Comment to the paper "The Cost of Avoiding Crime: The Case of Bogotá" by Alejandro Gaviria, Carlos Medina, Leonardo Morales and Jairo Núñez

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The paper by A. Gaviria et al. uses an econometric model with hedonic prices to estimate the value households are willing to pay to avoid crime in Bogotá. They find that households living in the highest socioeconomic stratum are paying up to 7.2% of their house values to keep their average homicide rates constant and households living in the next stratum of richest population in the city would be paying up to 2.4% of their house values for the same purpose. They write "The result reveals the willingness to pay for security by households in Bogotá, and additionally, reveals that a supposed pure public good like security, ends up propitiating urban private markets that auction security. These markets imply different levels of access to public goods among the population, and actually, the exclusion of the poorest".

The purpose of this comment is to build a very simple model to make clear what the authors are measuring. The model will also help to point out that security is not a pure public good and to understand how inconvenient is to treat it as such.

Let us assume that the representative inhabitant of Bogotá is a quasilinear consumer whose utility function is $u = v(q) + s$ where q is the quantity demanded of housing (an index of square meters plus living equipment) and s is the quantity consumed of all other goods (measured as a quantity of money). The price of housing is p, there is a probability π that a fraction A of q is stolen. The probability π depends negatively on the level (units) of security per square meter bought x which cost c per unit. The consumer problem, whose income is m, is to find the values of q and x which solve

$$\text{max. } u = v(q) + s \qquad (1)$$

$$\text{s.t. } pq + s + \pi(x)Aq + cxq = m \qquad (2)$$

There is a firm producing housing in a perfect competition market. The production cost C depends on the production level. The firm solves

$$\text{max. } B = pq - C(q) \qquad (3)$$

for q.

There are several settings in which the relationship between consumer and firm can be studied. First, I will present the Pareto efficient solution, then the private solutions to end with the study of the public good solution.

To find the Pareto efficient levels for q and x the problem

$$\text{max. } u = v(q) + m - pq - \pi(x)Aq - cxq \qquad (4)$$

$$\text{s.t. } \bar{B} = pq - C(q) \qquad (5)$$

must be solved. It is equivalent to find the solution for

$$\text{max. } u = v(q) + m - \bar{B} - C(q) - \pi(x)Aq - cxq \qquad (6)$$

First order conditions for (6) imply that x and q should satisfy

$$c = -\frac{d\pi}{dx}A \qquad (7)$$

and

$$\frac{dv}{dq} - \pi(x)A = \frac{dC}{dq} + cx \qquad (8)$$

Equation (7) can be solved for x and then, introducing that value of x into (8), q is found. The Pareto efficient values x^e and q^e result from (7) and (8). As it is usual, they require equalization of marginal cost and marginal revenue –(7)– and marginal utility and marginal cost –(8) –. By the way, equation (8) shows clearly how harmful for society is crime: marginal cost of production for q increases by cx and marginal utility of consumption decreases by $\pi(x)A$: both supply and demand drop when compared with the case in which crime does not exist.

In the private solution the firm supplies q and also x as amenities (together with q as it is assumed in the paper). The demand function for q is obtained from

$$\max.\, u = v(q) + s \tag{9}$$
$$\text{s.t. } pq + s + \pi(x)Aq = m \tag{10}$$

and it is

$$p^d = \frac{dv}{dq} - \pi(x)A \tag{11}$$

where p^d is the reservation price. The supply function for q comes from the solution for

$$\max.\ B = pq - C(q) - cxq \tag{12}$$

and it is

$$p^s = \frac{dC}{dq} + cx \tag{13}$$

where p^s is the supply price. Equations (12) and (13) show that demand and supply for q depend on amenities provided $- x$ –. The changes in reservation and supply prices for q when the level of amenities changes are derived from (12) and (13) and they are

$$\frac{dp^d}{dx} = -\frac{d\pi}{dx}A \tag{14}$$

and

$$\frac{dp^s}{dx} = c \tag{15}$$

I understand that the coefficient a_2 of equation (1) of the paper measures (14) and that it represents the main result reported. Equations (14) and (15) show how the level of amenities provided with housing is determined: whenever $-\frac{d\pi}{dx}A$ is higher (lower) than c, the change in the level of p^d that consumers are willing to pay for a new unit of security provided as an amenity in housing is higher (lower) than the marginal cost that the firm requires to supply it and so amenities provided with housing increase (decrease); the process stops when the level of amenities provided with housing is such that $c = -\frac{d\pi}{dx}A$. Besides, the working of the market forces make $p^d = p^s$ for housing. Equations (7) and (8) are satisfied and the market solution is Pareto efficient. Security supplied as a private good (in the form of amenities) together with housing is efficient.

In the "public good setting" security is supplied by a public agency financed by a tax levied on housing values in such a way that $tpq = cxq$ where t is the tax rate. The Pareto solution in this case must satisfy

$$\text{max. } u = v(q) + m - pq - \pi(x)Aq - tpq \quad (16)$$

$$\text{s.t. } \bar{B} = pq - C(q) \quad (17)$$

$$tpq = cxq \quad (18)$$

and x^e and q^e solve the problem. But those are not the private solutions. Private solutions are obtained from

$$\text{max. } u = v(q) + m - pq - \pi(x)Aq - tpq \quad (19)$$

which requires that

$$\frac{\partial u}{\partial q} = \frac{dv}{dq} - p - \pi(x)A - tp = 0 \quad (20)$$

and

$$\frac{\partial u}{\partial x} = -\frac{d\pi}{dx}A = 0 \quad (21)$$

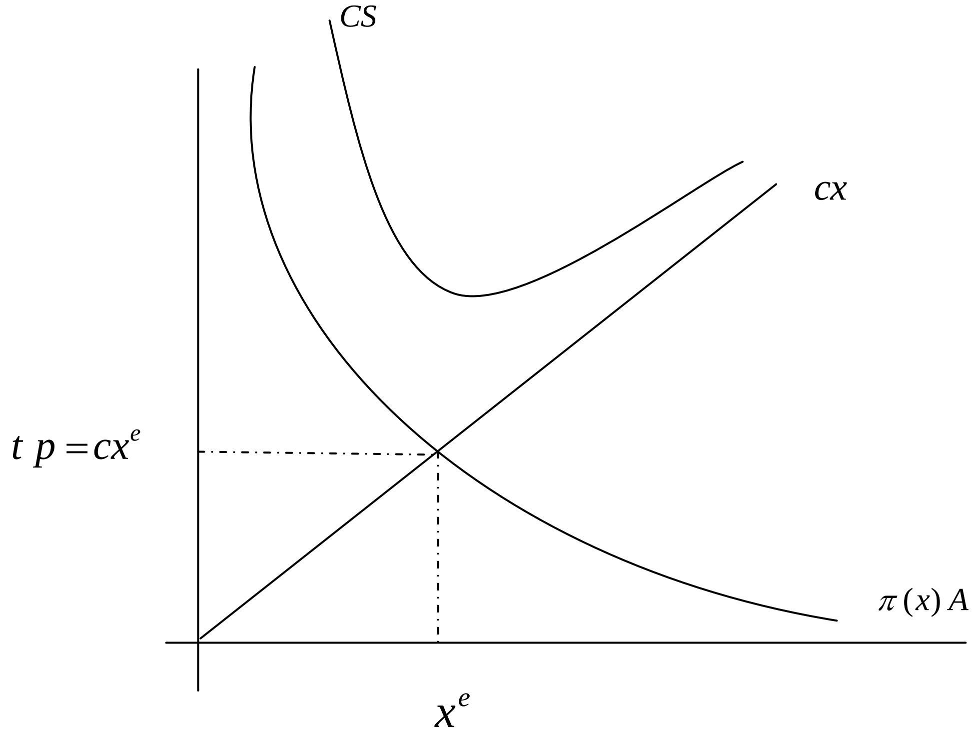
for the consumer. The firm solves

$$\text{max. } B = pq - C(q) \quad (22)$$

and makes $p = \frac{dC}{dq}$. The public agency chooses t to fulfill (18). The problem is posed by the demand for x as shown in (21). The consumer faces a flat t and so asks for a maximum level of x: that level for which an increase in security supplied no longer reduces the probability of suffering a crime so that $-\frac{d\pi}{dx}=0$. The problem is illustrated in the following picture. The efficient level for x is also the level which minimizes social cost CS

$$\text{min. } CS = cx + \pi(x)A \qquad (23)$$

because $\frac{dCS}{dx} = c + \frac{d\pi}{dx}A = 0$ is satisfied by x^e.



In the picture cx , $\pi(x)A$ and its sum CS are drawn. The point for which $\frac{d\pi}{dx}=0$ implies a much higher demand for security levels than x^e. The private solution for the “public good setting” is not Pareto efficient, even if $tp = cx^e$, because it divorces quantities from prices. On top of that, the consumer feels he gets a lower level of security than that he is paying for.

The use of quasilinear preferences does not allow exploring income and wealth effects that are important in the paper but assuming that A is higher for richer people than for poor people, it is possible to understand why $\frac{dp^d}{dx}$ is higher for richer agents.

The important conclusion that can be added to the paper is that security is not a public good and should not be treated as such. It is a private good publicly supplied because it has important externalities both positive and negative: a policeman in front of a house discourages crime in the whole block and a private guard in front of the same house displaces crime from it to other houses (perhaps in the same block). But, at the same time, private investment in security by agents belonging to the richer stratum allows public policy makers to displace public security expenditures from richer neighborhoods to poorer ones. The problem is not amenities but public policy. In fact the paper supports this conclusion when it says "…propitiating urban private markets that auction security. These markets imply different levels of access to *public goods* among the population, and actually, the *exclusion* of the poorest." (Italics are mine). If exclusion is possible then security is not a public good.