiently needy with a wage elasticity satisfying:

$$\epsilon_i^{\hat{w}} < -\frac{\lambda \hat{w}}{MC^0}$$

Proof. Consider first the case of deterrence.

$$\partial SC_i/\partial \tau = (k + w^\tau/\tau)\, l\left(\frac{a_i}{\hat{w}}\right) + MC(\tau, s)\, l'\left(\frac{a_i}{\hat{w}}\right) \frac{a_i}{\hat{w}^2} w^\tau/\tau.$$

It is efficient to increase deterrence if $\partial SC_i/\partial\tau|_{\tau=s=1} < 0$ when $\tau = s = 1$ or $\partial SC_i(1,1)/\partial\tau \times \frac{\hat{w}}{l_i w \times MC(1,1)} < 0$:

$$\frac{\hat{w}}{w} \times \frac{(k + w^\tau/\tau)}{MC(1,1)} - \epsilon_i^{\hat{w}} < 0,$$

$$\frac{\hat{w}}{w} \times \frac{(k + w)}{(w^{sc} + k - (w + W))} < \epsilon_i^{\hat{w}}.$$

For affluent individuals, $a_i > 0$, the wage elasticity is positive, $\epsilon^{\hat{w}} > 0$, and hence when the cost of crime is large enough, it is optimal to have some deterrence. It is never optimal to deter needy persons.

In case of a wage subsidy with $s = 1$ we have:

$$\partial SC_i/\partial s|_{s=\tau=1} = \lambda W \times l\left(\frac{a_i}{\hat{w}}\right) + MC(1,1)\, l'\left(\frac{a_i}{\hat{w}}\right) \frac{a_i}{\hat{w}^2} W. \tag{50}$$

It is efficient to subsidize legitimate labor if $\partial SC_i/\partial s|_{s=\tau=1}$ (namely reduce s to reduce social cost). Multiplying (50) by $\frac{\hat{w}}{l_i W \times MC(1,1)}$. this is the case if:

$$\frac{\hat{w}}{W} \frac{-\lambda W}{MC(1,1)} - \epsilon_i^{\hat{w}} > 0,$$

$$\frac{-\lambda \hat{w}}{(w^{sc} + k - (w + W))} > \epsilon_i^{\hat{w}}$$

Since the left hand side is negative, a necessary condition for a subsidy to be optimal is for the person to be sufficiently needy individual ($\epsilon^{\hat{w}} < 0$). Moreover, for a given needy person, if the cost of crime is sufficiently this it is optimal to have some wage subsidy. $\square$