The Location of Crime

Catherine de Fontenay[1]

In a recent press release, the Secretary of the Organization of American States (OAS), Jose Miguel Insulza, referred to security as a key challenge for Latin America, because the region has the world's highest crime statistics, and crime is growing (OAS, December 8, 2006). The illegal drug industry contributes to high crime rates, but is unlikely to be responsible for the steady increase in crime. For example, Argentina, which does not play a large role in drug trafficking, saw reported property crime in Buenos Aires grow by 500% from 1992 to 2001 (Giavedoni, 2003).

The other major international trend of the last fifteen years has been the opening to trade of China, India and the former Soviet Union. In the words of Richard Freeman: "Most people have not come to grips with the most fundamental reality change in the current era of globalization – the fact that the global labor force has virtually doubled in size in the last 15 years" (Freeman 2005). Workers in the manufacturing and service sectors of Latin America find themselves competing head-to-head with these new workers. Given the low wage rates in China and India, the end result in Latin America is often unemployment and/or downward pressure on wages. In poor countries with little income support, crime is often an economic response to distressed circumstances. Thus we might well expect worse conditions for workers to lead to higher crime.

Whatever the causes, the rise in crime also has consequences. Generally the focus has been on the effect of crime on the wellbeing of citizens, as it is a pressing issue for residents of high-crime areas. The recent opinion poll of Latin Americans by The Economist "shows clearly that the two sets of issues uppermost in voters' minds were *unemployment and poverty* on the one hand, and *crime and public security* on the other (The Economist, Dec 7th, 2006, italics mine); consequently they are also on the minds of politicians. But what receives much less attention is the role crime may be playing in deterring business activity. "Crime is growing and that discourages investment" said Insulza in the press release above; the OAS is one of the only organizations to mention the issue. Likewise, the academic literature has devoted much attention to the role of corruption in deterring investment, but not the role of crime. In many poor countries, crime has visibly shaped the economic activity undertaken: what economic activity can take place at night, or in a poor neighborhood, etc. It remains an open question how much economic activity overall is distorted or eliminated by the presence of crime.
This paper presents a very preliminary model of crime in the context of trade between countries. The interest of such a model is to consider the general equilibrium implications of crime: the effect of trade on crime rates, but also the effect of crime rates on trade and output. The restructuring that Latin American economies will undergo in the next decade, as the opening of China and India continues to put pressure on wages, may

[1] Preliminary and incomplete—please do not cite. Author affiliation: Melbourne Business School and Department of Economics, University of Melbourne. Corresponding address: C de Fontenay, Department of Economics, University of Melbourne, Parkville VIC 3010 Australia. The author would like to thank Chongwoo Choe, Tue Gørgens, and Jenny George. Responsibility for any errors remains my own.

be far less benign than that suggested by a standard trade model, because of the harmful economic consequences of increased crime. And in more general terms, the gains from trade may actually be negative, once the negative externalities from rising crime are taken into account.

1. The Literature

The prior theoretical literature on this topic is at the intersection of development economics and political economy. Authors such as Grossman and Kim (1995) and Hirschleifer (1995) have modeled economies in which agents decide whether to engage in productive activity or to attack other agents in the economy. The questions that this literature seeks to answer are mainly in the realm of political economy, however: when are secure property rights an equilibrium? When is anarchy an equilibrium?

The closest paper to this one is by Gerard Roland and Thierry Verdier (2003), on transition economies. They model a one-sector economy in which multiple equilibria can arise in the crime rate: if there are too many criminals, relative to productive citizens, the state cannot raise enough taxes to deter criminals, and make productive activity more attractive. So there may be a bad equilibrium in which all agents become criminals. Another closely related theory paper is by Burdett, Lagos and Wright (2003), exploring the role of inequality in the relationship.

On the empirical side, some studies have sought to establish whether there is a causal link between employment and crime, but there has been little attention to the two-way nature of the relationship, except for econometric completeness. Raphael and Winter-Ebmer (2001) and Britt (1994) have used instruments and time-series lags, respectively, to untangle the effect of crime on employment and vice-versa.

Given that much of the literature has been devoted to Europe and the US, there is not much literature on crime in developing countries. As a result, economic history papers are of particular interest: papers looking at the crime situation prior to the Industrial Revolution are in effect considering very poor economies. And some history papers cover a very broad sweep of time, allowing one to identify longer-term trends. There is still the notorious unreliability of crime statistics, because of huge variations in reporting rates across countries and across time (Gibson 2003).[2] But if historical sources note a huge upsurge in crime rates, it seems safe to infer that crime has indeed risen.

Several historical sources note a counter-cyclical pattern in crime, for example Gatrell and Hadden (1972; strong inverse correlation until 1860). Other sources (Field 1995) find very little evidence for such a pattern in modern data, but there may be a break in the employment-crime link once a country becomes more prosperous. Gurr (1977) found that

[2] Some studies (such as Fajnzylber et al. 1998) have used homicide rates as a proxy, arguing that other types of crime are correlated, and homicides are much less likely to go unreported; but there is some evidence that the measures are not that closely correlated, and that the relationship between property crime and homicides varies across time and place.

crime rose in the Great Depression. Earlier data shows the counter-cyclical pattern much more clearly: in particular, which the price of staples such as grains is high, there is more theft (Von Mayr 1867, several articles surveyed by P and P Brantingham 1984).

Interestingly, a couple of researchers pick up a link between trade and crime, without having a clear hypothesis to explain it. Researchers note a strong rise in crime in the 1560-1610 period, during which time England became the pre-eminent trading power, and in the early Industrial Revolution, when trade was also increasing.

2. The Model

The model is a standard two-good, two-input, two-country Heckscher-Ohlin model, augmented to include crime. Goods X and Y are produced under Cobb-Douglas production functions from capital and labour, in countries A and B:

$$X_A = K_A^{a} L_A^{1-a}$$
$$Y_A = K_A^{b} L_A^{1-b} \qquad 0 < \alpha, \beta < 1$$

Capital and labour are non-tradeable inputs. From this point we will write expressions in terms of the capital-labor ratio, "k", so we re-write the expression stating that all capital in the economy is used to produce X or to produce Y:

$$\overline{K}_A = k_{xA} L_{xA} + k_{xB} L_{xB} \qquad (0)$$

We assume w.l.o.g. that there is a higher ratio of capital to people in economy A: $K_A/N_A >> K_B/N_B$, where N is the number of people (a subset of whom work, and a subset of whom engage in crime). Note that we are thinking of differences between developing countries, rather than a North-South model. Country "A" might be Papua New Guinea, rich in minerals and relatively under-populated. In wealthy countries, crime is often connected to issues such as marginalization, and cannot be summarized by looking at merely the economic forces; there is also a greater role of the police force in wealthy countries, which we do not consider here.

Good Y is the numeraire, and thus "p" is the price of X relative to Y.

Consumers in all countries have the same Cobb-Douglas utility function:

$$U(X,Y) = K^{\gamma} L^{1-\gamma} \qquad 0 < \gamma < 1$$

In autarky, the relative prices of goods X and Y in country A reflect only the output of country A, and relative preferences:

$$\frac{1}{p} = \left(\frac{1-g}{g}\right)\frac{X_A}{Y_A} = \left(\frac{1-g}{g}\right)\frac{k_{xA}^{a} L_{xA}}{k_{yA}^{b} L_{yA}} \qquad (1)$$

while under free trade between countries A and B, prices reflect world output:

$$\frac{1}{p} = \left(\frac{1-\gamma}{\gamma}\right)\frac{X_A + X_B}{Y_A + Y_B} = \left(\frac{1-\gamma}{\gamma}\right)\frac{k_{xA}^{\alpha} L_{xA} + k_{xB}^{\alpha} L_{xB}}{k_{yA}^{\beta} L_{yA} + k_{yB}^{\beta} L_{yB}} \qquad (2)$$

Crime Model

Any model of crime is defined by two technologies: (a) the matching technology, which determines the probability with which robbers and producers meet and (b) the "attacking" technology.

Our matching technology departs slightly from the normal assumption of random matching. In most crime and political economy models, each agent meets other agents with probabilities equal to their proportions in the population (as in Roland and Verdier 2003); if a robber meets an honest person, they fight over the honest person's output. One unattractive feature of this technology is that it leads to multiple equilibria: If there are currently no robbers in the economy and identical agents, there is no incentive to become a robber, while there may be an incentive to be a robber in an economy with more crime.

So we assume that the matching takes place between robbers and **firms**, not honest agents. And we assume that there is a minimum efficient scale in firms, of "n"; all firms have exactly n people. Thus, if there are L_x workers in industry X, and L_y workers in industry Y, there are L_x/n and L_y/n firms of type X and Y respectively, and $(N - L_x - L_y)$ robbers. Thus, if we have an atomless distribution of agents, the probability of meeting an honest person in random matching is:

$$q = \frac{\frac{L_x}{n} + \frac{L_y}{n}}{(N - L_x - L_y) + \frac{L_x}{n} + \frac{L_y}{n}} = \frac{L_x + L_y}{nN - (n-1)(L_x + L_y)}$$

The probability a robber meets a firm of type X is: $\gamma_x = \dfrac{L_x}{nN - (n-1)(L_x + L_y)}$

The probability a robber meets a firm of type Y is: $\gamma_y = \dfrac{L_y}{nN - (n-1)(L_x + L_y)}$

One story that would give rise to similar probabilities of encounter as a random matching model is if the economy had T different locations for production: then the unique Nash equilibrium to a game in which robbers try to meet producers, and producers try to avoid robbers, would see equal proportions of robbers and of producers of each type, in each location.

In terms of the attacking technology, we assume that a robber is victorious in the attack with probability s; and if he is victorious, he carries away all of the firm's output (none of its inputs). This is equivalent to assuming that he always steals a share "s" of the output, of any firm he attacks.

Equalization of returns to labour

In line with the literature on property rights (Hirschleifer 1995, Grossman 1995), we model robbery as an occupation, which agents enter until the returns from crime equal the returns from productive labor in the X and Y industries.

If a firm meets a robber, the firm loses a fixed share of its belongings, ***s***. Therefore the firm's expected payoff is qY + (1-q)(1-s)Y = (q + 1 – s – q + sq)Y = (1 – s + sq)Y = "ψ"

Now we can express the equalization of the marginal product of inputs across industries. Considering an initial equilibrium with autarky, where the price of good X is "p_A" in country A, the first-order conditions for labour and capital to earn the same payoff in both X and Y are:

$$\begin{cases} p_A \gamma \alpha k_{xA}^{\alpha-1} = \gamma \beta k_{yA}^{\beta-1} \\ p_A \gamma (1-\alpha) k_{xA}^{\alpha} = \gamma (1-\beta) k_{yA}^{\beta} \end{cases} \quad \Rightarrow \quad \begin{cases} k_{yA} = \dfrac{(1-\alpha)\beta}{\alpha(1-\beta)} k_{xA} \\ \\ p_A = \dfrac{(1-\beta) k_{yA}^{\beta}}{(1-\alpha) k_{xA}^{\alpha}} \end{cases} \qquad (1)$$

Labour is distributing itself across industries in order to equalize its marginal product, but it is also distributing itself across crime and legal activity: so labour must earn the same return in crime as in legitimate activity.

$$p_A \gamma (1-\alpha) k_{xA}^{\alpha} = \gamma (1-\beta) k_{yA}^{\beta} = p_A \gamma_x sn k_{xA}^{\alpha} + \gamma_y sn k_{yA}^{\beta}$$

$$\Rightarrow \quad \gamma = \gamma_x sn \left(p_A \frac{k_{xA}^{\alpha}}{k_{yA}^{\beta}} \right) + \gamma_y sn \frac{1}{1-\beta}$$

$$\Rightarrow \quad \gamma = \gamma_x sn \left(\frac{1}{1-\alpha} \right) + \gamma_y sn \frac{1}{1-\beta}$$

Substituting for the values of ψ, etc:

$$\left(1 - s + s\frac{L_{xA} + L_{yA}}{nN_A - (n-1)(L_{xA} + L_{yA})}\right) = \left(\frac{L_{xA}}{nN_A - (n-1)(L_{xA} + L_{yA})}\right) sn \frac{1}{1-\alpha} + \left(\frac{L_{yA}}{nN_A - (n-1)(L_{xA} + L_{yA})}\right) sn \frac{1}{1-\beta}$$

$$(1-s)\left(nN_A - (n-1)(L_{xA} + L_{yA})\right) + s(L_{xA} + L_{yA}) = L_{xA} sn \frac{1}{1-\alpha} + L_{yA} sn \frac{1}{1-\beta}$$

$$\boxed{(1-s)nN_A = L_{xA}\left(n-1+sn\frac{\alpha}{1-\alpha}\right)+L_{yA}\left(n-1+sn\frac{\beta}{1-\beta}\right)} \qquad (2)$$

This equation expresses the constraints imposed on labour by the presence of crime in the economy, instead of the normal full-employment constraint: $L_{xA}+L_{yA}=N_A$.

The closing equations depend on whether there is trade or autarky: Consumers in all countries have the same Cobb-Douglas utility function:

$$U(X,Y) = X^{\gamma}Y^{1-\gamma} \qquad 0 < \gamma < 1$$

Thus, in autarky, the relative price of good X in country A reflects only the output of country A:

$$p_A = \left(\frac{\gamma}{1-\gamma}\right)\frac{Y_A}{X_A} = \left(\frac{\gamma}{1-\gamma}\right)\frac{k_{yA}^{\beta}L_{yA}}{k_{xA}^{\alpha}L_{xA}}$$

which, in combination with equation (1) yields:

$$p_A = \frac{(1-\beta)k_{yA}^{\beta}}{(1-\alpha)k_{xA}^{\alpha}} = \left(\frac{\gamma}{1-\gamma}\right)\frac{k_{yA}^{\beta}L_{yA}}{k_{xA}^{\alpha}L_{xA}} \quad \Rightarrow \quad L_{yA} = \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)L_{xA} \qquad (3)$$

Under free trade between countries A and B, the world price of good X reflects total world output:

$$p = \left(\frac{\gamma}{1-\gamma}\right)\frac{Y_A+Y_B}{X_A+X_B} = \left(\frac{\gamma}{1-\gamma}\right)\frac{k_{yA}^{\beta}L_{yA}+k_{yB}^{\beta}L_{yB}}{k_{xA}^{\alpha}L_{xA}+k_{xB}^{\alpha}L_{xB}}$$

We return to equation (1), noting that now the same price p must satisfy:

$$p = \frac{(1-\beta)k_{yA}^{\beta}}{(1-\alpha)k_{xA}^{\alpha}} = \frac{(1-\beta)k_{yB}^{\beta}}{(1-\alpha)k_{xB}^{\alpha}} \quad \textit{and} \quad \begin{cases} k_{yA} = \dfrac{(1-\alpha)\beta}{\alpha(1-\beta)}k_{xA} \\ k_{yB} = \dfrac{(1-\alpha)\beta}{\alpha(1-\beta)}k_{xB} \end{cases}$$

$$\Rightarrow \quad k_{yA} = k_{yB} = \frac{(1-\alpha)\beta}{\alpha(1-\beta)}k_{xA} = \frac{(1-\alpha)\beta}{\alpha(1-\beta)}k_{xB} \qquad (4)$$

Therefore

$$p = \frac{(1-\beta)k_{yA}^{\beta}}{(1-\alpha)k_{xA}^{\alpha}} = \left(\frac{\gamma}{1-\gamma}\right)\frac{k_{yA}^{\beta}(L_{yA}+L_{yB})}{k_{xA}^{\alpha}(L_{xA}+L_{xB})} \quad \Rightarrow \quad \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)(L_{xA}+L_{xB}) = L_{yA}+L_{yB} \qquad (5)$$

To close the system of equations under trade, we use (4) and the equation for the capital stock:

$$K_{xA} + K_{yA} = K_A$$

$$\Rightarrow \quad k_{xA}L_{xA} + k_{yA}L_{yA} = K_A$$

$$\Rightarrow \quad k_{xA}L_{xA} + \frac{(1-\mathsf{a})\mathsf{b}}{\mathsf{a}(1-\mathsf{b})}k_{xA}L_{yA} = K_A$$

$$\Rightarrow \quad \frac{K_A}{L_{xA} + \frac{(1-\mathsf{a})\mathsf{b}}{\mathsf{a}(1-\mathsf{b})}L_{yA}} = k_{xA} = k_{xB} = \frac{K_B}{L_{xB} + \frac{(1-\mathsf{a})\mathsf{b}}{\mathsf{a}(1-\mathsf{b})}L_{yB}}$$

$$\Leftrightarrow \quad \left(L_{xA} + \frac{(1-\mathsf{a})\mathsf{b}}{\mathsf{a}(1-\mathsf{b})}L_{yA}\right)\frac{K_B}{K_A} = L_{xB} + \frac{(1-\mathsf{a})\mathsf{b}}{\mathsf{a}(1-\mathsf{b})}L_{yB} \qquad (6)$$

Using the above, we will now make some simple comparisons. We will want to compare results with crime to results from a world in which crime is ruled out, that is, the usual Hecksher Ohlin world. And we want to examine the effect of trade, by making comparisons between a situation of autarky, and a situation with trade.

NO CRIME & AUTARKY

(a) $L_{yA} = \left(\frac{1-\mathsf{g}}{\mathsf{g}}\right)\left(\frac{1-\mathsf{b}}{1-\mathsf{a}}\right)L_{xA}$

(b) $L_{yB} = \left(\frac{1-\mathsf{g}}{\mathsf{g}}\right)\left(\frac{1-\mathsf{b}}{1-\mathsf{a}}\right)L_{xB}$

(c) $L_{xA} + L_{yA} = N_A$

(d) $L_{xB} + L_{yB} = N_B$

➔

$$L_{xA} = \frac{N_A}{1+\left(\frac{1-\mathsf{g}}{\mathsf{g}}\right)\left(\frac{1-\mathsf{b}}{1-\mathsf{a}}\right)} \qquad L_{yA} = \frac{N_A}{1+\left(\frac{\mathsf{g}}{1-\mathsf{g}}\right)\left(\frac{1-\mathsf{a}}{1-\mathsf{b}}\right)}$$

$$L_{xB} = \frac{N_B}{1+\left(\frac{1-\mathsf{g}}{\mathsf{g}}\right)\left(\frac{1-\mathsf{b}}{1-\mathsf{a}}\right)} \qquad L_{yB} = \frac{N_B}{1+\left(\frac{\mathsf{g}}{1-\mathsf{g}}\right)\left(\frac{1-\mathsf{a}}{1-\mathsf{b}}\right)}$$

NO CRIME & TRADE

(a') $\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)(L_{xA}+L_{xB})=L_{yA}+L_{yB}$

(b') $\left(L_{xA}+\frac{(1-\alpha)\beta}{\alpha(1-\beta)}L_{yA}\right)\frac{K_B}{K_A}=L_{xB}+\frac{(1-\alpha)\beta}{\alpha(1-\beta)}L_{yB}$

(c) $L_{xA}+L_{yA}=N_A$

(d) $L_{xB}+L_{yB}=N_B$

$$L_{xA}=\frac{K_A}{K_A+K_B}\left[\frac{N_A+N_B}{1+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}+\frac{N_A\frac{K_B}{K_A}-N_B}{1-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}\right]$$

$$L_{yA}=\frac{K_A}{K_A+K_B}\left[\frac{N_A+N_B}{1+\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}+\frac{N_A\frac{K_B}{K_A}-N_B}{1-\left(\frac{\beta}{\alpha}\right)\left(\frac{1-\alpha}{1-\beta}\right)}\right]$$

$$L_{xB}=\frac{K_B}{K_A+K_B}\left[\frac{N_A+N_B}{1+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}+\frac{N_B\frac{K_A}{K_B}-N_A}{1-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}\right]$$

$$L_{yB}=\frac{K_B}{K_A+K_B}\left[\frac{N_A+N_B}{1+\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}+\frac{N_B\frac{K_A}{K_B}-N_A}{1-\left(\frac{\beta}{\alpha}\right)\left(\frac{1-\alpha}{1-\beta}\right)}\right]$$

CRIME & AUTARKY

(a) $L_{yA} = \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)L_{xA}$

(b) $L_{yB} = \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)L_{xB}$

(c') $L_{yA} = \frac{(1-s)n}{n-1+sn\frac{\beta}{1-\beta}}N_A - \frac{n-1+sn\frac{\alpha}{1-\alpha}}{n-1+sn\frac{\beta}{1-\beta}}L_{xA}$

(d') $L_{yB} = \frac{(1-s)n}{n-1+sn\frac{\beta}{1-\beta}}N_B - \frac{n-1+sn\frac{\alpha}{1-\alpha}}{n-1+sn\frac{\beta}{1-\beta}}L_{xB}$

To simplify calculations, we summarize (c') and (d') as

(c') $L_{yA} = cN_A - aL_{xA}$

(d') $L_{yB} = cN_B - aL_{xB}$

➔

$$L_{xA} = \frac{cN_A}{a+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)} \qquad L_{yA} = \frac{cN_A}{1+a\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}$$

$$L_{xB} = \frac{cN_B}{a+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)} \qquad L_{yB} = \frac{cN_B}{1+a\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}$$

Strikingly, both countries have the same share of criminals (criminals as a % of labour).

CRIME & TRADE

(a') $$\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)(L_{xA}+L_{xB})=L_{yA}+L_{yB}$$

(b') $$\left(L_{xA}+\frac{(1-\alpha)\beta}{\alpha(1-\beta)}L_{yA}\right)\frac{K_B}{K_A}=L_{xB}+\frac{(1-\alpha)\beta}{\alpha(1-\beta)}L_{yB}$$

(c') $$L_{yA}=\frac{(1-s)n}{n-1+sn\frac{\beta}{1-\beta}}N_A-\frac{n-1+sn\frac{\alpha}{1-\alpha}}{n-1+sn\frac{\beta}{1-\beta}}L_{xA}$$

(d') $$L_{yB}=\frac{(1-s)n}{n-1+sn\frac{\beta}{1-\beta}}N_B-\frac{n-1+sn\frac{\alpha}{1-\alpha}}{n-1+sn\frac{\beta}{1-\beta}}L_{xB}$$

$$L_{xA}=\frac{cK_A}{K_A+K_B}\left[\frac{N_A+N_B}{a+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}+\frac{N_A\frac{K_B}{K_A}-N_B}{a-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}\right]$$

$$L_{yA}=\frac{cK_A}{K_A+K_B}\left[\frac{N_A+N_B}{1+a\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}+\frac{N_A\frac{K_B}{K_A}-N_B}{1-a\left(\frac{\beta}{\alpha}\right)\left(\frac{1-\alpha}{1-\beta}\right)}\right]$$

$$L_{xB}=\frac{cK_B}{K_A+K_B}\left[\frac{N_A+N_B}{a+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}+\frac{N_B\frac{K_A}{K_B}-N_A}{a-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}\right]$$

$$L_{yB}=\frac{cK_B}{K_A+K_B}\left[\frac{N_A+N_B}{1+a\left(\frac{\gamma}{1-\gamma}\right)\left(\frac{1-\alpha}{1-\beta}\right)}+\frac{N_B\frac{K_A}{K_B}-N_A}{1-a\left(\frac{\beta}{\alpha}\right)\left(\frac{1-\alpha}{1-\beta}\right)}\right]$$

Armed with these results, we now turn to address the following questions:

- Does trade cause crime to go up in either country?

- Does trade cause the total amount of crime?

Question one: Does trade increase crime in either country?

Assume wlog: Country A is capital intensive, country B is labor-intensive
Assume wlog: $\alpha<\beta$

Crime goes up in country A if $L_{xA}^{c,nt}+L_{yA}^{c,nt}>L_{xA}^{c,t}+L_{yA}^{c,t}$; is this true?

$$L_{xA}^{c,nt}+L_{yA}^{c,nt}=\frac{cN_A\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}$$

$$L_{xA}^{c,t}+L_{yA}^{c,t}=\frac{cK_A}{K_A+K_B}\left[\frac{(N_A+N_B)\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}+\frac{\left(N_A\frac{K_B}{K_A}-N_B\right)\left[1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)\right]}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}\right]$$

$$\frac{cN_A\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}\;?>?\;\frac{cK_A}{K_A+K_B}\left[\frac{(N_A+N_B)\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}+\frac{\left(N_A\frac{K_B}{K_A}-N_B\right)\left[1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)\right]}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}\right]$$

$$\frac{(N_AK_B-N_BK_A)\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}\;?>?\;\frac{(N_AK_B-N_BK_A)\left[1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)\right]}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}$$

If A is capital-intensive, then $N_AK_B-N_BK_A=N_AN_B\left(\frac{K_B}{N_B}-\frac{K_A}{N_A}\right)<0$

Thus the inequality is equivalent to

$$\frac{1+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}{a+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)} ? < ? \frac{1-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}{a-\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)}$$

If $a < \left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right)$, this never holds.

If $\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right) < a < 1$, then this always holds:

$$\frac{1+x}{a+x} < \frac{1-y}{a-y} \quad \Leftrightarrow \quad (1+x)(a-y) < (1-y)(a+x)$$

$$\Leftrightarrow \quad -y + ax < x - ay$$

$$\Leftrightarrow \quad 0 < (x+y)(1-a)$$

➔ Remains to prove that $\left(\frac{\alpha}{\beta}\right)\left(\frac{1-\beta}{1-\alpha}\right) < a < 1$:

$$\frac{\alpha}{\beta}\left(\frac{1-\beta}{1-\alpha}\right) < a = \frac{n-1+sn\frac{\alpha}{1-\alpha}}{n-1+sn\frac{\beta}{1-\beta}}$$ (it's clearly less than 1, since $\alpha<\beta$)

$$\Leftrightarrow \quad \frac{\alpha}{\beta}\left(\frac{1-\beta}{1-\alpha}\right)(n-1) + sn\frac{\alpha}{1-\alpha} < n-1+sn\frac{\alpha}{1-\alpha}$$

$$\Leftrightarrow \quad \frac{\alpha}{\beta}\left(\frac{1-\beta}{1-\alpha}\right) < 1$$

$$\Leftrightarrow \quad \alpha < \beta$$

So crime goes up (and employment goes down) in the capital-intensive country, because of crime.

Logic = If the two countries had the same crime rates, the factor prices would be equalized across countries, which means that wages in both countries would be the same. But if A has more capital, that makes crime more profitable in A ➔ that means that A must have a higher crime rate than B.

What about country B: we show that $L_{xB}^{c,nt} + L_{yB}^{c,nt} < L_{xB}^{c,t} + L_{yB}^{c,t}$.

$$L_{xB}^{c.nt} + L_{yB}^{c.nt} = \frac{cN_B\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}$$

$$L_{xB}^{c,t} + L_{yB}^{c,t} = \frac{cK_B}{K_A+K_B}\left[\frac{(N_A+N_B)\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)} + \frac{\left(N_B\frac{K_A}{K_B}-N_A\right)\left[1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)\right]}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}\right]$$

$$\frac{(K_AN_B-K_BN_A)\left[1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)\right]}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)} < \left[\frac{(K_AN_B-K_BN_A)\left[1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)\right]}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}\right]$$

$L_{xB}^{c,nt} + L_{yB}^{c,nt} < L_{xB}^{c,t} + L_{yB}^{c,t}$

Because $K_AN_B - K_BN_A = N_AN_B\left(\frac{K_A}{N_A}-\frac{K_B}{N_B}\right) > 0$, this inequality is equivalent to

$$\frac{1+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)}{a+\left(\frac{1-g}{g}\right)\left(\frac{1-b}{1-a}\right)} < \frac{1-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}{a-\left(\frac{a}{b}\right)\left(\frac{1-b}{1-a}\right)}$$

which is always true, as shown above. Therefore crime in country B goes down with trade (employment goes up).

Question two: Does trade increase total crime?

Strikingly, we find that trade has no effect at all on the total amount of crime: rather, crime has been re-located from the resource-poor country to the resource-rich country.

$$L_{xA}^{c,nt} + L_{yA}^{c,nt} + L_{xB}^{c,nt} + L_{yB}^{c,nt} = L_{xA}^{c,t} + L_{yA}^{c,t} + L_{xB}^{c,t} + L_{yB}^{c,t} = \frac{c(N_A + N_B)\left[1 + \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)\right]}{\alpha + \left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)}$$

The intuition comes from standard trade theory: Trade causes wages to go down and the return to capital to go up, in the resource-rich country (with the opposite effect in the resource-poor country). But that implies that wage work is less attractive than stealing, in the resource-rich country. So the number of criminals is higher in country A.

Conclusion

These are merely preliminary results, but they suggest that trade patterns can have strong effects on crime rates. They may also explain why crime rates have been on the rise in Latin America, as it competes with China and India for manufacturing jobs. And it conforms with the predictions of the "resource curse," that greater resources may lead to more violence and struggle for those resources.

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