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Larceny*

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Abstract. A dynamic general equilibrium model of larceny – or property crime – is presented in which both economic conditions and government policies affect the commission calculus. The model provides a behavioral framework that is used to estimate the effects of government policies on the commission of larceny. Calibrating the model using data from cities in Los Angeles County, the impact of a number of government policies and of economic development on larceny are quantified. The simulations show that longer prison sentences and higher conviction rates for criminals are the most effective methods to reduce larceny; subsidizing leisure activities, increasing police expenditures and income transfers have little effect on larceny. Using a game-theoretic optimality criterion, all the policies examined are currently overfunded.

Key words: Larceny, Crime, Government Policy.

JEL classification: K42, E62, D31

1. Introduction

VOTERS IN THE COUNTY OF LOS ANGELES narrowly approved a proposal in the November, 1996, election which raised residential property taxes by an average of $18 per home to increase funding for city parks. One rationale given for this tax hike was to reduce crime by building more recreational facilities, in-

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cluding basketball courts and soccer fields.[1] Will such a program reduce crime? Would hiring more police officers be a better use of public moneys? Tight budgets at all levels of government make identifying cost-effective crime-reduction programs a top priority in the "war on crime."[2]

A large body of evidence shows that individuals respond to economic and policy incentives when choosing whether to engage in crime.[3] Criminals are disproportionately persons of low legitimate earnings prospects who are particularly sensitive to economic conditions. Over the last twenty years, the demand for low-skill labor has fallen sharply as evidenced by declines in both the wages of low-skill workers and the hours that they spend working. Freeman (1996) reckons that earnings from many criminal activities exceed the legitimate wage for both youths and low-skill workers, leading them towards crime.

This paper builds a dynamic general equilibrium model of larceny – or property crime – to determine the efficacy of public policies designed to reduce larceny. The model identifies the tradeoffs between work, leisure, and larceny faced by agents who are heterogeneous in their income and wealth. Once agents' optima are ascertained, they are embedded into an optimal policy problem faced by the government. Funding levels for larceny-reduction policies are determined via a Stackelberg game with citizens. This game provides a natural optimality criterion to compare actual policies to optimal policies. After the general theory of larceny is specified, a parameterized version of the model is used to quantify the impact of policy changes on the commission of larceny. Quantitative analyses of this model are difficult, as time allocation choices are jointly endogenous. The endogeneity problem is circumvented using a hybrid empirical method where, in the first stage, statistical estimation determines parameter values that are fed into simulations in the second stage, maintaining the endogeneity of choices. Furthermore, the analysis focuses on the dollar value of larceny, rather than the number of crimes committed, so that aggregation is sensible and measurement error is reduced.

Predictions from the theory are tested using data for cities in Los Angeles County. Los Angeles absorbs a large number of international immigrants every year, whose average educational level has fallen over time (Borjas, 1994), and has experienced several years of budget crises, including cuts in state and federal aid. Determining effective crime prevention policies is as critical in Los Angeles as anywhere in the country. This paper focuses on larceny rather than on crimes such as murder or rape because larceny is primarily an economic offense. Violent

[1] I am referring to Proposition K which was forecasted to raise \$776 million for park improvements. A similar proposition, Measure A, was passed in the same election by the city of Los Angeles and raises \$319 million to increase the number of parks in urban areas.

[2] Determining cost-effective crime prevention policies is one of the recommendations for an overhaul of the criminal justice system made by Donziger (1996).

[3] This literature begins with Becker (1968). Schmidt & Witte (1984) contains a survey of the economic analysis of crime. In addition, the Winter 1996 issue of the *Journal of Economic Perspectives* contains a symposium on the economics of crime; see especially DiIulio (1996).

crime has a quite different etiology and the results here may not apply to such crimes.[4]

The model of larceny in this paper draws from the seminal contribution of Becker (1968) and the subsequent work by Ehrlich (1973), Sjoquist (1973) and Block & Heineke (1975). More recent contributions by Witte (1980), Davis (1988) and Grogger (1997) continue the Beckerian tradition of focusing on crime as a time-allocation problem, which is also done here. These models assume that criminals are rational actors, so that rising wages, higher conviction rates and longer prison sentences all reduce the incidence of crime. These implications have generally been borne out empirically (Witte, 1980; Tauchen, Witte & Griesinger, 1994; Levitt, 1995, 1997), and indeed are also derived from the model presented here. The innovations of the model in this paper are that *i)* both positive and negative incentives to engage in larceny are explicitly included in an intertemporal general equilibrium model, and *ii)* the model is used to quantify the impact of policy changes on the commission of larceny while preserving the endogeneity of agents' choices. Further, the model shows that the amount of larceny depends on the *distributions* of income and wealth, as do optimal government policies to combat larceny.

Policies to reduce larceny can be grouped into two broad categories: deterrence and incapacitation. Simulations of the model demonstrate that increased police expenditures, longer prison sentences, higher conviction rates, and increased income transfers all reduce larceny. Leisure subsidies, which the theory demonstrates have an ambiguous effect on larceny, are shown to have a trivial effect on larceny in Los Angeles County. Of the policies considered, longer prison sentences and higher conviction rates for criminals are the most effective methods to reduce larceny, though all policies fail to satisfy the optimality criterion. These results support the apparent efficacy of California's "three strikes" law as well as the skepticism regarding the allocation of tax revenue to leisure programs like midnight basketball. A welfare analysis shows that income transfers and longer prison sentences both raise aggregate utility for the unincarcerated, although the former is relatively impotent at reducing larceny.

This paper proceeds as follows. The following section specifies the theoretical model and derives implications from it relating the incidence of larceny to economic conditions and government policy. Section 3 derives additional testable implications from a parameterized version of the model. Section 4 tests these implications via estimation and simulation. Section 5 concludes with caveats and suggestions for further work.

2. A dynamic model of larceny

Consider an economy populated by a continuum of infinitely lived individuals, distributed over the unit interval, who vary by their wages and wealth.[5] Let i

[4] See Ehrlich (1975) for a model of murder.

[5] One can think of wage variations as being due to actual or perceived differences in human capital.

denote an agent of a particular wage-wealth type, and let μ be an appropriately defined probability measure over agents. Individuals allocate their time between hours spent in work, h^i, larceny, e^i, and leisure, l^i, with the total amount of time normalized to unity, $e^i + l^i + h^i = 1$.[6] Individual i earns wage w^i for an hour of legitimate work, and income $\pi^i K$ from expropriating other's resources, where π^i is an *expropriation technology*, as in Hirshleifer (1991), Grossman (1995), and Zak (1997), which maps the time spent in illegitimate activities e^i into the acquisition of a proportion of aggregate community wealth (capital), K. The expropriation technology also depends on the resources spent on the police, P, which reduces the rate that property is stolen. Formally, $\pi^i \equiv \pi(e^i, P) : [0,1] \times \Re^+ \to [0,1]$. By assumption, time spent in larceny yields a positive return, $\frac{\partial \pi}{\partial e^i} > 0$ with expropriation decreasing in police expenditures, $\frac{\partial \pi}{\partial P} < 0$. Table 1 presents the notation used in this paper.

Engaging in larceny carries two costs. The first is that larceny takes time away from work or leisure activities – an hour spent in larceny means an hour less time spent working or enjoying leisure. The second is the probability that the larcenist will be caught and convicted for his or her crime and will serve time in prison. Agents are unable to earn income while incarcerated and are also excluded from receiving government subsidies. Thus, higher income agents face a higher opportunity cost of prison time.[7] Let $J \in \mathbf{N}$ be the prison sentence for a larcenist, where, by assumption, all convicted larcenists receive identical sentences.[8] The indicator $z_t^i \in \{0,1\}$ identifies whether or not agent i is incarcerated at time t ($z_t^i = 0$) or is free ($z_t^i = 1$). If an agent is arrested in the current period, incarceration occurs in the beginning of the subsequent period. If z_t^i is zero (arrest) for the first time at time t, then it is zero for the next J periods. The indicator of arrests depends on the J-period history of larceny, on current police spending, P, as well as on an idiosyncratic white-noise variable $\epsilon^i \sim \Xi$,

$$z_t^i = G\left(e_{t-1}^i, e_{t-2}^i, ..., e_{t-J}^i, P_t; \epsilon_t^i\right), \tag{1}$$

with $G(\cdot) : [0,1]^{J-1} \times \Re^+ \times \Re \to \{0,1\}$. The more time a person spends in larceny, the greater the expectation that he will be caught and convicted, $\frac{\partial EG(\cdot)}{\partial e_{t-m}^i} \equiv G_m > 0 \ \forall m \in \{1, 2, ..., J\}$. Similarly, as police expenditures increase, more criminals are arrested and sent to jail, $\frac{\partial EG(\cdot)}{\partial P} > 0$. The idiosyncratic stochastic shock to $G(\cdot)$ captures the random effect of detecting criminal activity; some criminals will be in the "wrong place at the wrong time" and will be apprehended, with $\frac{\partial EG(\cdot)}{\partial \epsilon^i} > 0$.[9] Note that ϵ_t^i is realized at time t and therefore z_t^i is known at t with certainty, but $z_{t+1}^i, z_{t+2}^i, ...$ are random variables at time t.

[6] In order to simplify the language used in this paper, I will call all property crimes "larceny," a classification that includes burglary, motor vehicle theft and general theft.

[7] By assumption, a convict's wealth is held without interest until the agent is released from prison.

[8] To keep the model's focus on the economic incentives to commit larceny, arrest and trials are not modeled; all those captured are convicted. See Hunt (1996) for a model of optimal arrest and sentencing.

[9] If ϵ^i is uniformly distributed, then agents with identical criminal records and current time in larceny have identical probabilities of arrest and conviction. One could also allow ϵ^i to depend, say, negatively on an agent's income so that poorer agents are more likely to be apprehended.

Table 1. Notation used in the model

Variable	Definition
I. General Model	
i	Identifier of agent type
e^i	Time spent in larceny
l^i	Time spent in leisure
h^i	Time spent working
H	Aggregate hours spent working
$\pi(e^i, P)$	Expropriation technology
$\overline{\pi}$	Average expropriation
P	Police expenditures
J	Prison sentence for convicted larcenists
C^J	Cost to incarcerate one agent
G_e	Marginal probability of prison time for larcenists
η	Proportional leisure subsidy
σ	Income transfer
z^i	Incarceration identifier $\{0, 1\}$
ϵ^i	Stochastic arrest and conviction disturbance
τ	Tax rate on labor income
c^i	Consumption
R	Yield on savings (1 + net interest rate)
r	Gross interest rate
δ	Physical capital depreciation rate
a^i	Wealth
w^i	Wage
ϕ^i	Labor productivity parameter
K	Capital stock
y^i	Income from all sources
$U(c^i, l^i)$	Utility from consumption and leisure
Y	Aggregate output produced using production function $F(K, H)$
β	Subjective discount factor
μ	Measure of agents
II. Parameterized Model	
j	City identifier
N_j^i	Number of agents of type i
d_j^i	Proportion of agents of type i
Λ_j^i	Dollar losses due to larceny
Z	Expected income loss during prison time
α	Utility of leisure relative to consumption
θ	Productivity of time in larceny
D	Scale factor in expropriation technology
γ	Effectiveness of police expenditures in reducing larceny
ν	$= \frac{1}{1-\theta}$
ν_1	$= -\gamma\nu$
A	$= \ln(D^\theta \theta^{\theta\nu})$

Individual i receives return $\pi(e^i, P)K$ for time e^i spent in larceny, where larceny occurs at the firm, after production. Define average losses from larceny as

$$\overline{\pi} = \int_{-\infty}^{\infty} \int_{0}^{1} \pi(e^i, P) d\mu d\Xi. \tag{2}$$

Then, individual i's expected return on assets a^i, net of loses from larceny, is $(1-\overline{\pi})Ra^i$, where $R = 1 + r - \delta$ is the yield on investment, r is the interest rate, $\delta \in [0, 1]$ is the depreciation rate of capital and $r - \delta$ is the net interest rate. Since individuals are atomistic, an individual's choice of e^i has no effect on $\overline{\pi}$. Aggregating assets over all agents sums, in equilibrium, to community wealth, $K_t = \int_0^1 a_t^i d\mu$.

This economy contains a single good that can be used for either consumption or investment. Agent i receives utility $U(c^i, l^i)$ by consuming good c^i and leisure l^i. Utility is continuous, strictly increasing and concave in both arguments, and satisfies the Inada conditions, with future utility flows discounted by $\beta \in (0, 1)$. Consumption is funded by net-of-tax labor income, which is hours worked times the wage less taxes, $w^i h^i(1-\tau)$, for tax rate $\tau \in (0, 1)$, plus investment income, which is the net interest rate less average larceny times wealth, $(r-\delta)(1-\overline{\pi})a^i$, plus income from larceny, $\pi(e^i, P)K$, plus income from government programs. Five government programs appear in an agent's budget constraint, shown below as Eq. (4), that affect decisions regarding larceny: Police expenditures P, a lump-sum income transfer σ, a subsidy for leisure activities η, the length of prison sentences J, and the combined arrest and conviction rates $G_1, G_2, ...G_J$ which will assume are equal and will denote as G_e. Combining all these elements, the lifetime utility maximization problem faced by unincarcerated individual i born at time $t = 0$ is

$$Max_{c,h,l,e} E\, \Sigma_{t=0}^{\infty} \beta^t U(c_t^i, l_t^i) \tag{3}$$

s.t.

$$\begin{aligned} c_t^i &= z_t^i \left[w_t^i h_t^i (1-\tau_t) + \eta_t l_t^i + K_t \pi(e_t^i, P_t) + \sigma_t + (r_t - \delta)(1-\overline{\pi}_t) a_t^i \right] \\ &\quad + a_t^i (1-\overline{\pi}_t) - a_{t+1}^i && (4) \\ 1 &= h_t^i + l_t^i + e_t^i && (5) \\ z_0^i &= 1, \quad \forall i && (6) \end{aligned}$$

where individual i has assets a_0^i at time $t = 0$ and the initial distribution of assets satisfies $K_0 = \int_0^1 a_0^i d\mu > 0$. The optimal allocations among work, leisure, and larceny depend on the costs and benefits of each activity, including the effects of government policies. Constraint (5) is the adding-up condition on time, while (6) states that when the economy begins, no agents are incarcerated. After $t = 0$, agents who are incarcerated consume neither goods nor leisure (and are excluded from government programs) and thus do not have a utility maximization problem to solve until released from prison.

The necessary and sufficient conditions for optimal time allocations and next period's asset holdings are given implicitly by[10]

$$U_1(c_t^i, l_t^i)\left[-w_t^i(1-\tau_t) + K_t\frac{\partial\pi}{\partial e_t^i}\right] + G_e\Sigma_{j=t+1}^{t+J}\beta^{j-t}EU_1\left(c_j^i, l_j^i\right)y_j^i = 0, \quad (7)$$

$$U_1\left(c_t^i, l_t^i\right)\left[-w_t^i(1-\tau_t)+\eta_t\right] + U_2\left(c_t^i, l_t^i\right) = 0, \quad (8)$$

and

$$U_1\left(c_t^i, l_t^i\right) = \beta ER_{t+1}(1-\overline{\pi}_{t+1})U_1\left(c_{t+1}^i, l_{t+1}^i\right), \quad (9)$$

where

$$y_j^i \equiv w_j^i h_j^i(1-\tau_j) + \eta_j l_j^i + K_j\pi_j^i + \sigma_j + (r_j-\delta)(1-\overline{\pi}_j)a_j^i \quad (10)$$

The optimality conditions have straightforward interpretations. Equation (7) shows that agents engage in larceny up to the point at which the marginal utility from larceny equals the discounted expected present value of utility foregone if caught and convicted, with $EG_e\Sigma_{j=t+1}^{t+J}\beta^{j-t}EU_1(c_j^i, l_j^i)y_j^i$ the discounted expected loss of future utility times income from incarceration due to current criminal activity. In this expression, EG_e is the increase in the likelihood of future arrest from an increase in time spent in larceny today. If the wage w^i increases, agent i will optimally engage in less larceny (and less leisure) and will spend more time working. The optimality condition for leisure, equation (8), shows that the subsidy for leisure activities, η, partially offsets the opportunity cost of leisure (the wage) when choosing how much leisure to enjoy.

Denote the optimal larceny, work and leisure time allocations, found from (7), (8) and the adding up condition for time (5) as $e_t^{i\star} = e(w_t^i, a_t^i; \tau_t, \eta_t, P_t, \sigma_t, J)$, $h_t^{i\star} = h(w_t^i, a_t^i; \tau_t, \eta_t, P_t, \sigma_t, J)$, $l_t^{i\star} = l(w_t^i, a_t^i; \tau_t, \eta_t, P_t, \sigma_t, J)$. Once these are determined, the optimal value for next period's asset holdings, $a_{t+1}^{i\star} = a(w_t^i(1-\tau_t)h_t^{i\star} + \eta_t l_t^{i\star} + \sigma_t + a_t^i(r_t-\delta) + K_t\pi(e_t^{i\star}, P_t); ER_{t+1}(1-\overline{\pi}_{t+1}))$, from Eq. (9) can be found. The savings correspondence $a_{t+1}^{i\star}$ is generically increasing in the wage and decreasing in the tax τ, with decisions based on the expected after-larceny return to savings, $ER_{t+1}(1-\overline{\pi}_{t+1})$. Summing the savings choices at time t generates the period $t+1$ capital stock through the capital market clearing condition,

$$K_{t+1} = \int_0^1 a_{t+1}^{i\star}d\mu. \quad (11)$$

The dynamical system (11) shows that for some initial capital stock $K_0 > 0$, the economy grows as long as the average level of larceny is not too high.[11]

Witte (1995) argues that criminals are more present-oriented than are non-criminals. By equation (7), present-oriented people highly value the present gain

[10] The Inada conditions rule out corner solutions to the above problem which is consistent with data showing that the majority of criminals engage in both legitimate and illegitimate work (DiIulio, 1996). Relaxing the Inada conditions, some agents might choose to spend no time in larceny, but the derivation of aggregate property stolen, which is of primary interest here, is unaffected by these agents.

[11] A complete dynamic analysis of a simplified version of this model is contained in Zak (1997).

from larceny relative to the foregone income if jailed (e.g. when $\beta \simeq 0$). As a result, these people spend more time in larceny. Freeman (1996) presents evidence that criminals underestimate the true expectation of being caught and convicted of a crime EG_e. Equation (7) shows as a person's expectation of conviction EG_e falls, he or she optimally chooses to spend more time in larceny.

2.1. Firms and markets

Once individuals determine their labor supply schedule $h_t^{i\star}$, the labor and capital markets open as firms seek to hire employees and rent capital for production. Summing across all individuals, aggregate labor supply at time t is

$$H_t = \int_0^1 h_t^{i\star} d\mu. \tag{12}$$

Firms maximize profits in a competitive environment and have access to a neoclassical production function $F(K, H)$ that satisfies the Inada conditions. Firms choose production inputs by solving

$$Max_{K,H} F(K_t, H_t) - K_t r_t - H_t w_t. \tag{13}$$

Wages for type i individuals are proportional to the marginal product of aggregate labor, with the constant of proportionality determined exogenously. Thus, agents who are less productive, or are perceived as such, receive lower wages. Let us partition the unit interval into I subintervals, with each subinterval i constituting a group of persons of mass N^i who have an identically perceived level of productivity. Define ϕ as an I-vector with generic element ϕ^i, such that $\Sigma_{i=1}^I \phi^i N^i = 1$. Then, factor prices are

$$r_t = F_1(K_t, H_t) \tag{14}$$

and

$$w_t^i = F_2(K_t, H_t)\phi^i, \tag{15}$$

where $F_j(K, H)$, for $j = 1, 2$, denotes the j^{th} partial derivative of the production function.[12]

Firms' first-order conditions (14) and (15) reveal that if a particular set of agents receives lower wages, either because they produce less or because of discrimination, larceny in this group will be higher.[13] This includes the young,

[12] The discrete partition of agents is used simply for clarity of exposition. Though a continuous partition could be used, issues such the perception of agents' productivity and discrimination are more easily seen when productivity levels are discrete.

[13] Discrimination raises aggregate larceny if the mass of agents whose wages are reduced by discrimination is at least as large as the mass of those wages are raised due to discrimination; those hurt by discrimination are poorer than those who benefit from discrimination; and $\frac{\partial^2 e^{i\star}}{\partial (w^i)^2} > 0$. The first two conditions constitute the standard effect of discrimination (oppressing a large group of the poor for the benefit of a few who are wealthy) while the latter is simply the diminishing marginal impact of wages on larceny (since $\frac{\partial e^{i\star}}{\partial w^i} < 0$).

who are a primary source of crime, as well as ethnic minorities who may receive lower wages due to discrimination or deficient language skills. These implications match the empirical analyses of Witte (1995), DiPasquale & Glaeser (1996) and Grogger (1997) and those discussed in DiIulio (1996).[14]

2.2. Government policy

Next, consider the problem faced by government policy-makers. The government minimizes losses from larceny by choosing policies $\{\tau, \eta, P, \sigma, J\}$ given individuals' optimal decision rules and the cost of each policy while satisfying a revenue-expenditure balance.[15] Anti-crime policies are funded by tax revenue $\tau \int_0^1 w^i h^i d\mu$ on (legitimate) labor earnings. I make two assumptions in solving this problem. First, policies apply uniformly to all people, rather than directed at certain groups. This simplifies the analysis and is consistent with the "targeting problem" where policies are difficult to aim at those individuals who are most likely to commit crime and instead are instituted generally (see Donohoe & Siegelman, 1995). Second, I assume that the expropriation function $\pi(e^{i\star}, P)$ is strictly convex in all policies. Under this assumption, the solution to the government's policy problem has a unique solution.

The timing of decisions is as follows: After observing the set of government policies, agents execute their optimal decisions given implicitly by (7), (8), and (9), which are parameterized by government policy variables. That is, the government and citizens play a Stackelberg game with the government moving first. Using this set-up, the government's problem is

$$Min_{\tau,\eta,P,\sigma,J} K_t \int_0^1 \pi(e_t^{i\star}, P_t) d\mu \tag{16}$$

s.t.

$$\tau_t \int_0^1 w_t^i h_t^{i\star} d\mu \quad = \quad \int_0^1 (\eta_t l_t^{i\star}) d\mu + \sigma_t + P_t + EG_e C_t^J,$$

where C^J is the cost to imprison convicted larcenists when sentences are length J, and EG_e is the proportion of the population in prison.

The solution to (16) equates, at the margin, expenditures on each government policy with the (dollar) reduction in larceny that it produces. This is one of the optimality criteria used to evaluate policies in Section 4. Note that the government policy problem is atemporal; the government chooses policies to reduce the current level of larceny, ignoring their effect on future larceny.[16] Further, policies are dependent upon each other – the optimal amount of police expenditures, in general, depends on the amount spent on income transfers and leisure

[14] The implication for the commission of larceny by the "young" in the model can be made explicit by adding age as part of the definition of an agent's type and restricting agents' lifetimes to be finite.

[15] Note that conviction rates are endogenous, given a choice by the government of the other policies.

[16] If policies are intertemporal, solutions may not exist to the game in (16); see the discussions in Boldrin (1993) and Leininger (1986).

subsidies. As a result, the effect on larceny of changing one policy may depend on funding levels of other policies. The derivation of optimal policies in (16) is a generalization of the optimal penalties for crime in Becker (1968).

Optimal government policies have the form $\tau_t^\star = \tau(\mu)$, $\eta_t^\star = \eta(\mu)$, $P_t^\star = P(\mu)$, $\sigma^\star = \sigma(\mu)$, and $J_t^\star = J(\mu)$, where, as above, μ is the measure of agents by wealth and wages which characterizes the state of the economy. More simply, optimal policies depend on the joint distribution of wealth and wages, rather than, say, average income or average wealth.[17] Policies to reduce larceny reflect the fact that this crime is driven by the differences in legal earnings among individuals, differences in wealth, as well as aggregate community wealth (by the adding up condition for capital (11)).

Combining all the elements above, an equilibrium for this model can be defined.

Definition. A *competitive equilibrium* is a set of prices $\{r_{t+1}, w_t^i\}$ given the wage distribution vector ϕ, and government policies $\{\tau_t, \sigma_t, \eta_t, P_t, J\}$ for $t = 0, 1, 2, \ldots$ which individuals take as given when solving their optimization problem (3) such that, given initial assets and a law of motion for the measure of individuals by wealth and wages, $\mu_{t+1} = \Omega(\mu_t)$, individuals maximize lifetime utility using (7), (8) and (9), firms maximize profits using (14) and (15), and, given consumer and firm choices, the labor and capital markets clear by (11) and (12). Finally, given time allocation rules, government policies for each time t are a perfect Nash equilibrium to the Stackelberg game solved by the government in (16).

Note that a competitive equilibrium may not exist for some specifications of the model since the choice of e_t^i depends on $e_{t+1}^i, e_{t+2}^i, \ldots$ so that there is a problem of regress. This can be solved by assuming that future choices follow a fixed rule, or that agents are myopic. I shall revisit this issue in the next section where I set up and solve a parameterized version of the model.

Assuming that a competitive equilibrium exists, the equilibrium level of larceny at time t is

$$K_t \int_0^1 \pi(e^{i\star}(w_t^i, a_t^i; \tau_t^\star, P_t^\star, \sigma_t^\star, \eta_t^\star, J^\star) d\mu. \tag{17}$$

Several implications can be drawn from the analysis thus far. First, the effect of community wealth, K, on larceny is ambiguous. When K is low, wages are low so that the opportunity cost of larceny is low, resulting in more time spent in larceny. But, since there is less wealth to steal, the payoff to time spent in larceny has also fallen. In addition, lower wages indicate that the opportunity cost of leisure has fallen, so more leisure time will be taken. The net effect of a change in K on larceny depends on the relative strengths of the desire for leisure

[17] Optimal policies do not include those that exhibit “tipping points” or hysteresis in which there is a convex impact of policies on crime over some interval as has been observed in the “broken windows” program in New York City (Kelling & Coles, 1998). A different specification for $\pi(e^i, P)$ would admit such effects, but this would lead to multiple (local) solutions to (16). On the relevance of tipping points, see Chamlin (1991).

versus the payoff to larceny. Second, discrimination generally reduces output. If discrimination keeps the wages of some group low, larceny in this group will be higher and the net return to investment for all agents is lower than it would otherwise be, reducing investment as in Zak & Knack (1998). Thus, if wage discrimination against minorities is common, communities with high proportions of minorities will exhibit high rates of larceny and will produce less output.

Third, optimal government policies to combat larceny depend on aggregate community wealth K as well as the distributions of wealth and wages. When incomes are low, government resources to fund policies are scarce and, as a result, larceny will be common. A similar effect obtains when the distribution of income is unequal. An unequal income distribution indicates that a large mass of agents have (relatively) low wages; more larceny therefore occurs than in an identical economy with less inequality.[18] Thus, the model shows that inequality reduces output, as in Alesina & Rodrik (1994), Persson & Tabellini (1994) and Zak & Knack (1998). Poor communities, such as urban ghettoes, may have chronically high levels of larceny due to policy underfunding even when community wealth is low. These communities may be stuck in "poverty-larceny" traps where high levels of larceny generate a feedback loop that leads to permanently low incomes and low rates of investment which cause larceny to remain high. This matches the empirical analyses of Freeman (1983, 1994, 1995, 1996) showing that crime occurs most often in low-income areas.

3. A parameterized model

Because larceny depends on aggregate wealth, K, and several government policies in a nonmonotone fashion, this section builds a parameterized version of the model to investigate the impact on larceny of these factors. The parameterized model also forms the basis for the simulation exercises in Section 4.

Let the utility function for all agents i be

$$U(c^i, l^i) = \ln(c^i) + \alpha \ln(l^i), \tag{18}$$

for $\alpha > 0$, and let the expropriation technology be

$$\pi^i = D(e^i)^\theta P^{-\gamma}, \tag{19}$$

for $\gamma, \theta \in (0, 1)$ and $D > 0$. The parameter θ denotes the productivity of time spent in larceny, γ captures the effectiveness of police expenditures in deterring criminal activity, and D is a scale factor. The parameterization of the expropriation technology (19) is used, rather than a more general "contest success function" as described in Skaperdas (1996), because its simple multiplicative form allows

[18] Observe that as wages become large, the time spent in larceny approaches zero. Therefore, when the distribution of wages widens (e.g. in a mean preserving spread), the time in larceny for high wage agents remains near zero, but for low wage agents time in larceny increases nontrivially, raising aggregate larceny as long as $e^{i\star}$ is convex.

a closed-form solution for aggregate larceny to be found and permits direct estimation of the parameters θ and γ which are needed for the simulations.[19]

Because of the aforementioned existence problem, assume that current decisions are made by setting future time allocations l^i, e^i and h^i (which determine expected future income y^i in the optimality condition for time spent in larceny (10)) to their steady state values. Using this assumption, the parameterization above leads to the following optimal time allocation rules for individual i,

$$e_t^{i\star} = \left[\frac{D\theta K_t P_t^{-\gamma}}{w^i(K_t) + EG_e \Sigma_{j=t+1}^{t+J} y_j^i}\right]^{\frac{1}{1-\theta}} \tag{20}$$

$$\begin{aligned} h_t^{i\star} &= \left[\frac{w^i(K_t) - (1+\alpha)\eta_t}{(1+\alpha)(\eta_t + w^i(K_t))}\right]\left[1 - e_t^{i\star}\right] \\ &\quad - \left[\frac{\alpha}{(1+\alpha)(w^i(K_t) + \eta_t)}\right]\left[\sigma_t + e_t^{i\star} K_t P_t^{-\gamma}\right] \end{aligned} \tag{21}$$

$$l_t^{i\star} = \left[\frac{\alpha}{w^i(K_t) + (1+\alpha)\eta_t}\right]\left[w^i(K_t) h_t^{i\star} + \sigma_t + e_t^{i\star} K_t P_t^{-\gamma}\right], \tag{22}$$

where y^i in Eq. (20) is defined in (10). The dollar value of larceny is thus

$$K_t \int_0^1 P_t^{-\gamma} (e_t^{i\star})^\theta d\mu, \tag{23}$$

where $e_t^{i\star}$ is defined in Eq. (20).

Several implications of the model can be clarified using optimality conditions (20) to (22) and the aggregate larceny Eq. (23). First, when wages rise, the incidence of larceny in (20) falls. This suggests that larceny will increase when unemployment increases; Sjoquist (1973) and Yamada, Yamada & Kang (1991), indeed find strong business cycle effects on the crime rate. Second, recall that in the general model of the last section, changes in capital, K, had an ambiguous effect on larceny. The parameterized version of the model can be used to show that, holding government policy constant, individual i will devote *less* time to larceny when K increases if

$$(1-\tau)w^i(K_t) + EG_e \Sigma_{j=t+1}^{t+J} y^i(K_j) < K_t \left[w^{i\prime}(K_t)(1-\tau) + G_e \Sigma_{j=t+1}^{t+J} y^{i\prime}(K_j)\right]. \tag{24}$$

Equation (24) demonstrates that individuals with low wages that are insensitive to the level of community wealth ($\phi^i \simeq 0$) commit more larceny when wealth rises as inequality (24) is not satisfied. Those with higher wages are more likely to satisfy (24) and will therefore commit fewer larcenies as aggregate wealth increases. Thus, the net effect of changing community wealth on larceny depends on the *distribution* of wages. Growth in aggregate resources may occasion an

[19] Though the expropriation technology (19) is not strictly bounded below unity, the calibration of the model via parameter D in Section 4 will generate, for any observed value of P, a value of π^i which is less than one even when $e^i = 1$. Moreover, after calibration the equilibrium value $e^{i\star}$ is very close to zero for all agents and the estimated value of γ is small so that the simulation results are relatively insensitive to the specification in (19). I thank a referee for pointing this out.

increase in crime in communities where additional resources are not shared with people on the bottom of the earnings ladder.

Next, we examine the effect of government policy on larceny. Using (23), increasing police expenditures, P, unambiguously reduces larceny as does a higher conviction rate for larcenists, EG_e. Increasing the length of prison sentences J, which increases the income foregone while incarcerated, also reduces larceny. These implications are consistent with the empirical work of Levitt (1995, 1997), DiPasquale & Glaeser (1996), Tauchen, Witte & Griesinger (1994), Freeman (1994) and Witte (1980) who show that deterrence and incarceration reduce crime. The model does not support the "replacement criminal" hypothesis (see Witte, 1995) in which incarcerated criminals are replaced by others waiting in the wings to engage in crime.[20] As a result, uniform changes in the economic environment or in government policy do affect the equilibrium amount of larceny as agents substitute away from larceny when its relative payoff falls.

Increases in the other two government policies, subsidizing leisure activities, η, and income redistribution, σ, have ambiguous effects on larceny. Leisure subsidies raise the time spent in leisure activities, but their effect on the time spent working and in larceny does not follow an interpretable rule. The same is true for income maintenance programs such as AFDC. The model shows that income transfers decrease the time spent working but may increase or decrease both leisure time and time in larceny depending on the strengths of the income and substitution effects. This suggests that the debate regarding programs such as midnight basketball is warranted – the effect on larceny of such a policy depends on the underlying economic conditions, especially the distribution of income, and policies already in place. On net, its effect on larceny may be positive, negative or zero.

To examine the impact of leisure subsidies and income transfers on the commission of larceny, and to quantify the effects of the other policies, we next turn to simulations of the parameterized model.

4. Policy and larceny

If the goal of this paper is to quantify the impact of government policy on the commission of larceny, why develop the behavioral model in the previous section rather than simply correlate policies and outcomes? The theory of larceny in this paper focuses the subsequent empirical analysis in several ways that the previous empirical literature on crime has overlooked. Foremost is that the "production" of larceny is endogenous, being determined at the same time that work and leisure decisions are made, and that the economic and policy environments establish the trade-offs between legitimate and illegitimate activities. The model in this paper could be estimated if the time allocations between work, leisure and larceny were

[20] The model could generate the replacement of incarcerated criminals if the return to theft was proportional to the number of individuals involved in this activity as in the insurrection model of Grossman (1991), but the data do not appear to support such an assumption.

known, but such data are not available.[21] The second broad implication of the theory is that policy variables affect larceny nonlinearly. While the estimation of linear models of crime can be used to determine policies' correlations with outcomes, if a policy's true impact is nonlinear, the determination of optimal funding that comes from linear versus nonlinear models will be quite different. Further, since the model shows that the impact on larceny of all of the policies considered depends on the economic environment and on the existing mix of policies, all these interactions must be considered when evaluating a change in policy. For this reason, a hybrid technique is adopted to determine the quantitative impact of economic and policy changes on larceny. In the first stage, statistical methods produce estimates of the parameters in the aggregate larceny equation. In the second stage, these parameters are used in a simulation model that is calibrated to data from Los Angeles County for 1989. After calibration, simulations allow individuals to respond to policy changes via their optimality conditions which determines the new level of larceny.

The empirics begin with the parameterized aggregate larceny Eq. (23), evaluated at a steady state using micro-level data on households partitioned by age and ethnicity (White, Black, American Indian, Aleut and Eskimo, Asian, Hispanic and other).[22] In this way, the empirics control for ethnicity as it relates to variations in income and wealth (and discrimination), without presuming that a particular ethnic group is more or less likely to commit larceny. It is important to note that Eq. (23) is derived in terms of the dollar value of larceny and the dollar value of crime-prevention policies. This is a departure for the usual practice of estimating the *number* of crimes from the FBI's Uniform Crime Reporting (UCR) database, which is prone to underreporting. Underreporting occurs because when an individual commits multiple crimes at one time, only the most grievous crime is listed in UCR data. Even grand larceny, when accompanied by other felonies, may not be sufficiently heinous to receive top billing. In addition, aggregating the number of larcenies, with each incident having a different value of property stolen, has less meaning than aggregating the losses due to larceny.[23] By using the dollar value of larceny as the focus of the analysis, the effect of government policies to reduce larceny can be directly compared with their costs.

The data are of three broad classes. First, data on losses from larceny, arrest and conviction rates, and prison terms come from the UCR database and California's Department of Justice, Bureau of Criminal Statistics publication, *Criminal Justice Profile, 1990*. Second, demographic and economic data come from the 1990 census, with the data collected in 1989. Government policies are the third class of data and are taken from *Financial Transactions Concerning Counties of California* and census data. The description and sources of each variable, means,

[21] Grogger (1997) faces a similar lack of data for time spent in crime, and estimates his model by using an additional crime participation probit equation.

[22] Since the model is stochastic, there is not a true steady state. I use the term loosely here to mean that agents have been in the economy sufficiently long that the factors in their optimality rules are stationary, as are the distribution of assets and the capital stock.

[23] Data on the dollar value of larceny are generally considered to understate actual losses by at least a factor of two due to unreported crimes.

and standard deviations are presented in the Appendix in Tables 3 and 4. The data cover the 128 cities in Los Angeles County. Due to missing values, simulations are based on 85 cities in Los Angeles County, accounting for 90 percent of the county's population. The data are collected by age and ethnic group within each city and then aggregated to the city level for simulations. Reported simulation results are aggregated from the city level to the county level, showing the changes in larceny for Los Angeles County as a whole.[24]

Prior to estimation, the integral in the larceny Eq. (23) is discretized by dividing the population within a city into I groups and normalizing all values by the population within a city.[25] Let Λ_j denote per capita dollar losses due to larceny in city j and define the expected income loss for time spent in prison as

$$\begin{aligned} Z_{jt}^{i} &= EG_e \Sigma_{m=t+1}^{t+1+J} \beta^{j-t} \\ &\times \left[(1-\tau_{jm}) w_{jm}^{i} h_{jm}^{i\star} + \eta_{jm} l_{jm}^{i\star} + K_{jm}\pi(e_{jm}^{i\star}, P_j) + \sigma_{jm}\right], \end{aligned} \tag{25}$$

where $e^{i\star}, h^{i\star}, l^{i\star}$ are given by (20), (21), and (22), with the relative preference for leisure is fixed at $\alpha = 2$ and the discount factor $\beta = .95$ following the real business cycle literature (Cooley, 1995).[26] Using this notation, and letting $\nu \equiv \frac{1}{1-\theta}$, the discretized amount of per capita larceny in city j is

$$\Lambda_j = D^{\nu} K_j^{\nu} P_j^{-\gamma\nu} \theta^{\theta\nu} \Sigma_{i=1}^{I} (Z_j^i)^{-\theta\nu} \frac{N_j^i}{N_j} \tag{26}$$

where $\frac{N_j^i}{N_j}$ is the proportion of individuals of type i living in city j. Defining lower-case variables to be logarithms and letting $A \equiv \ln(D^{\nu}\theta^{\theta\nu})$, $\nu_1 \equiv -\gamma\nu$, and $d_j^i \equiv \frac{N_j^i}{N_j}$, the estimable equation can be written

$$\lambda_j = A + \nu k_j - \nu_1 p_j + \ln\left[\Sigma_{i=1}^{I} (Z_j^i)^{\nu-1} d_j^i\right]. \tag{27}$$

Parameter estimates cannot be found from Eq. (27) without a simplification. Observe that the last term in (27) cannot be constructed without foreknowledge of ν, and is therefore approximated by $(\nu-1)\ln[\Sigma_{i=1}^{I}(Z_j^i)d_j^i]$ which is foregone income if incarcerated for each agent type, times the relative weight of these agents in their city. Under this simplification, there is a unique estimate for each parameter in (27) when the cross-parameter restrictions from the theory are imposed (the constant is not restricted since data is lacking on D). Note that standard statistical measures (e.g R^2) do not have the usual interpretations because of the nonlinearity of the parameter restrictions.[27]

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[24] City level simulation results are available upon request.

[25] By using per capita values on city-level basis, I am implicitly assuming that criminals do not cross city boundaries to commit larceny. Glaeser & Sacerdote (1996) cite criminological research that "strongly suggests that criminals do not travel long distances to perform crimes" due the difficulty of transporting goods and the higher probability of arrest when traveling long distances from the crime scene.

[26] Recall that α enters into the derivation of $h^\star$ and $l^\star$ in (21) and (22).

[27] On the misinterpretation of R^2 for models that are nonlinear in the parameters, see Kvålseth (1985).

Table 2. The effects of increasing government policies and wages by 1%.

Policy:	Leisure Subsidies	Income Transfers	Conviction Rates
Change, $ larceny	-4.4 E^{-11}%	-0.0000030%	- 0.0001489%
Change, time in larceny	-2.6 E^{-10}%	-0.0017805%	-0.0875611%
Change, time in work	0.0000000%	-0.0708906%	+0.0000035%
Change, time in leisure	+2.6 E^{-10}%	+0.0726710%	+0.0875576%
Cost per capita	$0.501	$3.16	$0.0002
Benefit-cost per capita	- $0.501	- $3.16	-$0.0001
Cost, reduce larceny $1	$ 1.6 E^{10}	$1,458,188	$1.93
Change in Utility	-0.0005326%	+0.0014389%	- 0.1710675%

Policy:	Prison Sentences	Police Exp.	Police & Convictions	Wages
Change, $ larceny	-0.0067590%	-0.0000025%	- 0.0001514%	-0.0015469%
Change, time in larceny	-2.6246357%	-0.0014883%	- 0.0890481%	-0.9057925%
Change, time in work	+0.0001057%	+0.0000241%	+0.0000276%	+0.1037403%
Change, time in leisure	+2.6245300%	+0.0014642%	+0.0890205%	+0.8020522%
Cost per capita	$0.0061	$2.18	$2.18	$0.0026
Benefit-cost per capita	- $0.0028	- $2.18	- $2.18	- $0.0015
Cost, reduce larceny $1	$1.87	$1,203,473	$20,107	$2.33
Change in Utility	0.0000030%	-0.0000005%	- 0.1710679%	+0.1247205%

Table 5 in the Appendix reports the estimation of (27) by OLS. The estimated parameters are then used to back-out values for the deep parameters (θ and γ) in the time allocation rules for larceny, work and leisure. The resulting estimates (minus and plus one standard error) are $\hat{\theta}$ =.0017 (-.1291, .1054) and $\hat{\gamma}$ =.001499 (.0003, .0027). The estimated parameters have the predicted signs and, as assumed, lie on the unit interval.

Next, aggregate larceny, Eq. (26), is calibrated by choosing a value of the scale parameter D so that the model reproduces the dollar value of larceny committed in Los Angeles County in 1989, namely $620,366,098 or about $72 per person. This value of D is 0.0048327648505, which satisfies the calibration criterion of a percentage difference between the model and the data of less than 10^{-13}. The calibrated model produces reasonable estimates for the endogenous allocation of time among work, leisure and larceny. Specifically, the time allocations from the model predict that, on average, individuals spend about one-quarter of their time working, roughly three-quarters of their time in leisure activities, and less than 1 percent of their time in larceny.[28]

[28] Note that "leisure time" should be interpreted to include time for personal care, sleep, work in the home, and commuting as well as strictly leisure activities. The values reported in the text from this point on constitute population-weighted averages. The exact values predicted by the calibrated model for time allocations are h = 0.22955506535, l = 0.77043638673, e = 0.00000854792. Using a 40 hour work week, the time allocation expected for h is 0.238, showing that the model fits the data quite well.

Next, we examine the impact on larceny of changes in seven policies from their base levels. These policies are leisure-time subsidies, transfer payments, conviction rates, sentences lengths for those convicted of larceny, police expenditures and a combination of changes in police expenditures and conviction rates. The effect of rising wages is also examined. Table 2 presents the effects of these policy changes on aggregate larceny, time allocations among larceny, work and leisure, aggregate utility, the cost of the each program, the benefit-cost differential which is used to evaluate the optimality of policies as specified by the government's problem (16), and the cost-effectiveness of each policy in reducing larceny by one dollar.[29] Each policy change is discussed briefly below.

First, consider expenditures on leisure activities. This variable is measured as the total spent on parks, recreation, marinas and wharves, libraries, museums, sports arenas, stadiums and community centers on a per city basis, with per capita values ranging from \$1 to \$3,075. Raising each city's leisure expenditures by 1 percent raises the time spent in leisure slightly, with a corresponding reduction in time in larceny, while work time is unchanged. The result is that this policy, which costs \$0.50 per person, has essentially no effect on aggregate larceny, failing the optimality criterion. Recall that the theory did not permit us to sign the effect of leisure subsidies on larceny unambiguously, so the results reported here depend on the base values of other policies in the model as well as on the distribution of income.

Next we examine the effect of transfers on larceny. Census data for AFDC payments received by households for the cities in Los Angeles County has spotty coverage and is therefore a poor measure of the transfers that households receive. A measure with wider coverage is state and local income transfers, found in *Financial Transactions for Counties of California, 1989–1990*. This value is \$319 per capita, countywide. Starting from this base value, the model is simulated when transfers increase 1 percent. With this policy change, time worked falls 0.071 percent, leisure time increases 0.073 percent and time spent in larceny falls slightly. As a result, aggregate larceny falls, but by very little. Such a policy would cost Angelenos \$3.16 per capita and would not reduce per capita larceny losses by a measurable amount. Again, this policy fails the optimality test.

The next set of simulations quantifies the impact of law and order policy changes. If legal changes increase conviction rates for larceny by one percent from a county-wide average of 13.1 percent, to 13.231 percent, the dollar value of property crime falls less than \$0.0001 per capita as time in larceny falls by 0.086 percent. The cost of this policy change results from more larcenists being imprisoned. Prison is estimated to cost \$15,000 per year per person (California Department of Corrections, 1997), which, with the higher conviction rate, translates into an additional cost of \$0.0002 per capita. Thus, net benefits of this policy

[29] The cost-benefit analysis understates the social benefits of incapacitation and deterrence as larcenists typically commit other crimes. Thus, the net benefits of different policies should be considered a lower bound on achievable social gains.

are negative.[30] The negative net benefit of raising conviction rates is replicated for the other law-and-order policies. Increasing sentences for larceny by 1 percent from a base of two years causes time spent in larceny to fall 2.6 percent and reduces the dollar value of larceny by 0.007 percent, the largest impact of any of the policies considered. The increased prison population produces a negative benefit-cost calculation of $0.003 per person failing the optimality criterion.[31] Alternatively, deterring larceny by increasing each city's police expenditures by 1 percent results in less time being spent in crime, with most of this time going into increased leisure. Again, this policy is inefficient: it costs $2.18 per person but decreases larceny by less that a penny per person. If raising police expenditures 1 percent also raises the conviction rate 1 percent (if, say, better evidence is collected), there will be a larger decrease in larceny, but again the net benefit is a loss of $2.18 per person to fund an expanded police force.

The final "policy" considered is the effect of economic development on larceny. Annual average wages for cities in Los Angeles County range from $3,900 (the city of Industry) to $82,709 (Rolling Hills). If wages were to rise uniformly by 1 percent, larceny would fall by 0.0015 percent. When this change is part of the natural growth process, uniformly rising wages lead to less larceny without any direct costs (when the distribution of income is unchanged). But a government program to raise the wages for all residents in order to reduce larceny fails the optimality test.

The penultimate row of both panels of Table 2 shows the cost of reducing larceny by one dollar for each of the scenarios considered. The least cost policy to reduce larceny is longer prison sentences, which costs $1.87 per capita to reduce larceny by one dollar per capita. Even though this policy does not satisfy the benefit-cost criterion, it suggests that the $5.3 billion prison construction program currently ongoing in the state of California is among the least expensive ways to reduce larceny.[32] The next least expensive way of reducing larceny is by raising the conviction rate, which costs $1.93 per person to reduce larceny by one dollar. The other policies considered range from $20,000 to nearly $16,000,000 per capita to reduce larceny by one dollar per capita. These calculations show that all of the policies considered do little to reduce larceny, and thus the reduction of larceny via policy changes is prohibitively expensive. This suggests that households may find other methods to reduce larceny, such as hiring private security guards or living in gated communities.

Using an income-based cost-benefit criterion to evaluate policies is an incomplete analysis of the welfare effects of larceny-reduction policies, since it does not account for the value of changes in leisure time. The last line of both panels of Table 2 reports the impact on aggregate utility of each policy change, where the

[30] An example a policy change that would lead to higher conviction rates is a relaxation of evidentiary admission rules for trials.

[31] Because of the intertemporal nature of prison, this exercise involves raising sentences from two years to three, a 50 percent increase and then adjusting the values by $\frac{1.01}{1.50}$ to rescale it to a 1 percent increase so that it is comparable to the other policy changes. Foregone income by those incarcerated is discounted at 5 percent.

[32] In 1997, 25.3 percent of the California prison population was incarcerated for property crimes.

social welfare function weights each agent who is not incarcerated identically.[33] These calculations show that three of the policies considered – income transfers, longer prison sentences, and increasing wages – raise welfare. Interestingly, even though income transfers spectacularly fail the (aggregate) cost-benefit criterion, they raise aggregate utility. This occurs because the tax used to fund transfers is an income tax, so that the highest income agents, who do not engage in larceny, pay the most, while such transfers result in a net subsidy to low-income agents. Longer prison sentences raise welfare because they are the most efficious policy to reduce larceny, resulting in the largest impact for the revenue spent. The other welfare enhancing change is increasing wages, which raises welfare since individuals choose more leisure and work, but less larceny as wages increase. All other policies reduce aggregate welfare, with the largest reduction resulting from increased conviction rates, and the smallest being raising police expenditures which the simulations show have very little impact on larceny.

The sensitivity of the results to changes in parameter values is presented in Table 6 in the Appendix. This table reports the optimality calculation and welfare analysis for each policy when the parameters backed out from the estimation are increased or decreased by their standard errors, that is, using $\{\hat{\theta} + SE, \hat{\gamma}\}$, $\{\hat{\theta}, \hat{\gamma} + SE\}$, and $\{\hat{\theta}, \hat{\gamma} - SE\}$.[34] The case $\hat{\theta} - SE$ is not examined as this results in $\theta < 0$ which the theory disallows. Increasing θ indicates that the expropriation technology is more productive, while increasing (decreasing) γ raises (lowers) the efficacy of the police at deterring larceny. Table 6 confirms the baseline analysis in Table 2; almost every policy change to combat larceny fails the optimality criterion. Nevertheless, when θ is higher, several policies do meet the optimality test (and raise welfare). Longer prison sentences, higher conviction rates, and rising wages all decrease larceny more than they cost to implement. For the higher value of θ, larceny can by reduced by \$1 per capita by increasing prison sentences or raising conviction rates, both of which cost 3 cents per capita. Policies are efficient as agents are now more sensitive to the trade-off between returns in the legitimate versus illegitimate sectors. Though not shown in the table, longer prison sentences continue to be the most effective way to reduce larceny for all parameter values examined. Variations in γ have very little impact on the level of larceny, and all policy changes are suboptimal when θ is at its base value.

5. Conclusion

This paper presented a dynamic general equilibrium model of larceny in which individuals allocate their time among work, leisure and crime, responding to

[33] In models with heterogeneous agents, there are many possible social welfare functions. I am using an *equal treatment* function (Azariadis, 1993, p. 190ff) of the form $\overline{U} = \Sigma_i N^i [\ln(c^i) + \alpha \ln(l^i)]$. Since imprisoned agents do not receive utility from consuming goods or leisure, they are not part of the calculation of social welfare. Nevertheless, as prison is a stochastic draw, aggregate welfare represents average utility across free and imprisoned agents.

[34] I thank a referee for suggesting this analysis.

economic and policy incentives. Simulating the endogenous choices for time allocations in the model using data from cities in Los Angeles County shows that larceny is endemic. Policy changes have very little impact on the commission of larceny, which is primarily a response to poor labor market conditions. Of the policies considered, the largest reduction in larceny occurs when prison sentences are lengthened, followed by an increase in conviction rates. The baseline simulations show that all the policies examined are already funded beyond optimal levels.

The results in this paper are subject to several caveats and the analysis suggests several extensions. The most important caveat is that the simulations are for Los Angeles County and may not hold for other municipalities. In addition, particular functional forms are used in the simulations upon which the results depend. Though the modest results found here suggest that the model is not overstating the impact of policy changes on larceny, it may be underpredicting the actual effects as larceny often accompanies other crimes. The model also does not consider the effect of social and neighborhood interactions on the commission of crime which Glaeser, Sacerdote & Scheinkman (1996) have shown are important. Further, the analysis does not consider the role-model effect of directed leisure activities, like the Police Athletic League, which are generally believed to have a greater impact on at-risk youth than simply building more sports facilities (Crane, 1991; Mendel, 1995). Other programs that may reduce larceny that warrant further research are intervention in at-risk families, the impact of religious organizations, and community-based counseling (Freeman, 1986; Witte, 1995; DiIulio, 1996). The estimates reported here should be considered lower-bounds on achievable social gains. Lastly, the model could be extended to include time spent in school and the accumulation of human capital to capture the effect of education on reducing crime (Witte, 1995; Tauchen, Witte & Griesinger, 1994). Nevertheless, as the model shows, larceny is primarily committed by low-income individuals who are the most likely to be credit constrained in the acquisition of human capital (Galor & Zeira, 1993). The analysis in this paper shows that for all the policies considered, income net of taxes will be highest when larceny is tolerated rather than combated, as in the work on predation by Grossman & Kim (1996).

6. Appendix

Table 3. Data sources

Variable	Definition	Source
Λ_j	Per capita dollar losses from larceny	UCR
K_j	Community wealth, proxied by p. c. income	1990 Census
d^i	Proportion in age & ethnic group i	1990 Census
η_j	Leisure expenditures	City Gov't Finances, 1990
w_j^i	Wage income	1990 Census
P_j	Police expenditures	City Gov't Finances, 1990
J	Prison sentences	Average Time Served in Cal., 1990
G_e	Arrest and conviction rate	Cal. Criminal Justice Profile, 1990
σ_j	Per capita transfers	Fin. Trans. for Cal., 1989– 1990

Table 4. Summary statistics

Variable	Mean	Std. Dev.
Λ_j	$976	$6,382
K_j	$18,954	$12,816
d^i	0.0118	0.0484
Z_j^i	$ 1,738	$ 1,278
η_j	$ 114	$ 280
w_j^i	$17,457	$12,645
P_j	$ 884	$6,179
J	2	–
G_e	.131	–
σ_j	$ 316	–

1. All reported values are per capita. The data for J, G_e, and σ are county-wide and therefore have no variance.
2. Expected income loss if imprisoned, Z^i, is defined as: wages + leisure subsidy + larceny earnings + transfers, using a two year prison sentence and discounting income at 5% per year.

Table 5. Estimation of larceny equation

Parameter	Estimate	Std. error
A	-11.07899	3.045795
ν	1.001688	0.116084
ν_1	0.001499	0.001171

Table 6. Per capita benefits – costs of various policy changes when parameters vary

POLICY:	$\hat{\theta}+SE,\hat{\gamma}$	$\hat{\theta},\hat{\gamma}+SE$	$\hat{\theta},\hat{\gamma}-SE$
Leisure Subsidies	-\$0.501	-\$0.501	-\$0.501
Transfers	-\$3.157 ⋆	-\$3.157 ⋆	-\$3.157 ⋆
Conviction rates	\$0.032	\$0.00	\$0.00
Sentence lengths	\$0.906 ⋆	-\$0.003 ⋆	- \$0.003 ⋆
Police	- \$ 2.178	- \$ 2.178	- \$2.178
Police & Conviction rates	- \$2.178	- \$2.178	- \$2.178
Wages	\$0.048 ⋆	-\$0.002 ⋆	-\$0.002 ⋆

1. ⋆ denotes an increase in aggregate welfare for this policy change.
2. Parameter values are $\hat{\theta}+SE = .1054$, $\hat{\gamma}+SE = .0027$, $\hat{\gamma}-SE = .0003$.
The case $\{\hat{\theta}-SE,\gamma\}$ is not analyzed as $\hat{\theta}-SE = -.1291 < 0$ which is disallowed.

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