On the intergenerational nature of criminal behavior

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Abstract

Empirical evidence suggests that family background and parental criminality are strong predictors of an individuals' criminal behavior. The aim of this paper is to account for this intergenerational nature of criminal behavior within a simple theoretical model. Drawing on the literature of cultural transmission, we model the dynamics of moral norms of good conduct (honest behavior). Individuals' criminal behavior and morality are strategic complementarities that reinforce each other. We establish the existence of multiple steady states and provide conditions on the socialization process under which both types - honest and dishonest - survive in the long run even though parents commit crime but at the same time agree that honesty is desirable. Our model provides a novel explanation of why crime is highly concentrated in specific areas and also why crime rates tend to be persistent over time. An empirical application reveals that our model can account for the differential reductions in property crime rates across US federal states since the 1980s.

Keywords crime, cultural transmission

JEL-Classification H26, Z13, D91

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1 Introduction

...I never wanted this for you [Michael]...I always thought that when it was your time, that you would be the one to hold the strings. Senator Corleone, Governor Corleone, something.

– Vito Corleone

It is a well established fact that crime runs in the family. Despite having a long history in criminology[1], the familial nature of criminal behavior has only recently attracted the interest of the economics of crime literature, see Hjalmarsson and Lindquist (2012, 2013) and Duncan et al. (2005).[2] According to these studies, family background and, in particular, parental criminality are among the most relevant predictors of an individual's criminal behavior, more important even than own income or employment status. Hjalmarsson and Lindquist (2012), for example, show that a son (daughter) with a criminal father has 2.06 (2.66) times higher odds of having a criminal conviction than a son (daughter) with a noncriminal father and that parents' behavior and socialization processes may account for a large share of this intergenerational crime relationship. The aim of this paper is to rationalize this stylized fact within a theoretical model based on the cultural transmission of moral values and socialization within the family.

The idea that preferences, beliefs and moral norms are transmitted through generations and adopted by learning and other forms of social interaction has recently received considerable attention in the economic literature. Indeed, based on some studies on sociology and anthropology (see in particular Boyd and Richerson (1985), Cavalli-Sforza and Feldman (1981)), many studies, following the seminal papers of Bisin and Verdier (2000, 2001), argue that the transmission of a particular trait (social status, religion, ethnicity, etc.) is the result of a socialization process inside and outside the family (like e.g. role models and peers).

In our model, to account for the familial nature of criminal behavior, we consider the formation of an 'honesty' trait. Individuals' decisions to commit crime are not only affected by economic incentives but are also influenced by rules of good conduct and morality inherited from previous generations.[3] Parents rationally anticipate that their own criminal behavior has

[1] See Rowe and Farrington (1997) and the historical references therein. Thornberry (2009) provides a thorough review of the criminology literature.

[2] See also Eriksson et al. (2014) for an attempt to quantify the relative importance of family background and neighborhood effects in determining criminal behavior.

[3] See also Tabellini (2008) who studies the cultural transmission of a norm that affects individuals' decisions to behave cooperatively in situations like for example, the Prisoner's

a negative impact on the transmission process of the 'honesty' trait. More specifically, the transmission process encompasses direct socialization inside the family and indirect socialization via neighborhood effects and social interactions (horizontal and oblique socialization). This creates a strategic complementarity between current behavior and values, which reinforces the effects of changes in exogenous variables and in the external environment (e.g. crime deterrence or education policies)[4]. The more individuals commit crime, the lower is the likelihood of successfully transmitting positive moral values which in turn expands the share of individuals with norms of bad conduct in society. Thus, policies aimed at deterring criminal behavior may not only alter economic incentives but also have long-lasting and amplifying effects through changes in the cultural transmission process.

Our analysis is related to the literature on cultural transmission and the economics of crime. However, in contrast to most of the cultural transmission literature (see e.g. Bisin and Verdier (2000) and Bisin and Verdier (2011)), we assume that all parents, irrespective of their type, agree that one of the traits (honesty) is superior.[5] We further assume that the parents' criminal behavior (rather than effort) has a direct negative impact on the children's probability of adopting the honest trait. While the standard assumption in the literature is that the transmission process requires some costly effort without further specification of its nature or the kind of activities necessary to produce it, we suggest that the observation of the parents' behavior by their kin is the mechanism through which children may assimilate the cultural traits of their parents. This is consistent with recent empirical evidence on the intergenerational nature of criminal behavior (see e.g. Hjalmarsson and Lindquist (2012, 2013)) and allows us to establish a clear difference between the distribution of traits and actual observed behavior. Specifically, even individuals with norms of good conduct may commit crime if it is economically profitable (and, similarly, individuals with norms of bad

Dilemma. Similarly, Hauk and Sáez-Marti (2002) analyze the evolution of morality and corruption.

[4] Glaeser et al. (2003) refer to this mechanism as the 'social multiplier'.

[5] Although it seems reasonable that parents try to transmit their own cultural trait when it comes to language or religion, this is different regarding traits and values associated with poor economic outcomes and low socioeconomic status (e.g. working in the informal economy, crime, etc.). So far there are only three studies exploring the theoretical implications when parents with different traits agree on which trait is desirable: Patacchini and Zenou (2011) focus on educational outcomes, Sáez-Marti and Zenou (2012) on work ethics whereas Sáez-Marti and Sjögren (2008) model the merit-guided learning on the part of children. Our analysis complements these studies by exploring the transmission of moral values and their role in determining criminal behavior.

conduct need not commit crime if it is not economically profitable).[6] Moreover, and importantly, the interplay between economic incentives and cultural transmission implies that parents may deliberately transmit the bad trait to their children as a by-product of their own behavior even though they agree that it is not the desired one. This case is novel to the literature.[7]

Another important ingredient of our model is the assumption that cultural transmission may be biased in favor of one particular trait or depends on the relative frequency of the trait in the population (see Boyd and Richerson (1985) and Sáez-Marti and Sjögren (2008)). The main idea behind this kind of oblique transmission process is that children learn from a large group of randomly selected peers (instead of a single one, which is the standard assumption in the literature).[8] With unbiased (or linear) oblique transmission and positive levels of crime for all types of parents, however, the unique possible steady state is the one in which all individuals acquire the undesired trait even though all parents agree on which trait is desirable. By contrast, with frequency-dependent or negative bias, we show that both traits can co-exist in equilibrium even if all parents commit crime. In the case of frequency-dependent transmission the extinction of the honest type may occur if the fraction of holders in society is large enough. The children's bias thus affects the actual equilibrium proportions. Specifically, biased transmission may imply multiple steady state equilibria such that initial conditions regarding the distribution of cultural traits may determine whether there will be diversity or assimilation in the long run. Therefore, contrary to previous papers, our theory can explain why criminal behavior persists even though parents agree that norms of good conduct (honesty) are desirable. Furthermore, we show that the introduction of a public education campaign not only implies that culture will always be diverse - independent of the children's bias - but also that it is a powerful policy instrument to fight criminal behavior.

The equilibrium multiplicity can also be used to explain the spatial pattern of crime observed in the United States. Indeed, a positive relationship between urban size and crime rates is a well-established empirical fact

[6] Conley and Wang (2006) use a similar approach to model the crime decision taking into account the degree of honesty of individuals. In their model, however, moral values are exogenously given.

[7] The main idea is also captured by Vito Corleone's initial quote from the famous movie *The Godfather*. Even though Vito never wanted his son Michael to be involved in the family's criminal enterprize, and actually hoped he would go into politics, in the end, Michael could not escape the criminal influence of his family.

[8] The importance of peer and neighbor effects in determining criminal behavior has recently been emphasized by Glaeser et al. (1996), Bayer et al. (2009) and Damm and Dustmann (2014).

(Glaeser and Sacerdote (1999); Kahn (2010)). For example, the rate of property crime in cities with more than 250,000 population is 1,144 per 100.000, and 875 per 100,000 in places under 10,000 in population. Similar patterns can be found for violent or other types of crimes (Glaeser, 1998).

Existing social interaction models of crime behavior focus either on social interactions with peers and neighbors (see e.g. Patacchini and Zenou (2012), Calvo-Armengol et al. (2007), Ballester et al. (2006, 2010), Calvo-Armengol and Zenou (2004), Glaeser et al. (1996)) or on externalities related to the number of criminals in specific areas (e.g. Conley and Wang (2006), Freeman et al. (1996), Sah (1991))[9]. Our model complements these studies by explicitly modeling the role of socialization within the family as a crucial determinant of criminal behavior which has been neglected so far. In fact, our analysis is the first to formally explore the intergenerational nature of criminal behavior. Our paper thereby not only adds further insights towards understanding the cause of multiple equilibria in crime models but also provides a novel and reasonable explanation for the existence of a differential in criminal activity across space and time, in particular the geographical concentration of crime activity and the phenomenon of urban ghettos (see e.g. Grogger and Willis (2000)).

Furthermore, an empirical application reveals that our model can account for the differential reductions in property crime rates across US federal states since the 1980s. Indeed, despite similar changes of economic variables and increases in the size of crime deterrence expenditures, states with almost the same crime rates in the late 70s may end up with completely different levels of crime in mid 2000. According to our theory, the (non-)existence of a social multiplier effect may be the key explanatory factor of why crime tends to be relatively persistent in some states whereas anti crime policies may have a large impact in others.

The remainder is organized as follows. Section 2 describes the model, establishes the existence of multiple steady states and presents comparative static results. Section 3 introduces a public education campaign into the basic framework and analyzes the consequences for the cultural transmission process and the existence of crime equilibria. Section 4 relates the theoretical findings of our model to data on crime in the US. Section 5 concludes.

[9] See Zenou (2003) for an overview. Empirical evidence for these explanations is provided by Glaeser and Sacerdote (1999), Kling et al. (2005), Ludwig et al. (2001), Bayer et al. (2009) and Sah (1991).

2 The Basic Model

We consider a society populated by overlapping generations where the size of each generation is normalized to one. All agents live for two periods. When young (first period), individuals acquire their preferences; when old (second period), they become parents, have one child and decide how to split their time between joining the labor force and engaging in criminal activities.[10] Each old individual may either possess a high productivity θ^h or a low productivity θ^l to earn income in the legal market. We denote the time invariant share of individuals with low productivity in the economy by η. The ability to commit crime is assumed to be the same for all individuals[11] and the net return from committing crime depends on economic factors (market income, apprehension probability, individuals' ability) and on moral norms of good conduct which are in turn determined by a transmission and socialization process from their parents.

In the following, we first consider how young agents adopt these cultural traits which in turn affect economic outcomes during old-age.

2.1 The transmission process

There are two different types of cultural traits in society, L and H. These types are referred to as dishonest and honest, respectively. Parents are altruistic and care about the type of their children. In contrast to most of the existing literature, however, we consider that all parents, independently of their own type, agree that one of the traits (honesty) is preferable.[12] This is consistent with evidence by Rowe and Farrington (1997) who show that even criminal fathers disapprove their son's offending.[13] Socialization affects the adoption of traits only during childhood so that adult individuals keep the acquired trait throughout their lifetime. As in Bisin and Verdier (2000, 2001), the transmission of traits is modeled as a combination of so-

[10] Similar assumptions can, e.g., been found in Block and Heineke (1975) and Lochner (2004). Note further that we normalize the individuals' time endowment to one.

[11] There is no empirical evidence of a clear positive correlation between the market productivity and the skills to commit a crime, that is, individuals with high productivity are not more productive in the crime sector (see for example Lochner (2004) and Lochner and Moretti (2004)).

[12] By contrast, Tabellini (2008), and also Hauk and Sáez-Marti (2002) and Bisin and Verdier (2000), assume that parents prefer their own trait.

[13] Indirect evidence in favor of this assumption also comes from survey data. In the response to NORC's General Social Survey's question, 'Which three of the qualities listed would you say are the most desirable for a child to have?', 'honesty' is the most cited quality across the sample (Bisin and Verdier, 2011, p.394).

cialization inside the family (vertical socialization, namely the parents' behavior) and socialization outside the family (oblique socialization, namely the social environment where children live). However, in contrast to the existing theoretical literature, but consistent with evidence in Hjalmarsson and Lindquist (2012) and others, we posit that the parents' behavior (the decision to commit crime) rather than effort has a direct positive effect on the probability of the child adopting the bad type through vertical transmission, e.g. through social learning or adopting parental role models. Still, the probability of adopting a specific type also depends on peer group effects and thus on socialization by society through a process of oblique transmission. The importance of peer group effects in determining criminal behavior has been emphasized, e.g., by Damm and Dustmann (2014), Bayer et al. (2009) and Glaeser et al. (1996).

More formally, let μ_t $(1-\mu_t)$ be the proportion of L-type (H-type) adults and $x_t^{L,k} \in [0,1]$ ($x_t^{H,k} \in [0,1]$) the fraction of time a L-type (H-type) parent with ability $k = h,l$ devotes to criminal activities in period t. Then, the total probability that the child of an L-type (H-type) adopts L (resp. H) is given by:

$$P_k^{LL} = x_t^{L,k} + (1 - x_t^{L,k})S(\mu_t) \tag{1}$$

$$P_k^{LH} = (1 - x_t^{L,k})(1 - S(\mu_t)) \tag{2}$$

$$P_k^{HH} = (1 - x_t^{H,k})(1 - S(\mu_t)) \tag{3}$$

$$P_k^{HL} = x_t^{H,k} + (1 - x_t^{H,k})S(\mu_t) \tag{4}$$

where $S(\mu_t)$ captures the process of oblique transmission, namely how children are influenced by society (peers). Before discussing the properties of the transmission function $S(\mu_t)$ in more detail, we first interpret equations (1)-(4). The child of a dishonest parent will also be dishonest with probability equal to the parents' time spent on criminal activities (eq.1). If this direct transmission fails (with probability $1 - x_t^{L,k}$), the child acquires the dishonest trait from his/her neighborhood (with probability $S(\mu_t)$). The probability that a child of dishonest parents becomes honest is defined by equation (2). This may only happen if the child does not acquire the bad trait from either his/her parents or his/her peers. For honest parents (equations (3) and (4)), the interpretation is similar. Note further that an increase in the parents' criminal activities unambiguously lowers the probability of the children to adopt the good trait, i.e. $\partial P^{iH}/\partial x_t^{i,k} < 0$, $i = L,H$, $k = h,l$.

The oblique transmission function $S : [0,1] \to [0,1]$ is assumed to be twice continuously differentiable and increasing such that $S(0) = 0$ and $S(1) = 1$. The standard assumption in the literature is that children are randomly

matched to one role model who provide them the trait to copy. This results in an unbiased oblique transmission function, $S(\mu_t) = \mu_t$, so that children acquire each of the traits with a probability equal to their share in the population. Following Sáez-Marti and Sjögren (2008) and Boyd and Richerson (1985), however, we assume that oblique transmission may well be biased. Such biases result if the peer group children interact with is of fixed size and consists of randomly-drawn individuals from the whole population, and children evaluate the relative merit of the variants of traits observed in this group. Specifically, three different cases are distinguished in the sociobiological literature:

- Positive bias: the probability that the naive agent adopts type L is always larger than if he had acquired one role model randomly, $S(\mu_t) > \mu_t$ for all $\mu_t \in (0,1)$.
- Negative bias: the probability that the naive agent adopts type L is always smaller than if he had acquired one role model randomly, $S(\mu_t) < \mu_t$ for all $\mu_t \in (0,1)$.
- Conformism or frequency-dependent bias: when the frequency of trait L in the population is smaller (larger) than $\hat{\mu}_t$, the probability that a naive agent adopts L is decreased (increased) relative to the unbiased transmission, $S(\mu_t) \gtreqless \mu_t$ for $\mu_t \gtreqless \hat{\mu}_t$. 'Pure' conformism corresponds to $\hat{\mu}_t = 1/2$.

A graphical representation of the different cases is provided by Figure 1.

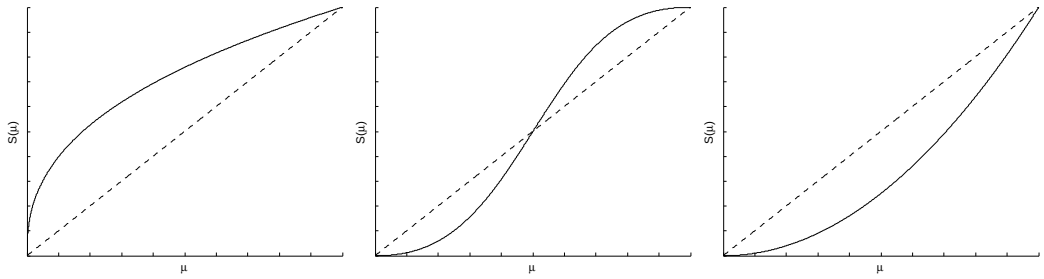

Figure 1: Positive bias (left), frequency-dependent bias (middle) and negative bias (right).

2.2 The parents' decision

We now turn to the analysis of the parents' decision to engage in criminal activities. This decision depends on economic incentives as well as on type-

dependent moral costs, γ^i, $(i = H,L)$. Furthermore, as explained in the previous section, parents are altruistic and care about their children's type.

Risk neutral parents maximize utility

$$U_t^{i,k} = (1-x_t^{i,k})(1-\lambda(1+\phi))\theta^k + \rho\lambda x_t^{i,k}\tilde{\theta} - (1-\rho)\psi - \gamma^i \frac{(x_t^{i,k})^2}{2} + \beta\left(P_k^{iH}\gamma^H + P_k^{iL}\gamma^L\right) \tag{5}$$

subject to equations (1)-(4) by choosing the fraction of time devoted to criminal activities $x_t^{i,k}$, $(i = H,L,\ k = h,l)$. This utility function has a standard cost/benefit structure established by the seminal contribution of Becker (1968). The benefits from the criminal activity are given by $\rho\lambda x_t^{i,k}\tilde{\theta}$ and are increasing in the average legal market income $\tilde{\theta} = \eta\theta^L + (1-\eta)\theta^H$, the fraction of income that can be stolen λ and the probability of not being apprehended ρ.[14]

The costs of committing crimes are measured by the probability of being caught $1-\rho$ times the fine ψ (which is a minimum level of income in case a criminal is caught) and the opportunity costs of forgone earnings in the legal sector $(1-\lambda(1+\phi))\theta^k$ $(k = L,H)$. The parameter $\phi \in [0,(1-\lambda)/\lambda[$ captures additional monetary costs incurred when being victimized, e.g. broken windows or doors, time spent reporting the crime to the police, etc. Also, as in Conley and Wang (2006) and Verdier and Zenou (2004), agents have a type-dependent moral cost of committing crime equal to $\gamma^i(x_t^{i,k})^2/2$ $(i = H,L)$, where γ^i captures their degree of honesty. So the higher γ^i and the crime effort, the higher the moral cost.

Finally, the last term of the utility function captures the altruistic concern and β the degree of altruism. We employ a joy-of-giving formulation[15] as the modeling of the children's utility is beyond the scope of this paper. The important aspect here is that the type adopted by the child affects his well-being in adult life by shaping moral concerns regarding criminal behavior and that parents care about this. More specifically, an increase in the fraction of time spent on criminal activities enhances the probability of the child adopting the L-type and thus reduces the utility from the altruistic concern.[16]

[14] For technical simplicity, we have assumed that each agent is equally sensitive to being the victim of a crime and each criminal steals a share of average income in the economy, that is, criminals cannot monitor and pick up their victims based on their income (see Imrohoroglu et al. (2004, 2006) and Bethencourt (2014)).

[15] See e.g. Andreoni (1990). Alternatively, we could assume that parents care about some type-dependent and exogenously given level of their children's utility. This would not affect our results.

[16] In fact, it is straightforward to prove that $P_k^{iH}\gamma^H + P_k^{iL}\gamma^L$ is decreasing in $x_t^{i,k}$ $(i = H,L,\ k = h,k)$.

Solving the parents' maximization problem gives the optimal fraction of time spent on criminal activities:

$$x_t^{i,k} = \frac{1}{\gamma^i}\left(\rho\lambda\tilde{\theta} - (1-\lambda(1+\phi))\theta^k - \beta(1-S(\mu_t))(\gamma^H - \gamma^L)\right) \tag{6}$$

with $k = h,l$ and $i = H,L$. Clearly, the optimal share $x_t^{i,k}$ is increasing in the average market income $\tilde{\theta}$, the share of income that can be stolen λ and the probability of not being apprehended ρ whereas it is decreasing in individuals' productivity in market activities θ^k, the relative size of the level of moral costs for both types $\gamma^H - \gamma^L$ and the probability with which children acquire the honest trait from their neighborhood $1 - S(\mu_t)$ (which is in turn negatively related to the share of dishonest types in society). Consequently, horizontal transmission and parents' time spend on criminal activities are complements as parents spend more time on criminal activities the larger the share of individuals with the dishonest trait in society.

2.3 Dynamics and steady states

Given equation (6), the dynamics of the population of agents with type L are then determined by the following difference equation:

$$\begin{aligned}\mu_{t+1} =& \mu_t\eta P_l^{LL} + \mu_t(1-\eta)P_h^{LL} + (1-\mu_t)\eta P_l^{HL} + (1-\mu_t)(1-\eta)P_h^{HL} \\ =& S(\mu_t) + \left[\tilde{y} - \beta(\gamma^H - \gamma^L)(1-S(\mu_t))\right]\left[\frac{\mu_t}{\gamma^L} + \frac{1-\mu_t}{\gamma^H}\right](1-S(\mu_t))\end{aligned} \tag{7}$$

where $\tilde{y} = \tilde{\theta}(\rho\lambda - (1-\lambda(1+\phi)))$. The change in the fraction of L-types can be obtained from equation (7) as:

$$\triangle\mu_{t+1} = S(\mu_t) - \mu_t + \Gamma(\mu_t) \tag{8}$$

with

$$\Gamma(\mu_t) = \left[\tilde{y} - \beta(\gamma^H - \gamma^L)(1-S(\mu_t))\right]\left[\frac{\mu_t}{\gamma^L} + \frac{1-\mu_t}{\gamma^H}\right](1-S(\mu_t)) \tag{9}$$

It is straight forward to see that $\Gamma(\mu_t) \geq 0$ for all $\mu_t \in [0,1[$ if each individual spends at least some time committing crime. In the following, we are looking for conditions under which the different traits coexist in equilibrium even if all parents agree that the honest trait is preferable but, at the same time, all parents devote some (individuum specific) fraction of their time to commit crime.

We denote by $\mu(t,\mu_0)$ the path produced by equation (7) when the initial condition is μ_0, M the set of steady states and $\bar{x} \equiv (\tilde{y} - \beta(\gamma^H - \gamma^L))/\gamma^H$ the time an honest individual spends on criminal activities when $\mu_t = 0$.

Proposition 1 ***Existence of steady states.***

(i) $\mu^* = 1 \in M$.

(ii) *If oblique transmission is unbiased or positively biased (in favor of trait L), then* $M = \{1\}$ *and* $\mu(t, \mu_0) \to 1 \ \forall \mu_0$.

(iii) *If oblique transmission is negatively biased (against trait L), two cases may arise:*

- *For* $S'(1) > \frac{1}{1-\tilde{y}/\gamma^L}$, $M = \{\mu^*, 1\}$ *with* $\mu^* \in [0,1)$ *and* $\mu(t, \mu_0) \to \mu^* \ \forall \mu_0 \neq 1$.
- *For* $S'(1) < \frac{1}{1-\tilde{y}/\gamma^L}$ *and* $\bar{x}$ *small enough, then there exist at least two interior equilibria,* μ_1^*, μ_2^*, *with* $\mu_1^* < \mu_2^* < 1$, *such that:* $\mu(t, \mu_0) \to \mu_1^* \ \forall \mu_0 < \mu_2^*$ *and* $\mu(t, \mu_0) \to 1 \ \forall \mu_0 > \mu_2^*$. *For* $\bar{x}$ *large enough,* $M = \{1\}$ *and* $\mu(t, \mu_0) \to 1 \ \forall \mu_0$.

(iv) *If oblique transmission is conformist and* $\bar{x}$ *is small enough, then there exist at least two interior equilibria,* μ_1^*, μ_2^*, *with* $\mu_1^* < \mu_2^* < 1$, *such that:* $\mu(t, \mu_0) \to \mu_1^* \ \forall \mu_0 < \mu_2^*$ *and* $\mu(t, \mu_0) \to 1 \ \forall \mu_0 > \mu_2^*$. *For* $\bar{x}$ *large enough,* $M = \{1\}$ *and* $\mu(t, \mu_0) \to 1 \ \forall \mu_0$.

Proof: *See appendix.*

Proposition 1 establishes that both traits can only survive if the desired trait is easy to adopt through oblique transmission. Otherwise, even though parents agree that honesty is desirable, as long as committing crime is economically profitable, the desired trait disappears. Figure 2 illustrates the cultural dynamics for two different cases of proposition 1: (i) when the oblique transmission function is negatively biased and there exists one interior rest point and (ii) when there is conformism and there exist two interior steady states. In all cases we have represented $\triangle\mu$ as a function of μ. We denote all steady states: stable equilibria are marked with green circles and unstable ones with red circles. Clearly, the honest type can survive even in a situation in which all parents commit crime:

First, when the interaction with peers is negatively biased against acquiring trait L, both traits L and H will survive in equilibrium. Second, when the oblique transmission function is characterized by conformism, an equilibrium with diversified culture characterized by a low share of the L-trait exists. However, if the starting share of trait L in the population is sufficiently large, then trait H will disappear. Notice that in both cases (with conformism or a negative bias), multiple interior stable steady states can emerge. Such a result explains why - depending on initial conditions

- the economy may reach an equilibrium of assimilation or an equilibrium with cultural diversity. This has important implications for the analysis of suitability and effectiveness of deterrence policies against crime or policies devoted to modify the values that children assign to different traits.

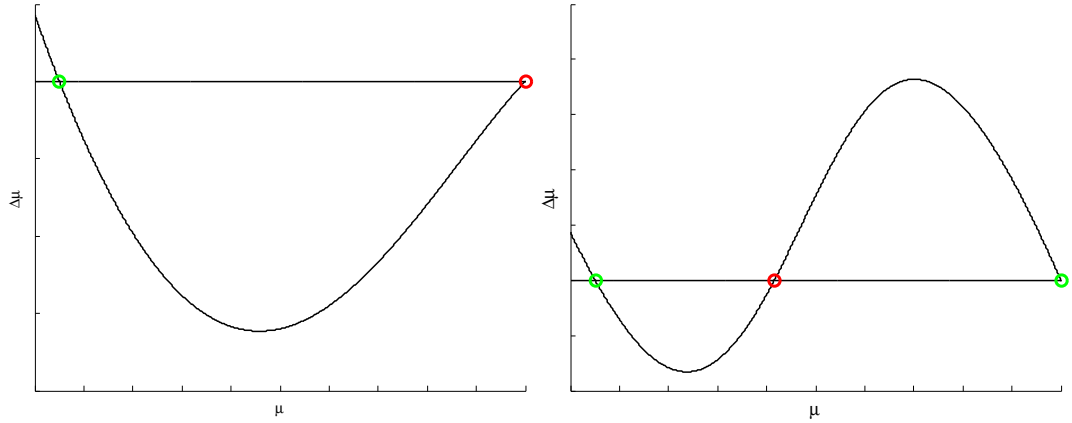

Figure 2: Negative bias with one interior steady state (left panel); Conformism with two interior steady states (right panel).

It is now interesting to see how the possible equilibrium multiplicity of types translates into different individuum specific crime rates. The aggregate share of criminal activities in period t is given by

$$\begin{aligned}\tilde{x}_t =& \mu_t \eta x_t^{L,L} + \mu_t(1-\eta)x_t^{L,H} + (1-\mu_t)\eta x_t^{H,L} + (1-\mu_t)(1-\eta)x_t^{H,H} \qquad (10)\\ =& \left(\tilde{y} - \beta(\gamma^H - \gamma^L)(1-S(\mu_t))\right)\left(\frac{(1-\mu_t)}{\gamma^H} + \frac{\mu_t}{\gamma^L}\right)\end{aligned}$$

Clearly, this share is monotonically increasing in the share of dishonest individuals μ_t in the economy. At the individual level, however, the contributions of each group to the aggregate share of criminality differ substantially. Figure 3 illustrates the population weighted crime rates (i.e. each of the four summands in (10)) as a function of μ and indicates the resulting steady state levels when there is either a negative bias or conformism. We observe that, despite the overall positive relationship between $\tilde{x}_t$ and μ_t, the contribution of groups with the honest trait is monotonically declining: The positive effect on crime through increases in the share of dishonest individuals is not large enough to offset the reduction in the population weight of these groups.

The multiplicity of interior steady states can be considered as a novel explanation for understanding the existence of a differential in criminal activity across place and time (see e.g. Glaeser (1998), Glaeser and Sacerdote

(1999) and Grogger and Willis (2000)). In fact, there exists considerable variation in US crime rates, with center cities showing more criminality than suburbs. For example, the property crime rate in center cities is three to two times larger than that in the suburbs (Grogger and Willis, 2000).

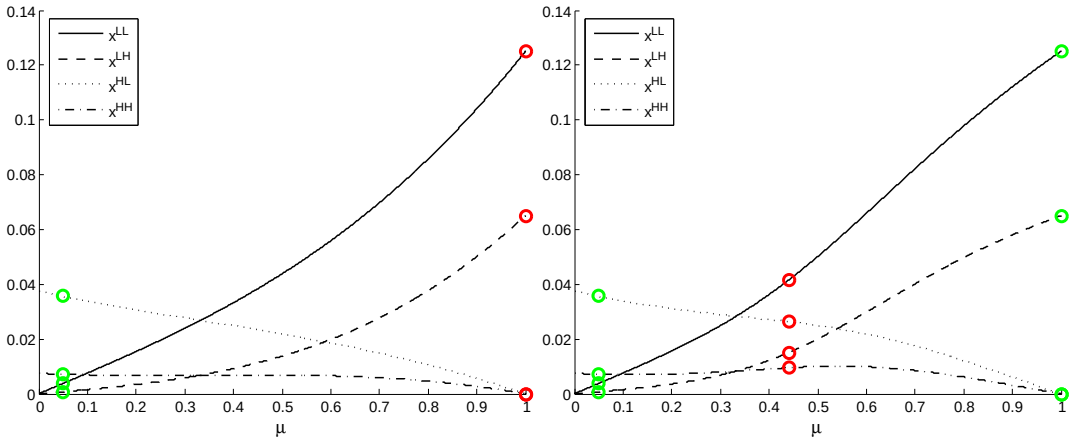

Figure 3: Population weighted crime rates with negative bias and one interior steady state (left panel, $S(\mu) = \mu^2$); Population weighted crime rates with conformism and two interior steady states (right panel, $S(\mu) = \mu^2/(\mu^2 + (1-\mu)^2)$). Parameters: $\theta^L = 1.8$, $\theta^H = 2$, $\gamma^L = 0.5$, $\gamma^H = 1$, $\rho = 0.7$, $\lambda = 0.5$, $\beta = 0.1$, $\phi = 0.4$.

2.4 Comparative static analysis

Let us now consider some comparative static results. We are in particular interested in changes in the apprehension probability ρ (e.g. through an increase in crime deterrence expenditures) and in changes in the relative evaluation of both types $\gamma^H - \gamma^L$ (e.g. by increasing parents' awareness of the importance of honest behavior).

Consider first changes in ρ. Figures 4 and 5 illustrate the cultural dynamics resulting from different levels of ρ and the corresponding average shares of criminal activities both under negative and frequency-dependent transmission. If the apprehension probability is low (solid lines), $\mu = 1$ is the only stable equilibrium and average steady state crime levels are high. Increasing the apprehension probability clearly not only has a direct positive effect on crime reduction by lowering economic incentives (the standard deterrence effect)[17] but also a social multiplier effect resulting from changes

[17] In fact, there is a long-established relationship between the probability of apprehension

in the number and properties of steady state equilibria. This amplifying effect emerges as a decrease in the share of criminal activities increases the probability of individuals adopting the honest trait. The larger is the share of honest individuals in the economy, the lower is the share of criminal activities. This positive feedback process terminates at a new steady state with a lower share of dishonest individuals in the population and a lower share of criminal activities. Graphically, the standard effect implies the downwards shift of the curve $\tilde{x}(\mu)$, while the multiplier effect reflects the transition to a new lower stable steady state determined by the shifted curve. If the increase in ρ is sufficiently large, economic conditions prevent parents from committing crime which in turn implies that $\mu = 0$ is a stable steady state. The reason is that, with a negative bias, children always have a higher probability of adopting the good type whereas it depends on the relative frequency of types with conformism.

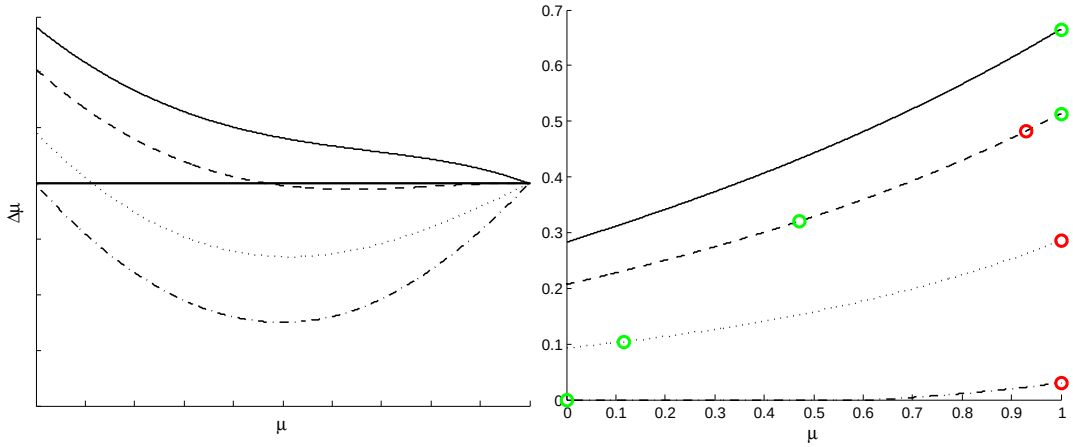

Figure 4: Changes in ρ with negative bias. Dynamics (left) and average share of criminal activity (right).

Now, consider an increase in the parents' awareness of the relevance of the honest trait, i.e. $\gamma^H - \gamma^L$. With a negative bias this always increases the share of honest types in the steady state and decreases the average share of criminal activities. Figure 6 illustrates the cultural dynamics resulting from different levels of the the parents' awareness and the corresponding

and criminal outcomes dating back to the seminal contribution by Becker (1968). Moreover, this relationship has found strong empirical support in many countries (see e.g. Di Tella and Schargrodsky (2004), Draca et al. (2011) and Levitt (2004)) For the US, Imrohoroglu et al. (2004, 2006) and Engelhardt et al. (2008) use calibration methods and data on property crimes to show that the apprehension probability is one of the most important factors to explain variations over time in thee crime rates.

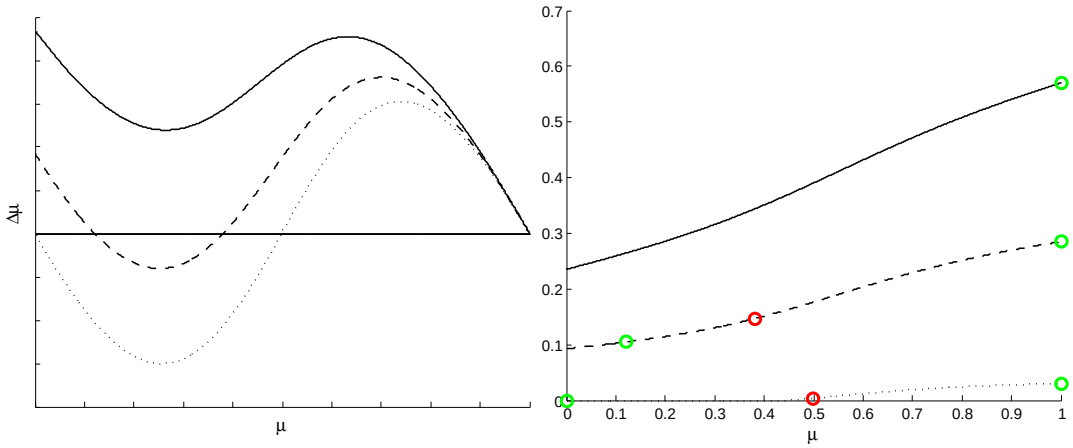

Figure 5: Changes in ρ with conformism. Dynamics (left) and average share of criminal activity (right).

average crime rate under negative bias. In particular, for $\gamma^H - \gamma^L = 0$ (solid line), the crime rate is independent of μ as the parents' decision to commit crime has no effect on the transmission process. By contrast, if relative differences of type evaluations are sufficiently large, parents' concerns about their children's well being prevents them from committing crime, which in turn implies that $\mu = 0$ is a stable equilibrium. With conformism (see figure 7), the effects of increasing parents' awareness are qualitatively similar to reductions in ρ. The same conclusion can also be reached for the comparative static effect of decreasing the share of income that can be stolen, λ. The important policy implication is that crime deterrence policies and information/education policies shaping the evaluation of types by parents are substitutes in fighting criminal behavior.[18]

Finally, we consider two exercises related to income growth and inequality. The first one consists of an increase in the average market income through increases in individuals' productivities (θ^H and θ^L) while leaving the level of inequality (the skill premium θ^H/θ^L) unchanged. Such an increase in the average income has a direct positive effect on criminal activities by increasing the net return from committing crime.[19] However, like in previous exercises, there also exists a social multiplier effect derived from the cultural transmission mechanism as a higher share of criminal activities increases the children's probability of adopting the dishonest behavior. As a

[18] See also section 3.

[19] The marginal cost of committing a crime increases less than the marginal benefit as the part of the marginal cost determined by the cultural transmission process remains fixed (see equation (6)).

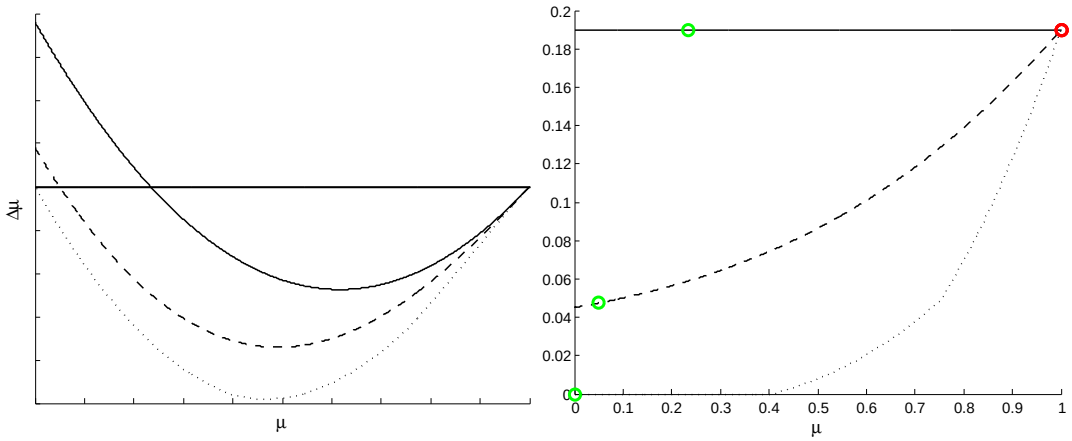

Figure 6: Changes in $\gamma^H - \gamma^L$ with negative bias. Dynamics (left) and average share of criminal activity (right).

result, a new steady state with a higher share of dishonest individuals in the population and a higher crime rate arises. Graphically, these changes could be plotted as in figures 6 and 7 but with curves moving into opposite directions. The finding that a higher average income increases crime stands in contrast to the theoretical predictions in Conley and Wang (2006), who show that income growth that affects all members of a society equally has no impact on the equilibrium level of crime. One important difference between the two models, however, is that moral values are endogenously determined in the present paper whereas they exogenously given in Conley and Wang (2006).

The second exercise consists of an increase in individuals' productivities such that the skill premium θ^H/θ^L (the level of inequality) rises while the average market income remains unchanged. In this case, net benefits of committing crime increase for low ability individuals, thus rising their time share spent on criminal activities, but decrease for high ability individuals, which in turn reduces their criminal activities. Notice that for a sufficiently large increase in inequality, highly productive individuals will quit their criminal activities. Up to this point, large increases in inequality would thus increase the incentives of low ability agents to commit more crimes and so the aggregate crime rate in the economy would increase. Related figures of such changes would be similar to those derived from an increase in the average income. These predictions provide a theoretical explanation for a positive relationship between property crime and income inequality which is generally supported by empirical evidence (see e.g. Freeman (1996, p.33),

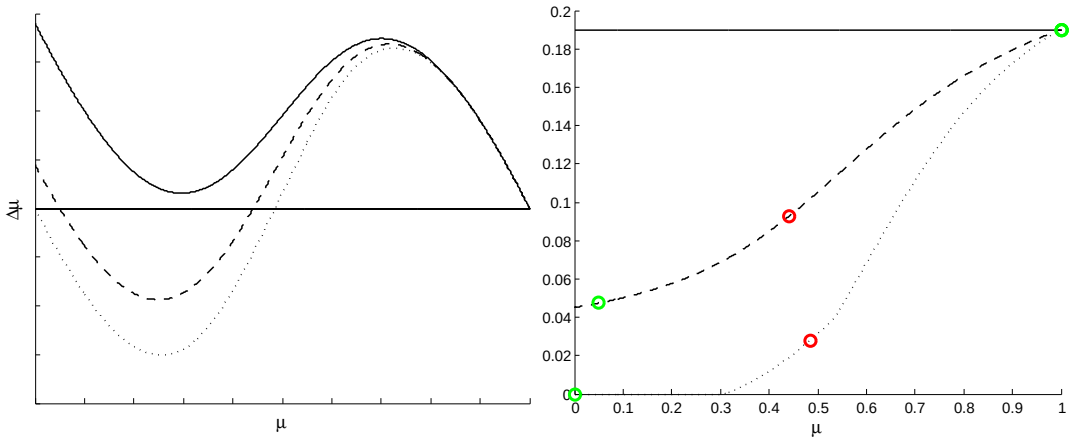

Figure 7: Changes in $\gamma^H - \gamma^L$ with conformism. Dynamics (left) and average share of criminal activity (right).

Demombynes and Oezler (2005) and references therein).[20] Furthermore, our theoretical findings are in line with Chiu and Madden (1998) who show that an increase in inequality unambiguously increases property crime. In their model, in which moral considerations are absent, income inequality affects property crime by rendering legal work less attractive for poor individuals and by increasing the potential proceeds from crime.

3 Public education campaign

This section analyzes the effectiveness of public education campaigns used to emphasize the importance of norms of good conduct.[21] Following Hauk and Sáez-Marti (2002), we assume that children are first exposed to the influence of their parents before undergoing public education. Hence, only children who have not adopted their preferences through direct socialization by their parents can be affected by public education. An education campaign consists of a publicly chosen effort level $\kappa \in [0,1]$ which is assumed to be equal to the probability with which a child adopts honest preferences in school.[22] Public

[20] Note, however, that few studies also report a negative relationship between inequality and crime, see e.g. Brush (2007) and Chintrakarn and Herzer (2012).

[21] See Lochner (2011) for a survey on the relationship between crime and education.

[22] Clearly, we make two simplifying assumptions: first, we assume that the education campaign only affects the cultural transmission process but leaves individuals' productivity unchanged. Allowing for an explicit process of human capital formation is beyond the scope of this paper. Second, we assume that the public education campaign is exogenously given without stating how it is financed. This is not restrictive, however, since we might assume

education efforts affect the probabilities of honest and dishonest children as follows:

$$P_k^{LL} = x_t^{L,k} + (1 - x_t^{L,k})S(\mu_t)(1-\kappa) \tag{11}$$

$$P_k^{LH} = (1 - x_t^{L,k})((1 - S(\mu_t))(1-\kappa) + \kappa) \tag{12}$$

$$P_k^{HH} = (1 - x_t^{H,k})((1 - S(\mu_t))(1-\kappa) + \kappa) \tag{13}$$

$$P_k^{HL} = x_t^{H,k} + (1 - x_t^{H,k})S(\mu_t)(1-\kappa) \tag{14}$$

As before, the parents' time spent on criminal activities $x_t^{i,k}$, ($i = H,L$, $k = h,l$), determines the probability of children adopting the dishonest trait (eqs. (11) and (14)). With the complementary probability $1 - x_t^{i,k}$ children remain naive and acquire the bad trait through society (with probability $S(\mu_t)$) given that public education fails (with probability $1-\kappa$). By contrast, a child will be honest if it does not acquire the bad trait from either his/her parents or, if public education fails, from his/her peers (eqs. (12) and (13)).

The parents' optimal fraction of time spent on criminal activities is now:

$$x_t^{i,k} = \frac{1}{\gamma^i}\left(\rho\lambda\tilde{\theta} - (1 - \lambda(1+\phi))\theta^k - \beta(1 - S(\mu_t)(1-\kappa))(\gamma^H - \gamma^L)\right) \tag{15}$$

with $k = h,l$ and $i = H,L$. The new change in the fraction of L-types with public education is given by:

$$\triangle\mu_{t+1} = S(\mu_t)(1-\kappa) - \mu_t + \Gamma(\mu_t) \tag{16}$$

with

$$\Gamma(\mu_t) = \left[\tilde{y} - \beta(\gamma^H - \gamma^L)(1 - S(\mu_t)(1-\kappa))\right]\left[\frac{\mu_t}{\gamma^L} + \frac{1-\mu_t}{\gamma^H}\right](1 - S(\mu_t)(1-\kappa)) \tag{17}$$

It is straight forward to see that $\Gamma(\mu_t) > 0$ for all $\mu_t \in [0,1]$ if each individual spends at least some time committing crime. The introduction of public education has two effects: its direct effect is to increase the proportion of honest agents, while its indirect effect is to decrease parents' time spent on criminal activities which in turn reinforces the direct effect. Note further that $\triangle\mu_{t+1} > 0$ if $\mu_t = 0$ and $\triangle\mu_{t+1} < 0$ if $\mu_t = 1$. These observations imply:

Proposition 2 *Suppose that the government runs a public education campaign, i.e.* $\kappa \in (0,1]$. *Then, there exists at least one interior equilibrium* μ^* *such that* $\mu(t,\mu_0) \to \mu^*$ *for all* μ_0.

that the required tax revenue is collected by a lump sum tax. Extending the present model to capture general equilibrium effects arising from the public provision of education is an interesting topic left for future research.

The above analysis establishes the existence of at least one interior steady state such that honest and dishonest types, and therefore groups with high and low criminality, co-exist in society. Importantly, with a public education campaign, the existence of interior rest points no longer depends on the children's bias. In fact, even with unbiased horizontal transmission (i.e. $S(\mu_t) = \mu_t$) culture remains diverse. However, as in proposition 1, the functional form of S still affects the number and stability of interior equilibria. Figure 8, for example, illustrates the cultural dynamics and the average share of criminal activities with conformism for different intensities of the education campaign. The solid lines correspond to $\kappa = 0$. Clearly, if society is initially in the high crime steady state, an intensive education campaign with a high enough κ is successful in fighting crime as it affects affects the population dynamics and the proportion of honest individuals increases.

The crime reducing effect of education is well documented by empirical evidence, see Lochner and Moretti (2004), Lochner (2004), Deming (2011) and Anderson (2014). Lochner and Moretti (2004), for example, find that if the average years of schooling increase by one year then, both violent and property crime decline by about 11-12 percent, while Deming (2011), using data from public school choice lotteries, shows that peer effects may account for gains in school quality implying a significant decline in criminality. Finally, Anderson (2014) estimates that if the the compulsory schooling age increases from 16 to 17 or 18 years of age then, arrests at these ages reduce by nearly 10 percent, with similar impacts on both property and violent crime.

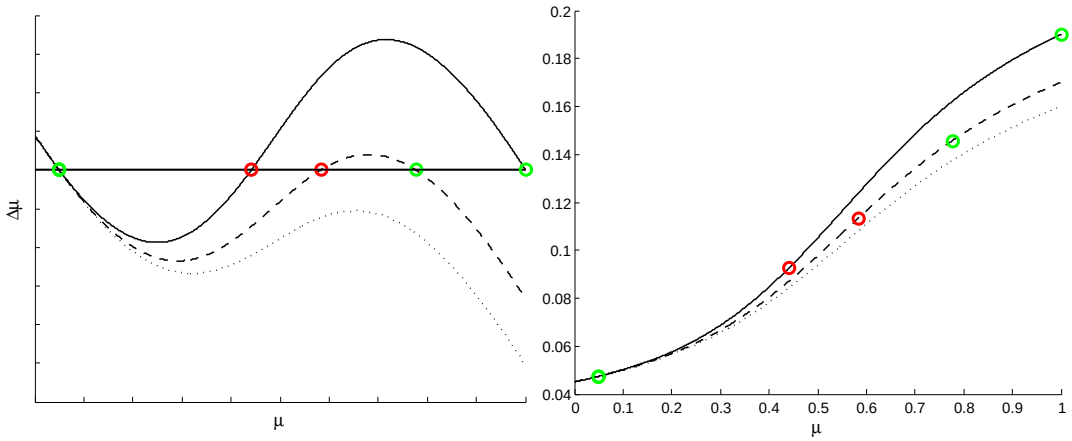

Figure 8: Changes in κ with conformism. Dynamics (left) and average share of criminal activity (right).

4 Empirical application

The aim of this section is to emphasize the relevance of our theoretical findings by accounting for some empirical facts which characterize criminality in the United States. Our analysis focuses on the evolution of the property crime rates among US federal states during the period from 1975-2005.

The literature on crime economics has widely documented the reduction in the number of property crimes in US in recent years. Simultaneously, the increase in the size and the strength of deterrence programs has been pointed out as one of the main factors contributing to this reduction (see e.g. Imrohoroglu et al. (2004)). Figure 9 illustrate these two patterns by plotting the dynamics of the property crime rate and total justice expenditures over GDP from 1975 to 2005. Such aggregate numbers, however, may hide the existence of large differential reductions in crime rates at the federal state level. For example, states with similar crime rates in 1975 and similar deterrence policies over time may end up with completely different levels of crime. These differences can either be explained by changes in other relevant variables and/or the existence of the multiplier effect related to policies as described in the previous sections. Specifically, the (non-)existence of such an amplifying effect may explain why crime tends to be relatively persistent in some states while it is more responsive to anti crime policies in others. The objective of this section, however, is to assess the extent to which the intergenerational cultural transmission mechanism is responsible for the variance of changes in crime rates at the state level and how it accounts for the decline in the aggregate crime rate.

We start by calculating property crime rates and total justice expenditures by US federal states as a percentage of GDP for the time period under consideration. Table 1 shows the values of these variables in 1975 and 2005. We then divide states into ten groups according to their initial crime rate in 1975. The first group includes states with the lowest crime rates, this is, states which report crime rates less than 3,000 offenses per 100,000 habitants. The second group includes states with crime rates between 3,000 and 3,500, and the following groups are defined by intervals which increase by 500. In all states that belong to one of these nine groups, we observe that crime rates decrease whereas justice expenditures increase.[23] While the overall pattern is thus similar to the one at aggregate level, there exist, however, large differential reductions in crime inside each of these groups.

In order to discriminate between the underlying forces of these differ-

[23]Note that there is an additional group, group 10, where we summarized those states that faced an increase in crime over the time horizon under consideration.

ences, namely changes in relevant economic variables versus the social multiplier, we first calculate Gini indexes, per capita GDP and expenditures per pupil for all groups in the time period under consideration. Table 2 shows the average change and the coefficient of variation of average changes (per group) of the Gini coefficient, GDP per capita and expenditure per pupil in public elementary and secondary schools from 1975 to 2005. Clearly, these variables have increased quite uniformly among all states.[24] Notice that, according to our theory, such changes imply positive effects on crime thereby mitigating the effect of the improvements in the deterrence policy.[25] Thus, once we disregard differences in economic variables as the main forces explaining the differences in the crime rates patterns, we focus on the the multiplier effect derived from the application of the deterrence policy as a plausible mechanism to account for the differences in the drop in crime rates among US states.

According to our theory, increases in crime deterrence expenditures may not only have a direct effect on crime by altering economic incentives, but may also have amplifying effects through changes in the transmission process, depending on initial conditions (see figures 4 and 8). We may indeed identify such amplifying effects in the data. For example, though starting from similar initial crime rates and with similar economic changes, New Hampshire (group 2) experienced a sharp decrease whereas the decline in crime is more modest in Kentucky, Pennsylvania and Vermont. Similar patterns can also be found for Connecticut and New York (group 5), Rhode Island (group 6), Massachusetts (group 7). On the other hand there are cases in which some states experienced only a very modest decrease in crime relative to other states with similar initial crime rates and similar economic and spending patterns over time, see for instance Wyoming and Montana (group 3) and Georgia and Oklahoma (group 4). This pattern is consistent with figure 5 in which increases in crime deterrence expenditures may only affect economic incentives but do not alter the resulting steady state of the dynamic process. Finally, we have the case in which states starting with similar crime levels and applying the same policies are split into two different subgroups with different trajectories, see for example Michigan, Delaware and California which experience similar and larger reductions in crime than Colorado and Oregon (group 8).

Relative changes in other unobservable variables may also contribute

[24] We have also calculated the coefficient of variation for the Gini coefficient, GDP per capita and education expenditures per pupil for each state. These results confirm our conclusion that economic variables show a similar movement across states and time.

[25] In fact, group 10 which includes those states that experienced increases in the crime rate also experienced the largest increase in income inequality.

to the differential decrease in crime rates such as, for example, changes in the parents' awareness of the importance of transmitting the honest trait or changes in the size of the moral cost of committing crimes. However, we have not found any evidence suggesting that there have been large differences in the behavior of these variables over time and space.

Summarizing, the analysis of the available empirical evidence suggests that the multiplier effect derived from the cultural transmission of traits is a leading force in explaining the large differences in the evolution of the crime rates among the US federal states (see also Glaeser et al. (2003)).

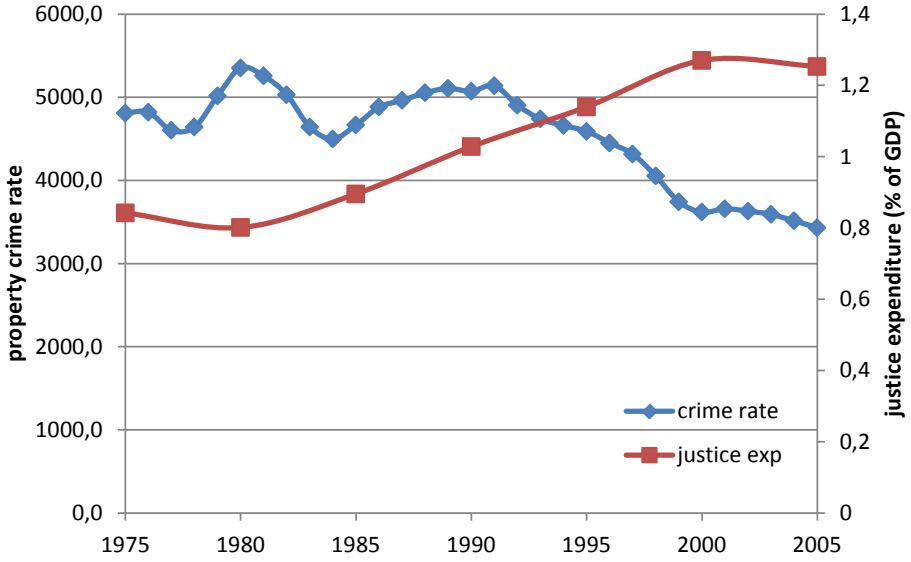

Figure 9: US federal state property crime rates and total justice expenditures (as % of GDP) 1975 - 2005. Source: UCR, http://www.ucrdatatool.gov/, Bureau of Justice Statistics, own calculation. Total justice expenditures are approximated by an unweighted average of total spending by federal states.

5 Conclusions

This is the first paper to theoretically account for the intergenerational nature of criminal behavior. To do so, we have considered a dynamic model of cultural transmission of moral norms. Individuals with heterogenous productivities allocate their time endowment to work in the market sector and to commit crime. The decision to commit crime, in turn, has a direct negative impact on the socialization process within the family (the child's probability of adopting norms of good conduct). We show the existence of high and low

crime equilibria. Furthermore, we find that both traits, honesty and dishonesty, can survive even if all parents commit crime but at the same time agree that honesty is desirable. This equilibrium multiplicity provides a novel explanation of why crime is highly concentrated in specific areas ('ghetto culture') and why crime rates tend to be persistent over time. Specifically, our model may explain why states or communities with the same initial crime rates and similar economic conditions and crime deterrence policies over time may end up with completely different levels of crime. The reason is that in our model crime deterrence not only alters economic incentive to commit crime but may also directly affect the socialization process and thus have long-lasting and amplifying effects ('the social multiplier') depending on initial conditions. Similar effects arise from policies aimed at shaping the evaluation of types by parents. Moreover, we have shown that a public education campaign which is used to emphasize the importance of norms of good conduct is an effective tool to reduce crime by increasing the share of honest individuals in society and by altering the existence of steady state equilibria.

Our model could be extended in two natural ways: first, one may assume that not only moral norms are determined through a process of cultural transmission but also individuals educational achievements or work habits (see Sáez-Marti and Zenou (2012)) which are affecting the opportunities to earn legal market income. Second, allowing for an explicit process of human capital formation (as e.g. in Lochner (2004)) where public education is financed by taxes on wage income enables one to address the distributional consequences of criminal behavior and anti crime policies.

Acknowledgements

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Appendix

Proof of proposition 1:

(i) It is straight forward to see that $\triangle\mu = 0$ if $\mu = 1$. Just note that $S(1) = 1$.

(ii) Since $S(\mu) \geq \mu$ and $\Gamma(\mu) > 0$ for all $\mu \in [0,1[$, $\mu = 1$ is the only possible steady state. If we evaluate the derivative of $\triangle\mu$ with respect to μ at

$\mu = 1$, we get

$$\frac{d(\triangle\mu)}{d\mu}|_{\mu=1} = S'(1)(1-\tilde{y}/\gamma^L) - 1 \tag{18}$$

so that $\mu = 1$ is stable whenever $S'(1) < \frac{1}{1-\tilde{y}/\gamma^L}$.

(iii) As has been shown in (ii), the condition $S'(1) < (>)\frac{1}{1-\tilde{y}/\gamma^L}$ ensures that $\mu = 1$ is a locally (un)stable equilibrium. Also, we have $\triangle\mu > 0$ at $\mu = 0$. Consequently, if $\mu = 1$ is unstable, there is at least one stable interior rest point. If $\mu = 1$ is stable, however, there is either an even number or no interior steady states depending on the size of $\triangle\mu$ evaluated at $\mu = 0$, i.e. the size of $\bar{x}$.

(iv) With frequency dependent transmission, $\mu = 1$ is always a locally stable equilibrium as $S'(1) < 1$ (see also (ii)). The existence of interior rest points and their stability properties follow analogous to (iii).

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		1975		2005	
	state	crime rate	justice exp (% of GDP)	crime rate	justice exp (% of GDP)
G 1	North Dakota	2284	0.49	2025	0.93
	South Dakota	2534	0.66	1767	0.88
G 2	Kentucky	3000	0.69	2531	1.23
	Pennsylvania	3020	0.89	2422	1.38
	New Hampshire	3247	0.78	1839	0.95
	Vermont	3386	0.97	2370	1.25
G 3	Maine	3740	0.76	2419	1.07
	Iowa	3768	0.57	2845	0.94
	Wisconsin	3824	0.81	2669	1.42
	Wyoming	3952	0.54	3158	1.77
	Idaho	3937	0.70	2697	1.33
	Montana	3999	0.73	3146	1.47
	Minnesota	4092	0.69	3088	1.04
G 4	Virginia	4166	0.84	2649	1.07
	Georgia	4167	0.90	4145	1.21
	Oklahoma	4275	0.66	4047	1.24
	Kansas	4469	0.73	3806	1.16
	Ohio	4506	0.78	3668	1.36
	Indiana	4579	0.60	3460	1.00
G 5	Connecticut	4689	0.85	2579	0.99
	New Jersey	4731	1.15	2337	1.39
	New York	4779	1.31	2102	1.60
	Utah	4881	0.72	3837	1.33
	Missouri	4904	0.83	3929	1.12
	Texas	5017	0.62	4319	1.10
	Illinois	5033	0.82	3092	1.13
G 6	Maryland	5198	1.16	3551	1.44
	New Mexico	5305	0.78	4132	1.72
	Rhode Island	5342	0.94	2728	1.38
G 7	Massachusetts	5635	1.11	2358	1.07
	Alaska	5657	1.08	3615	1.49
	Washington	5750	0.83	4890	1.18
	Hawaii	5808	0.72	4800	1.22
G 8	Michigan	6115	1.00	3098	1.50
	Colorado	6212	0.80	4041	1.15
	Delaware	6276	0.89	3118	1.09
	Oregon	6314	1.01	4402	1.44
	California	6549	1.29	3321	1.73
G 9	Florida	7033	1.12	4013	1.68
	Nevada	7474	1.46	4246	1.53
	Arizona	7794	1.31	4827	1.58
G 10	West Virginia	1946	0.55	2633	1.25
	Mississippi	2095	0.71	3274	1.29
	Alabama	3080	0.71	3900	1.17
	Arkansas	3192	0.58	4068	1.30
	North Carolina	3380	0.81	4080	1.05
	DC	5929	1.53	4490	0.79
	Nebraska	3356	0.64	3432	1.01
	Louisiana	3645	0.76	3696	1.29
	Tennessee	3874	0.81	4300	1.12
	South Carolina	4130	0.92	4370	1.11

Table 1: Property crime rates and justice expenditures (as % of GDP) in 1975 and 2005. Sources: UCR, Bureau of Justice Statistics.

	Gini coefficient		GDP per capita		Expenditures per pupil	
	Av. change	Coef of Var.	Av. change	Coef of Var.	Av. change	Coef of Var.
G 1	22.26	0.05	88.52	0.35	105.05	0.15
G 2	26.14	0.10	98.90	0.18	146.50	0.13
G 3	24.49	0.09	79.73	0.11	101.49	0.16
G 4	25.21	0.09	91.34	0.11	119.33	0.09
G 5	27.68	0.08	97.37	0.10	100.64	0.12
G 6	20.71	0.12	97.46	0.20	112.47	0.18
G 7	22.73	0.08	71.41	0.43	78.42	0.28
G 8	23.75	0.09	98.25	0.14	77.05	0.12
G 9	26.14	0.21	83.72	0.04	76.46	0.13
G 10	32.74	0.07	93.64	0.11	126.73	0.05

Table 2: Average change (per group) and (standardized) coefficient of variation of average change of Gini coefficient, GDP per capita and expenditure per pupil in average daily attendance in public elementary and secondary schools (in constant 2011-12 dollars) from 1975 to 2005. Groups are the same as in table 1. Sources: Frank (2008), US Bureau of Economic Analysis, National Center for Education Statistics and own calculations.