Crime versus Globalization

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Preliminary and Incomplete

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 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). These two issues may in fact be related. 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.

This paper develops a model of global trade in which the entry of labor-rich countries onto world markets may lead to a rise in crime in other countries. Moreover, the resulting crime rates may be higher than in autarky! The interest of such a model is to consider the full implications of crime in a globalized world: 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 may 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.

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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:

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

Capital and labour are non-tradeable inputs. (From this point we will write expressions in terms of the capital-labor ratio, "k".)

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

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

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

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

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

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

In the absence of crime, trade will imply that the capital-ratio is identical in both industries and both countries, but the countries will have a different mix of industries.

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. The 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, which determines the share of output a robber can capture (or, equivalently, a robber's probability of success in an encounter).

For the matching technology, we assume an atomless distribution of agents, and random matching, so that each agent meets other agents with probabilities equal to their proportions in the population (as in Roland and Verdier 2003). Thus, if there are L_{xA} workers in industry X and L_{yA} workers in industry Y, and a total number of agents N_A in the economy, the probability of a robber encountering a "firm" (defined as a worker and the capital s/he uses) of type X is L_{xA}/N_A and of type Y is L_{YA}/N_A; the probability of a producer *not* encountering a robber is $(L_{xA} + L_{YA})/N_A$. One story that would give rise to such random matching 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.

We assume decreasing returns in the "attacking" technology: as the output of the firm grows, the total amount captured by the robber increases, but it is a decreasing share of output. The output per worker of each firm is k_{xA}^{α} and k_{yA}^{β} in industries X and Y, and the share captured by the robber is k^{-d}, where d < α,β. Thus the expected profits of a firm in industry X in the presence of crime is $p_x\left(1-k_{xA}^{-d}+k_{xA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)k_{xA}^{\alpha}$, and in industry Y is $p_y\left(1-k_{yA}^{-d}+k_{yA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)k_{yA}^{\beta}$.

In the absence of crime, the first-order conditions for factor price equalization across industries would be:

$$p_x\alpha k_{xA}^{\alpha-1}=p_y\beta k_{yA}^{\beta-1} \tag{3}$$

$$p_x(1-\alpha)k_{xA}^{\alpha}=p_y(1-\beta)k_{yA}^{\beta} \tag{4}$$

Note that the marginal product of capital must be equal across industries in a country, but not across countries, as we assume that capital is immobile.

In the presence of crime, the first-order condition for capital becomes

$$p_x\left(1-k_{xA}^{-d}+k_{xA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)\alpha k_{xA}^{\alpha-1}=p_y\left(1-k_{yA}^{-d}+k_{yA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)\beta k_{yA}^{\beta-1} \tag{5}$$

The first order condition equalizing the marginal product of labor across industries is similar. And, since the marginal product of labor is also equal to the wage rate, it must also be equal to the expected earnings of a robber:

$$\begin{aligned}p_x\left(1-k_{xA}^{-d}+k_{xA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)(1-\alpha)k_{xA}^{\alpha}&=p_y\left(1-k_{yA}^{-d}+k_{yA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)\right)(1-\beta)k_{yA}^{\beta}\\&=p_xk_{xA}^{-d}\left(\frac{L_{xA}}{N_A}\right)k_{xA}^{\alpha}+p_yk_{yA}^{-d}\left(\frac{L_{yA}}{N_A}\right)k_{yA}^{\beta}\end{aligned} \tag{6}$$

The equation which closes the system states that all the capital in an economy is used:

$$k_{xA}^{\alpha}L_{xA}+k_{yA}^{\beta}L_{yA}=\overline{K}_A \tag{7}$$

Identical expressions hold for country B.

<u>The Results</u>

Interestingly, the relative factor intensity of capital across the two industries is not a function of the presence or absence of crime, or of trade: both (3) & (4) and (5) & (6) imply that:

$$k_{xA} = \frac{(1-\alpha)\beta}{\alpha(1-\beta)} k_{yA} \tag{8}$$

Results 1: No Crime
In the absence of crime, all of labor in the economy is used in production, and therefore $N_A = L_{xA} + L_{yA}$ closes the system.

Under autarky, the results are as follows

$$k_{xA} = \left(\frac{K_A}{N_A}\right) \frac{1+\frac{1-\beta}{1-\alpha}\left(\frac{1-\gamma}{\gamma}\right)}{1+\frac{\beta}{\alpha}\left(\frac{1-\gamma}{\gamma}\right)} \tag{9}$$

$$L_{xA} = \frac{N_A}{\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{1-\beta}{1-\alpha}\right)+1} \quad \text{or} \quad L_{xA} = \frac{(1-\alpha)\beta}{\beta-\alpha} N_A - \frac{\alpha(1-\beta)}{\beta-\alpha}\left(\frac{K_A}{k_{xA}}\right) \tag{10}$$

And if countries A and B are trading:

$$k_{xA} = \left(\frac{K_A + K_B}{N_A + N_B}\right) \frac{1+\frac{1-\beta}{1-\alpha}\left(\frac{1-\gamma}{\gamma}\right)}{1+\frac{\beta}{\alpha}\left(\frac{1-\gamma}{\gamma}\right)} \tag{11}$$

$$L_{xA} = \frac{(1-\alpha)\beta}{\beta-\alpha} N_A - \frac{\alpha(1-\beta)}{\beta-\alpha}\left(\frac{K_A}{k_{xA}}\right) \quad \text{as in equation (8).}$$

Equation (10) underlines that capital-labor ratios are now optimized in the entire economy, as they are determined by the total world supply of capital and labor.

Results 2: Crime
The non-linear structure of the crime technology renders closed-form results impossible, but in the case of autarky we can arrive at an implicit function for k_{xA}, and in the case of trade we arrive at a pair of implicit functions that can be solved for k_{xA} and k_{xB}. The Appendix outlines these implicit functions.

We use the model to provide an example of an instance in which trade causes crime to *increase* relative to autarky.

Consider the case of three countries, A, B, and C, each with 100 units of capital. Country A has 100 units of labor, Country B has 120, and Country C has 200. The entry of Country C into trade with A and B cause crime in country B to increase relative to the prior situation of trade between A and B, but also relative to an autarky state in Country B.

Assigned parameter values:

- α=0.3, β=0.7 (so X is the industry in which labor is relatively more productive than capital)
- γ=0.5 (so there is no tilting of preferences towards one of the goods)
- d = 0.2 (the decreasing returns in crime).

- Under autarky:

Country	Share of total population in sector X	Share of total population in sector Y	Share of total population in crime
A	12.9%	9.4%	77.7%
B	12.4%	8.5%	79.1%
C	11.4%	6.2%	82.4%

The crime rates are obviously not at realistic levels, but it is interesting to note the relationship between crime and surplus labor: the larger the labor force, the higher the crime rate. We note, too that the allocation of labor across sectors is inefficient: under these parameters, the optimal allocation of labor is to have 70% of labor in sector A and 30% in sector B, but the composition here puts more labor in sector B. Decreasing returns in the crime technology makes capital intensity relatively more attractive.

- Under trade between A and B:

Country	Share of total population in sector X	Share of total population in sector Y	Share of total population in crime
A	10.4%	10.6%	79.0%
B	13.2%	7.8%	78.9%

Trade between A and B causes crime to fall in country B, because the returns to productive labor rise, and crime to rise in country A, because the returns to productive labor fall.

Note that countries are not specializing to the degree that would be optimal, in the presence of trade: If there were no crime, country B should devote 74% of its labor to sector X, and country A should devote only 64%. But in the presence of crime, country B devotes 62% of its labor to sector X, and country A devotes 49%.

- Under trade between A, B and C:

Country	Share of total population in sector X	Share of total population in sector Y	Share of total population in crime
A	3.5%	14.7%	81.8%
B	7.4%	10.6%	82%
C	13.9%	4.1%	82.1%

Remarkably, crime goes up in both country A and B, relative to autarky, and falls very slightly in country C.

The welfare consequences of the regimes are even more striking:

Country	Utility per capita under autarky	Utility per capita under trade between A and B	Utility per capita under trade between A, B, and C
A	2.49	1.97	2.00
B	2.42	2.869	2.07
C	2.26		2.56

C's welfare goes down in the case of trade between the three countries, as we might expect from rising crime. But what can explain the fall in welfare in A, in a straightforward two-country trade interaction? There are two contributing factors: (1) the rise in crime in country A, as productive labor is more poorly remunerated and capital becomes more highly remunerated; and (2) distortions in the productivity of industries induced by the crime technology. If A cannot fully take advantage of its comparative advantage at prevailing world prices, then adjustments in world prices may be to its detriment.

This brief example shows that crime and the benefits of globalization may be deeply interrelated, and that crime may overturn our usual predictions about the benefits of trade. Trade can raise crime rates, even relative to autarky, and may reduce welfare in the countries engaged in trade. In light of these results, our predictions about the impact of labor market re-structuring over the next decade may be substantially more gloomy.

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Appendix: Capital/labor ratios in the presence of crime

Under autarky:

We solve for k_{xA} by replacing $\frac{p_y}{p_x}$ in equation (6) with its value in equation (1), and replacing k_{yA} with its value in terms of k_{xA}. Equation (6) being a pair of equations, this gives us a system of expressions for L_{xA} and L_{yA}, which can then be substituted into equation 7, to give the following implicit function:

$$0 = -(1-k_{xA}^{-d})(1-\alpha) - \left(\frac{1-\gamma}{\gamma}\right)(1-\alpha) + \left(\frac{1-\gamma}{\gamma}\right)(1-\alpha)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d} k_{xA}^{-d}$$
$$+\frac{K_A}{N_A}\alpha\left(1+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}\right)k_{xA}^{-d-1}$$

Then, returning to the expression for L_{xA}:

$$L_{xA} = \frac{(k_{xA}^{d}-1)(1-\alpha)+\frac{\alpha(1-\beta)}{\beta}\frac{K_A}{N_A k_{xA}}\frac{\alpha(1-\beta)}{\beta}}{\frac{\alpha}{\beta}+\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}}$$

and substituting into equation 7 gives L_{yA}.

Under trade between A and B:

We use the two equations of (6) to obtain an expression for L_{xA} in terms of k_{xA} only:

$$\frac{L_{xA}}{N_A} = \frac{1}{\alpha k_{xA}^{-d} - \beta\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d} k_{xA}^{-d} + (\beta-\alpha)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d} k_{xA}^{-2d}\left(1+\frac{\alpha}{1-\alpha}\frac{K_A}{N_A k_{xA}}\right)} \times$$
$$\left(\begin{array}{l}(1-\alpha)(1-k_{xA}^{-d})\left(1-\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}k_{xA}^{-d}\right)+\frac{K_A}{N_A}\alpha\left[\left((1-\beta)-\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}\right)k_{xA}^{-d-1}+(2\beta-1)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}k_{xA}^{-2d-1}\right]\\ -\left(\frac{K_A}{N_A}\right)^2\frac{\alpha^2(1-\beta)}{1-\alpha}\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}k_{xA}^{-2d-1}\end{array}\right)$$

We use this expression and (7) to obtain L_{yA}; an analogous expression defines L_{xB} and L_{yB}. Then we equalize $\frac{p_y}{p_x}$ from equation 2, to its value derived from equation (6) for country A and for country B:

$$\frac{p_y}{p_x}=\left(\frac{1-\gamma}{\gamma}\right)\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{1-\beta}\frac{k_{xA}^{\alpha}L_{xA}+k_{xB}^{\alpha}L_{xB}}{k_{xA}^{\beta-1}K_A-k_{xA}^{\beta}L_{xA}+k_{xA}^{\beta-1}K_B-k_{xB}^{\beta}L_{xB}}$$

$$\frac{p_x}{p_y}=\frac{(1-\alpha)}{(1-\beta)}k_{xA}^{-\alpha-\beta}\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-\beta}\frac{1-k_{xA}^{-d}+k_{xA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)}{1-\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}k_{xA}^{-d}+\left(\frac{(1-\alpha)\beta}{\alpha(1-\beta)}\right)^{-d}k_{xA}^{-d}\left(\frac{L_{xA}+L_{yA}}{N_A}\right)}$$