THE KOREAN ECONOMIC REVIEW
Volume 19, Number 2, Winter 2003

CREDIBLE JUDICIARY AND WELFARE SYSTEMS*

KOOKSHIN AHN** · TAESUNG KIM*** · GYU HO WANG****

If the "haves" perceive that their charity will rebound to their advantage indirectly, or prevent the economic environment from deteriorating, then they may find it advantageous to act as if they were benevolent. Then, a certain type of benevolence is a disguised pursuit of self-interest. This paper attempts to provide a self-interest based explanation for seemingly altruistic behavior. In particular, it develops a simple model of judiciary and welfare systems based upon self-interest. It first explains the existence of the welfare systems without assuming altruism, and the fact that crime is committed more often than not and that actual punishment of the crime seems always less than the optimal punishment level preventing the crime, assuming that crime is socially inefficient and can be prevented.

JEL Classification: K40, I30, C72
Keywords: Pursuit of Self-interest, Altruistic Behavior, Judiciary and Welfare System

I. INTRODUCTION

Why are higher income people often against a cutback in poverty programs? Why do many big business firms donate generously to various endowments for the poor? We can readily provide several reasons. They do so to sustain a good reputation and to reinforce their higher status. They may also do so out of moral obligation or altruism. A further reason for their benevolence may come from a fear that social unrest might arise if the economy gets worse.

Received for publication: Oct. 14, 2003. *Revision accepted:* Nov. 24, 2003.
* The authors would like to thank two anonymous referees for valuable comments.
** Professor, Department of Economics, Chung-Ang University,
*** The late professor, Division of Economics, Seoul National University,
**** Professor, Department of Economics, Sogang University.

This paper attempts to provide a self-interest based explanation for their seemingly altruistic behavior. If the "haves" perceive that their charity will rebound to their advantage indirectly, or prevent the economic environment from deteriorating, then they may find it advantageous to act as if they were benevolent. Then, a certain type of benevolence is a disguised pursuit of self-interest. (see, for example, Phelps (1975)). This paper attempts to develop a simple model of judiciary and welfare systems based upon self-interest.

The idea runs as follows: there are two groups of people in the society, the rich with big endowment and the poor with none. The poor have a temptation and a single chance to commit a crime against the rich. The crime could be either a property crime or violence. The rich set up a judiciary system under which two major functions, apprehension and punishment of criminals, are conducted. The punishment could be a fine or imprisonment. But it is costly for the rich to implement such a system. Along with a punitive measure on crime, the rich also establish the welfare system of giving a subsidy to the poor, which is also costly. We model this situation as follows: in the first stage the rich choose the amount of welfare transfer and the probability of apprehension of criminals, and in the second stage the poor choose whether to commit a crime or not, and what level if they do, and in the third stage punishment will be given to the poor, if apprehended, according to the punishment policy chosen by the rich. We assume the cost of apprehension depends on the apprehension probability chosen by the rich. The optimal welfare transfer, apprehension probability and punishment policy of the rich are also discussed, given the criminal behavior of the poor.

The purpose of this model is (a) to explain the existence of the welfare systems without assuming altruism, and (b) to explain the fact that crime is committed more often than not and that actual punishment of the crime seems always less than the optimal punishment level preventing the crime, assuming that crime is socially inefficient and can be prevented. In the analysis of our model, we focus on the equilibria which are sequentially rational, namely subgame perfect equilibria. In this equilibrium actual punishment in the third stage has to be optimal for the rich even after the poor has committed a crime. Reinganum and Wilde (1986) has applied this notion of equilibrium to the tax compliance problem and produced some interesting results.

On the other hand, following Gary Becker's seminal work on the economics of crime and punishment (1968) another widely adopted approach is a principal-agent structure to examine the optimal judiciary system toward criminal activity. (See, for instance, Brown and Reynolds (1973), Heineke (1975), Polinsky and Shavell (1979)). If we use principal-agent approach in our problem, in the first stage the rich not only choose welfare and probability of apprehension but also have the ability to pre-announce and pre-commit to the punishment policy regardless of its optimality when actual crime has been committed. In this approach, it is optimal for the rich to set the welfare as 0, apprehension probability as low as possible and the punishment level very high regardless of crime. This policy is optimal since punishment is so painful that the poor do not want to commit a crime and the rich do not have to pay the cost of punishment because no crime really occurs in equilibrium. However, this type of analysis explains neither the existence of welfare system and criminal activities nor the fact that criminal punishment is not harsh enough. Problem is that the punishment policy in principal-agent framework is not optimal out of equilibrium path. If crime is indeed committed, it is not credible to carry out the punishment as preannounced.

The rest of the paper is as follows. In section Ⅱ, we present our basic model. In section Ⅲ, the equilibria of our model and their properties are described, and one simple example is provided. We add some concluding remarks in section Ⅳ.

Ⅱ. THE BASIC MODEL

The society has two groups of people: the rich with endowment $\omega_0(>0)$ and the poor with no endowment. For the simplicity of analysis, we assume that the poor have a single opportunity to commit a crime, $c(\geq 0)$, in which 0 means no crime and bigger c means a severer crime. The rich maintain a judiciary system of allocating resources to search and apprehend criminals and punishing the apprehended criminals. The rich also establish a welfare system of transferring welfare $g(\geq 0)$ to the poor. Our model consists of the following three-stage game. In stage 1, the rich choose the probability, $p\,(0\leq p\leq 1)$ of apprehension of criminals and the welfare transfer, g. In the second stage, the poor decide the level of criminal activity, c, and in the final stage the rich choose the level of punishment, F for each crime c. F is also scaled in terms of a non-negative real number. So $F=0$ indicates no punishment.

The payoff functions are assigned as follows. The poor with welfare transfer g who commit a crime c get utility $u(c, g)$ if not apprehended, and $d(F, g)$ if apprehended and the punishment is F. We make the following assumptions on $u(c, g)$ and $d(F, g)$;

Assumption 1. $u_1(c, g)>0$, $u_{11}(c, g)\leq 0$, and $u_{12}(c, g)\leq 0$.
$d_1(F, g)<0$, $d_{11}(F, g)<0$, and $d_{12}(F, g)<0$.

$u_{12}\leq 0$ means that marginal utility of crime decreases as their wealth increases. $d_1<0$ means that the poor do not like the punishment, and $d_{12}<0$ means that marginal disutility of punishment increases as their wealth increases. The poor maximize the following expected utility;

$$U^P(c; p, g, F)=p\,d(F, g)+(1-p)\,u(c, g).$$

$v(c, \omega)$ is the utility function for the rich when they suffer from crime c and has wealth ω. Let $e(p)$ measures the enforcement cost of having the apprehension probability p.

Assumption 2. $v_1(c, \omega) < 0$, $v_2(c, \omega) > 0$. $e'(0) = 0$ and for all $p > 0$ $e'(p) > 0$, $e''(p) > 0$.

The rich prefers less crime and more wealth, and the enforcement cost and marginal enforcement cost increase as apprehension probability goes up. The rich, who donate g to the poor, choose p as the probability for the apprehension of criminals, and suffer crime c, get utility $v(c, \omega_0 - g - e(p))$.

$R(F, c)$ is the net utility to the rich when the criminal is apprehended, and punishment F against the crime c is performed. $R(F, c)$ represents the benefit of punishment, including possibly the recovery of damages in case of property crime, sense of retribution, etc, net of cost of carrying out punishment F against c.

Assumption 3. For all $c \geq 0$, $R(0, c) = 0$ and $R(F, c)$ is concave in F, i.e., $R_{11}(F, c) < 0$. $R_2(F, c) > 0$, $R_{12}(F, c) > 0$, and $R_1(F, 0) < 0$.

$R_{11}(F, c) < 0$ means that as F increases, the cost of implementing F eventually dominates the gain from it. Hence, for all $c \geq 0$, there exists an optimal level of punishment. $R_2 > 0$ and $R_{12} > 0$ mean that the net benefit and marginal net benefit of F increase as c becomes severer. $R(0, c) = 0$ means that with $F = 0$, the net benefit always equals zero. Finally, $R_1(F, 0) < 0$ means that the rich get no net benefit by punishing the innocent. The rich are assumed to maximize their expected utility,

$$U^R(p, g, F; c) = v(c, \omega_0 - g - e(p)) + pR(F, c).$$

Ⅲ. EQUILIBRIUM CHARACTERIZATION

We use a subgame perfect equilibrium as our solution concept. In our model, a subgame perfect equilibrium takes the following form:

Definition $(p^*, g^*, F^*(\cdot), c^*(\cdot, \cdot))$, where $F^*: R_+ \to R_+$ and $c^*: [0, 1] \times [0, \infty) \to R_+$, is a subgame perfect equilibrium if

i. For each $c \geq 0$, $F^*(c)$ maximizes $R(F, c)$,
ii. Given the punishment policy $F^*(\cdot)$, $c^*(p, g)$ maximizes $U^P(c; p, g, F^*)$ for each p and g,

iii. Given the punishment policy $F^*(\cdot)$ and the behavior of the poor $c^*(\cdot,\cdot)$, (p^*, g^*) maximizes $U^R(p, g, F^*; c^*)$.

We can now discuss the properties of a subgame perfect equilibrium of our model. From now on, a subgame perfect equilibrium is simply referred to as an equilibrium. As usual, by backward induction, we solve the game from the last stage.

3.1 The Punishment Policy

In the last stage, for each crime $c \geq 0$, the equilibrium punishment $F^*(c)$ has to maximize $R(F, c)$. By Assumption 3, $F^*(c)$ is completely characterized by the first order condition;

$$R_1(F^*(c), c) = 0. \tag{1}$$

Proposition 1. $R(F^*(c), c) \geq 0$ and $F^*(c)$ is strictly increasing in c.

Proof; Since $R(0, c) = 0$ and $R(F^*(c), c) \geq R(0, c)$, $R(F^*(c), c) \geq 0$.
By applying implicit function theorem to Equation (1), $\dfrac{dF^*(c)}{dc} = -\dfrac{R_{12}}{R_{11}}$.
By Assumption 3, $R_{12} > 0$ and $R_{11} < 0$. Therefore, $\dfrac{dF^*(c)}{dc} > 0$.

Proposition 1 shows that in equilibrium, the severer the crime is, the harder the punishment is. It seems to be a quite natural property of the credible punishment scheme. Note that $R(0, c) = 0$ and $R_1(F, 0) < 0$, $F^*(0) = 0$. Namely, when no crime is committed, zero punishment is the optimal one.

3.2 The Choice Problem of the Poor

Expecting correctly the punishment policy $F^*(\cdot)$ in the stage 3, for each p and g, the poor choose the level of crime $c^*(p, g)$ to maximize

$$U^P(c; p, g, F^*(c)) = pd(F^*(c), g) + (1-p)u(c, g).$$

Assuming an interior maximum, $c^*(p, g)$ is implicitly determined by the first order condition;

$$pd_1(F^*(c), g)\frac{dF^*}{dc} + (1-p)\,u_1(c, g) = 0. \tag{2}$$

For comparative statics, we assume that the second order condition holds with strict inequality,

$$\Delta \equiv p d_{11}\left(\frac{dF^*}{dc}\right)^2 + p d_1 \frac{d^2F^*}{dc^2} + (1-p) u_{11} < 0.$$

Proposition 2. $c^*(p, g)$ is strictly decreasing in both p and g.

Proof; By differentiating (2) with respect to p and g, respectively, we get

$$\frac{\partial c^*}{\partial g} = -\frac{p d_{12}\frac{dF^*}{dc} + (1-p) u_{12}}{\Delta}, \text{ and } \frac{\partial c^*}{\partial p} = -\frac{d_1 \frac{dF^*}{dc} - u_1}{\Delta}.$$

By Assumption 1 and Proposition 1, $\frac{\partial c^*}{\partial g} < 0$ and $\frac{\partial c^*}{\partial p} < 0$.

Proposition 2 shows that in equilibrium, the criminal activity decreases as the apprehension probability or the welfare transfer increases. These are again quite natural properties. With $\frac{dF^*(c)}{dc} > 0$, the severer crime invites the harder punishment. As p increases, since the poor put the larger weight on $d(\cdot, \cdot)$ which is decreasing in c through $F^*(c)$, the poor have fewer incentives to choose a higher c. In the similar way, as g increases, the marginal benefit from crime decreases, therefore, the poor choose a lower c.

3.3 The Choice Problem of the Rich

Given their punishment policy $F^*(\cdot)$ of the last stage and the behavior $c^*(\cdot, \cdot)$ of the poor, the rich choose (p^*, g^*) in the first stage maximizing

$$U^R(p, g, F^*; c^*) = v(c^*(p, g), \omega_0 - g - e(p)) + pR(F^*(c^*(p, g)), c^*(p, g)).$$

So, by assuming an interior maximum, the first order condition yields

$$v_1 \frac{\partial c^*}{\partial p} - v_2 e' + R + pR_2 \frac{\partial c^*}{\partial p} + pR_1 \frac{dF^*}{dc}\frac{\partial c^*}{\partial p} = 0, \text{ and}$$
$$v_1 \frac{\partial c^*}{\partial g} - v_2 + pR_2 \frac{\partial c^*}{\partial g} + pR_1 \frac{dF^*}{dc}\frac{\partial c^*}{\partial g} = 0.$$

Since the last term of above two equations is zero by Equation (1), it holds that

$$v_1 \frac{\partial c^*}{\partial p} + R - v_2 e' + pR_2 \frac{\partial c^*}{\partial p} = 0, \tag{3}$$

$$v_1 \frac{\partial c^*}{\partial g} - v_2 + pR_2 \frac{\partial c^*}{\partial g} = 0. \tag{4}$$

In determining p and g, the rich balance the positive and negative effects. The first two terms in Equation (3) denote the positive effect of raising p. First, as p increases, c decreases ($\partial c^* / \partial p < 0$). With v decreasing in c, U^R increases. $v_1 \frac{\partial c^*}{\partial p} (>0)$ measures this effect. Note that R is the net benefit when the crime is caught. With $R \geq 0$, as p increases, U^R also increases. The last two terms of Equation (3) indicate the negative effect of raising p. First, as p increases, the enforcement cost increases, which reduces the wealth held by the rich. Therefore, U^R decreases. Second, with p increase, c decreases. Then, R decreases, thereby, U^R decreases. These two effects have to be balanced in determining p.

Similarly, the first term of Equation (4) denotes the positive effect of raising g. As g increases, c decreases. With v decreasing in c, U^R increases. $v_1 \frac{\partial c^*}{\partial g} (>0)$ measures this effect. However, as g increases, the wealth held by the rich decreases proportionally. Hence, with v increasing in ω, U^R decreases. $-v_2 (<0)$ measures this effect. Finally, as g increases, c decreases. Then, R decreases, thereby, U^R decreases.

Again, these two effects have to be balanced in determining optimal g.

Proposition 3. In equilibrium, p^* is strictly positive.

Proof; Suppose $p^* = 0$. Then, since $e'(0) = 0$, Equation (3) reduces to $v_1 \frac{\partial c^*}{\partial p} + R$. Since $v_1 \frac{\partial c^*}{\partial p} > 0$ and $R \geq 0$, $v_1 \frac{\partial c^*}{\partial p} + R > 0$. Hence, Equation (3) cannot hold as an equality. This is a contradiction.

For concreteness, we consider an example which shows that in equilibrium the rich choose positive levels of welfare g and apprehension probability p, and the poor choose to commit a crime unless $p = 1$.

Let $R(F, c) = c \cdot \sqrt{F} - \frac{F}{2}$. Maximizing $R(F, c)$ with respect to F, the equilibrium punishment policy is given by $F^*(c) = c^2$. As is predicted in the Proposition 1, the equilibrium punishment level is increasing in the severity of crime.

Let $u(c, g) = c + g$ and $d(F, g) = (1 - F)g$. With $F^*(c) = c^2$, $U^p(c; p, g, F^*(c)) = p(1 - c^2)g + (1 - p)(c + g)$. Maximizing $U^p(c; p, g, F^*(c))$ with respect to c gives $c^*(p, g) = \frac{(1 - p)}{2pg}$. As is predicted in Proposition 2, $c^*(p, g)$ is decreasing in both p and g. Notice that $c^* > 0$ unless $p=1$.

Finally, let $e(p)=\frac{5}{2}p^2$ and $v(c,\omega)=\omega-c$. Then,

$U^R=\omega_0-g-\frac{5}{2}p^2-\frac{(1-p)}{2pg}+p\frac{c^2}{2}$. By solving Equations (3) and (4), we get $p^*=1/2$ and $g^*=1/2$, respectively.

Notice that since $c^*(p^*, g^*)=1$ in equilibrium, the poor commit a crime as an optimizing behavior. And the equilibrium punishment, $F^*(c^*)=1$, is optimal after crime has been committed.

Ⅳ. CONCLUDING REMARKS

In this paper we explained (a) why the welfare systems exist without assuming altruism and (b) why crime is committed more often than not and why actual punishment of the crime seems always less than the optimal punishment preventing the crime, assuming that crime is inefficient and can be prevented. In the analysis of our model, we focus on the equilibria which are sequentially rational, namely subgame perfect equilibria. In this equilibrium actual punishment in the third stage has the property that it is optimal for the rich even after the poor have committed a crime.

Admittedly, the current analysis is based upon a very simple model. Adding more institutional features seems to be a fruitful way for future research. In particular, one referee suggested that giving the voting right to both the rich and the poor is an interesting extension, thereby, the social institution such as the judiciary system or welfare system is determined by the interaction between classes with different preferences. That seems a fruitful way for future research agenda.

REFERENCE

Becker, G. (1968), "Crime and Punishment: An Economic Approach," *Journal of Political Economy*, 76, 169-21.

Brown, W., and M. Reynolds (1973), "Crime and Punishment: Risk Implications," *Journal of Economic Theory*, 6, 508-514.

Heineke, J. (1975), "A Note on Modelling the Criminal Choice Problem," *Journal of Economic Theory*, 10, 113-116.

Polinsky, M., and S. Shavell (1979), "The Optimal Tradeoff between the Probability and Magnitude of Fines," *American Economic Review*, 880-891.

Phelps, E. (1975), *Altruism, Morality, and Economic Theory*, Russell Sage Foundation, New York.

Reinganum, J., and L. Wilde (1986), "Equilibrium Verification and Reporting Policies in a Model of Tax Compliance," *International Economic Review*, 27, 739-759.