



*Inter-American Development Bank
Banco Interamericano de Desarrollo (BID)
Office of the Chief Economist
Oficina del Economista Jefe
Working Paper # 408*

Patterns of Crime Victimization in Latin America

By

Alejandro Gaviria and Carmen Pagés¹
Inter-American Development Bank

This version: October 29, 1999

¹ We thank Ricardo Fuentes for valuable research assistance and F. Bourguignon for excellent comments. This paper reflects the opinions of the authors and not necessarily those of the Inter-American Development Bank.

Abstract

In this paper we draw a profile of the victims of crime in Latin America. We show that –at least for the case of property crime– the typical victims of crime in Latin America come from rich and middle class households and tend to live in larger cities. We also show that households living in cities experiencing rapid population growth are more likely to be victimized than households living in cities with stable populations. We offer various explanations to these facts, and while we cannot yet provide definite answers to some of the questions raised by this paper, we are at least able to reject some plausible hypotheses. On the whole, our results imply that urban crime in Latin America is, to an important extent, a reflection of the inability of many cities in the region to keep up with the increasing demands for public safety brought about by a hasty and disorderly urbanization process.

JEL Codes: K40, K42, and O54.

© 1999
Inter-American Development Bank
1300 New York Avenue, N.W.
Washington, D.C. 20577

The views and interpretations in this document are those of the authors and should not be attributed to the Inter-American Development Bank, or to any individual acting on its behalf.

For a complete list of publications, visit our Web Site at:
<http://www.iadb.org/oce>

I. Introduction

Crime has become a staple feature of many cities in Latin America. Muggings, burglaries, car jackings and even homicides occur with alarming frequency and disarming impunity in many urban centers throughout this region. Despite the sense of urgency brought by the rising crime levels, few studies have attempted to explore the causes of urban crime in Latin America.²

Lack of reliable data has been perhaps the most important impediment to research on the evolution and nature of crime in developing countries in general and Latin American countries in particular. Official statistics in crime incidence are often incomplete and suffer from serious problems of under-reporting. Victimization surveys, the alternative to official records, are either unavailable or incomplete. Cross-country comparisons are even more difficult given the need of comparable data sets, which surely explains why most cross-country studies of crime have focused on homicide rates--a telling but incomplete indicator of criminal prevalence.

In this paper we use an unusual data set to study the patterns of crime victimization in Latin America. Our main source of data is the Latinobarometer, a public opinion survey covering 17 Latin American countries and more than 50,000 households over three years (from 1996 to 1998). This survey, albeit not specifically devised to study crime, provides comparable cross-country estimates of criminal incidence. We complement the Latinobarometer with victimization surveys for three countries: Colombia, El Salvador and Peru. These other surveys permit not only a more detailed analysis of victimization rates, but also a partial evaluation of the ability of Latinobarometer to measure criminal incidence.

²See Bourguignon (1999), Fajnzylber, Lederman and Loayza (1998) and, especially, Londono and Guerrero (1998) for previous attempts to uncover the causes of violent crime in Latin America. All these studies point to inequality as the single most important factor behind the higher rates of crime in Latin America.

Our analysis is more descriptive than analytical. We first lay out some empirical regularities and only then offer some interpretations. This reflects not so much our preferences as the constraints imposed by our sources of data. For the most part, our analysis focuses on how victimization rates vary with the socioeconomic status of the victims, with the population size of their city of residence, and with the city's recent population growth. We find that, on average, victimization rates increase with socioeconomic status, city size, and population growth at the city level.

We interpret the positive connection between socioeconomic status and victimization rates as evidence of either a strong tendency of criminals to look for their victims among the more affluent households or the presence of sharp diminishing returns of private investments in personal safety. We cannot provide a definitive interpretation of the relationship between city size and crime. We interpret this finding as evidence that larger cities have either lower probability of apprehension (perhaps because there are diseconomies of scale in the production of arrests or because larger cities invest relatively less in law enforcement) or a greater proportion of crime-prone individuals. We reject, on the other hand, the also plausible hypothesis that larger cities have more crime because they contain better victims.

Finally, we offer a plausible explanation for why rapid urban growth tends to be associated with more crime. We find that urban growth is negatively correlated with the levels of confidence in both the police and the judiciary. Moreover, we find that low confidence in the police is associated with higher levels of crime. This association survives even we take into account the possible endogeneity of the former variables. These findings suggest that rapid urbanization can, under some circumstances, set in motion a dynamic of mutual reinforcement between increasing crime rates and crumbling law enforcement institutions.

On the whole, our results imply that urban crime in Latin America is, to an important extent, a reflection of the inability of many cities in the region to keep up with the increasing demands for public safety brought about by a hasty and disorderly urbanization process.

The rest of this paper is as follows. Section 2 describes the data. Section 3 presents the empirical methodology. Sections 4, 5 and 6 examine the link between crime and socioeconomic status, city size and urban growth, respectively. Finally, Section 7 draws some general conclusions.

2. Victimization Data for Latin America

Victimization surveys are the most accurate instrument to measure criminal incidence, especially in developing countries where the fraction of crimes reported to the police is very small. Comparable victimization data is, however, difficult to come by. While accurate comparisons of victimization rates and patterns are readily available for the few developed countries included in the International Victimization Survey (IVS), a similar survey is not available for Latin American countries (or other developing countries, for that matter).³

In this paper we use the Latinobarometer to study the patterns of crime victimization in Latin America. The Latinobarometer is a public opinion survey covering 17 Latin American countries.⁴ The survey has been regularly conducted since 1996. Roughly, 1,500 individuals have been interviewed in each country each year. Although there have been some adjustments to the survey questions and answer formats every year, many questions have remained the same and are comparable over time. The sampling method varies slightly from country to country, as implementation is contracted out to national polling firms, but in most cases the selection included some quotas to ensure representation across gender, socioeconomic status, and age. Here we combine the last three annual data sets (1996, 1997 and 1998) to create a larger sample size.

³ The IVS covers all major European countries, Australia, Canada, and the United States.

⁴ In 1996, the Latinobarometer also included Spain. Unfortunately, this country was not included in the 1997 and 1998 rounds of the survey. Unless otherwise mentioned, Spain was not included in our analysis.

The survey is restricted to urban populations.⁵ Individuals from richer households have been oversampled in all countries and all years. We use weights throughout to alleviate this problem.⁶ The weights are created such that, for each country, the distribution of individuals across education groups in the sample matched the corresponding distribution of the urban population. All results below are weighted, but they do not differ substantially from the unweighted ones.

Although the Latinobarometer is not a victimization survey (its emphasis is on political attitudes and social values), all rounds of the survey have included a question on crime victimization at the household level.⁷ The Latinobarometer also contains detailed information about the demographic characteristics of both the respondent and the head of the household, and therefore it can be used to study the link between household characteristics and the probability of being victimized. In addition, The Latinobarometer contains information on people's trust on the police and the judicial system that may be useful, among other things, to assess the quality of law enforcement institutions; a key variable in any study of crime prevalence.

Figure 1 shows average victimization rates in all the countries included in the survey. The levels of victimization are staggering. In five countries (Peru, Ecuador, Mexico, Venezuela, El Salvador and Guatemala) more than 40 percent of the urban households have had at least one member victimized during the previous year. In Guatemala at least one individual in every two households has been victimized. Spain, the only industrialized country included in the survey, exhibits the lowest victimization rates in the sample. Uruguay, Panama and Chile exhibit the lowest victimization rates in Latin America.

An important shortcoming of the Latinobarometer is the absence of information about type of victimization. We will assume throughout that the victimization rates obtained from this survey

⁵ Informes metodológicos: Latinobarometro: 1996, 1997, 1998.

⁶ This is a common problem in large opinion surveys. The World Values Survey and Eurobarometer also oversample higher socioeconomic groups.

⁷ The specific wording of the question is, "Have you or any member of your family been assaulted, robbed or victimized in any way during the past twelve months?"

correspond mainly to property crime --an assumption justified by the fact that violent crimes usually represent a small fraction of all crimes (see, for example, Londono and Guerrero, 1998 and the results for Colombia, El Salvador and Lima presented below).

Another shortcoming of the Latinobarometer is the absence of data on household income or wealth. This is especially troubling given our interest in “profiling” the victims of crime in Latin America. The Latinobarometer includes, however, two sets of questions related to the socioeconomic status of the households. The first set includes questions about ownership of appliances and durable goods (respondents were asked if any member of the household owns a car, a computer, a television, a washing machine, and so on) and the second set includes questions about housing characteristics (respondents were asked if their place of residence has access to water and sewage).

In principle, one can use this information to construct an index of long-term socioeconomic status. The problem is, of course, how to weight the different household attributes. Here we use the statistical technique of principal components to compute the relative weight of the different attributes.⁸ First, we use principal components to construct an index of long-term economic status, and then we use this index to group all households in different “wealth” quintiles. We do this separately for each country, so the quintiles measure relative positions with respect to other households in the same country. Figure 2 shows the average years of education of the household head across wealth quintiles for the whole sample. As expected, education increases steadily across quintiles, lending partial support to our methodology.

Principal components have often been used to proxy for socioeconomic status in the absence of consumption or income data. Filmer and Pritchett (1998) take advantage of a few cases when information expenses is available on both asset ownership and consumption to perform an evaluation of such a procedure. They show that durable goods and housing attributes are observed with much more precision

⁸ This technique is often used to summarize the information contained in a large set of variables into a smaller set of mutually orthogonal components (each component corresponds to a different linear combination of the underlying variables). The first principal component is, by construction, the

than consumption expenditures, and that an index of wealth based on principal components is less sensitive to temporary disturbances than any measure of socioeconomic well-being consumption data.

In addition to the Latinobarometer, we use victimization surveys for three countries: Colombia, El Salvador and Peru. These surveys permit to refine the analysis in several respects. For example, they allow us to study how the patterns of victimization vary across different types of crime, and how demographic and criminal risk factors differ from one city to another.

For Peru we use the “Encuesta de Victimizacion de Lima Metropolitana” (INEI). This survey covers only Metropolitan Lima and includes 8,643 individuals distributed in 2,473 households. The survey was conducted in 1997 and has six different modules, each dealing with a different type of crime. Four modules apply to individuals (robberies, car thefts, assaults and vandalism) and two apply to households (burglaries and kidnappings). We use information from all modules to compute victimization rates at the household level in order to ensure comparability with the rates obtained from the Latinobarometer.

The victimization survey for El Salvador covers the main urban centers of the country and includes 5,664 individuals distributed in 1,222 households.⁹ The survey contains information on several types of crime, including property crimes, assaults and homicides. As in the case of Lima, we compute victimization rates at the household level on the basis of individual responses. For Colombia, we use a victimization module included in the 1997 round of Encuesta Nacional de Calidad de Vida. This module includes 5,623 urban households. The questions were administered only to the heads of household, and refer to incidents affecting either the respondent or any member of his family. As in El Salvador and Lima, this survey contains information on property crimes as well as other crimes such like homicides, assaults (including rapes) and kidnappings.

combination that captures the most common variation of the underlying data.

⁹ This survey was undertaken in 1997 in the context of the study “Epidemiología y costos de la violencia en America Latina” Londoño & Guerrero (1998).

The victimization rates obtained from Lima and El Salvador surveys are very high. In Lima, more than 70 percent of the households had at least one member victimized in 1997. Robberies are the most common offense, followed by burglaries and assaults. In El Salvador, almost 60 percent of urban households suffered from some form of victimization. Also here property crimes constitute the bulk of all offenses. In Colombia, victimization rates are surprisingly small, only 12 percent of the household reported an incident during the past year. However, the small rates obtained for robberies and assaults seem to imply that only serious offenses were reported, reducing the comparability with the other surveys.

3. Empirical Methodology

Most economic models of crime focus on the incentives faced by would-be criminals. The main conclusions of these models are well known: the higher the return of criminal vis-à-vis legal activities and the lower the probabilities of apprehension and incarceration, the higher the individual propensity to commit crimes (see Becker, 1968 and Ehrlich, 1973).

These models, however, offer few clues as to what individuals are most likely to be the victims of crime. Theoretical models, for example, do not offer many predictions regarding whether or not crime is more prevalent among disadvantaged social groups. This is, of course, an important issue not only from a fairness point view but also because it may provide important information about the causes of crime.

In this paper, we analyze this issue empirically, using the following specification to investigate the patterns of victimization in Latin America:

$$Y_{ijct} = c + X_{ijct} \mathbf{b} + Z_{jc} \mathbf{q} + \mathbf{l}_c + \mathbf{z}_t + \mathbf{e}_{ijct}, \quad (1)$$

where Y_{ijct} is the probability that individual i who lives in city j of country c will be a victim of crime in year t , X_{ijct} is a vector of household characteristics (including education of the household head, relative

socioeconomic status, and house ownership), Z_{jc} is a vector of city characteristics (including population and population growth), I_c is a country effect, Z_t is a year effect, and e_{ijct} is an individual error term.

Country effects are included to control for unobserved country attributes that don't change drastically over time (e.g., social capital). Year effects are included to control for unobserved factors that vary uniformly over time throughout the region (e.g., common macroeconomic shocks and changes in sampling procedures). Unless otherwise mentioned, the analysis below is robust to the exclusion of both country and year effects.

Equation (1) can be interpreted as a reduced form of a structural model that incorporates both demand and supply elements. Generally speaking, the demand for criminal offenses depends on the preferences of the individual in question, her assets and income, the level of public protection available to her, and the technology linking investments in private protection with the probability of apprehending a criminal. For its part, the supply of criminal offenses depends not only on the characteristics of the prospective victims but also on the characteristics of her surroundings, including socioeconomic and institutional factors.

Descriptive statistics of the most important covariates are shown in Table 1. The mean victimization rate of the sample is 37.7 percent, and the average schooling of household heads is 8.54 years. 73.1 percent of the households own a house, 30 percent own a car, and 7 percent live in "marginal" dwellings (i.e., those without access to water or sewage connections). Moreover, 22 percent of the households in the sample live in cities of more than 2 million inhabitants and only 8.8 percent live in cities of less than 20 thousand inhabitants.

In the following sections we focus on "wealth" effects (i.e., how victimization varies with socioeconomic status), city size and city growth effects (i.e., how victimization changes with city population and city population growth). We examine not only the independent contribution of these effects, but also how they interact with each other and with some country-level indicators (e.g., the Gini coefficient). We believe --

and below we offer reasons why-- that much can be learned about the root causes of crime by studying how crime victimization varies with socioeconomic status and city characteristics.

4. Victimization and Household Wealth

In this section, we study the effects of household wealth on the probabilities of victimization. Our goal is to describe the distribution of crime across socioeconomic groups and to study how this distribution is affected by some household attributes, including city of residence, house ownership and education levels of the family head.

The main results are summarized in Table 2. Column (1) shows how the probability of victimization changes across wealth quintiles (the baseline group is the first quintile).¹⁰ Victimization rates are substantially higher for the fifth and fourth quintiles and noticeable higher for the third quintile. Thus, an individual from the top quintiles is eight percentage points more likely to be a victim of crime than an individual from the bottom quintile (a difference of approximately 22 percent).¹¹

In column (2) we control for some important household attributes (education and employment of the head of the household, home and car ownership, and a few others) in order to study some of the channels through which material wealth could affect victimization rates. The effects of the different attributes are, for the most part, relevant, but cannot completely explain away the effect of material wealth on victimization rates. As shown, owning a house reduces victimization rates by more than 3.7 percentage points (a 11.5 percent difference over the baseline rates), which likely reflects greater investments in private protection by homeowners. Living in “marginal” households increases victimization rates by more than 2 percentage points, however, this effect is not statistically significant at conventional levels. Finally,

¹⁰ Table 4 shows victimization rates by socioeconomic status for all the countries in the sample. With the exception of Bolivia, Ecuador and Panama, crime rates peak at the fourth or fifth quintile.

¹¹ In a recent study, Cruz (1999) finds that victimization rates (weighted by the inverse of the frequency) increase with socioeconomic status in Cali, Rio de Janeiro and San José.

both employment status of the head and car ownership do not seem to have an important effect on victimization rates.

Column (3) reports wealth effects after controlling for the size of the city of residence. The effects are much smaller in this specification, suggesting that city size is an important channel through which household wealth raises the probability of victimization. That is, richer people tend to live in larger cities and larger cities tend to have higher victimization rates (the latter effect is thoroughly examined in the next section).¹²

To investigate whether the patterns of victimization by socioeconomic status are affected by the overall level of income inequality within a country, we add a measure of income inequality (the urban Gini coefficient) and its interactions with the wealth quintiles to the previous specification (country fixed-effects are excluded in this case for obvious reasons).¹³ The results are reported in Column (4). Inequality does not appear to be associated with higher victimization rates in our sample. Inequality, however, has a small but noticeable effect on the distribution of crime across rich and poor households. As inequality increases, the relationship between household wealth and victimization becomes flatter. Or put differently, in more unequal countries the poor seem to bear a larger share of all incidents of victimization.

We also study the connection between inequality and the distribution of crime across wealth groups using an alternative procedure. We first rank all families according to our wealth index, then we compute the location of the median victim of crime in the distribution of wealth (the higher this value, the larger the share of all crimes borne by rich households). And finally, we study the relationship between the median values and the Gini coefficients for our sample of Latin American countries.

¹² The effect of household wealth on criminal victimization appears to be larger in Latin America than in the United States. The raw data for the United States shows that there is a small positive correlation between property crime and household income (Bureau of Justice Statistics, 1998). This correlation is negative, however, after controlling for demographic characteristics and city size. There is, in particular, a clear negative association between household income and the incidence of burglaries, assaults and common thefts (Glaeser and Sacerdote, 1996)

¹³ Gini coefficients were computed from National Household surveys. See IDB (1998/9)

Figure 3 shows that there is a negative relationship between inequality and the victimization burden borne by the rich. This may be due to several factors. Perhaps more unequal societies devote more public resources to protect the rich (Bourguignon, 1999). Alternatively, rich and middle-income families may find it easier to insulate themselves from crime in more unequal societies (spatial segregation, for example, tend to be higher in more unequal societies). Finally, the extent to which criminal justice institutions pursue with greater vehemence victimizations that involve rich and middle income families could also be greater in more unequal societies.¹⁴

As mentioned earlier, while the Latinobarometer allows us to study how the incidence of crime varies across socioeconomic groups, it doesn't allow us to study how the intensity of crime varies in the same dimension. Below we address the latter issue using three recent victimization surveys for three Latin American countries.

Figure 4 shows the distribution of various types of crime across wealth quintiles in Colombia, Lima (Peru) and El Salvador.¹⁵ Overall victimization rates (the probability that at least one member of the household was victim of crime at least once during the previous year) tend to increase with wealth, especially in Colombia and El Salvador. More precisely, while property crimes (the bulk of all offenses) are much more prevalent among richer household, violent crimes are much more prevalent among poor households.

Why do the wealthy bear a disproportionate share of all property crimes? In theory, this result is consistent with two different types of models. In the first model, citizens and criminals are randomly matched and

¹⁴ The Latinobarometer offers indirect support to this idea. We use this survey to compute the percent of respondents that report that in their country all citizens are equal before the law. Then we study the connection between country averages and the Gini Coefficients. The two variables are negatively correlated with a coefficient of -0.45, implying that in more unequal societies people tend to be more suspicious about the fairness of the justice system.

¹⁵ Quintiles were defined using first principal components for Peru and Colombia and using self-reported income for El Salvador. The levels of the three graphs are not comparable because the questions differ substantially in the three surveys. Indeed, the much lower levels of Colombia are surely driven by the fact

the rich end up being more victimized due to the existence of substantial diminishing returns in private investments against crime (i.e., the marginal return of an extra peso spent in protection declines sharply as investments grow).¹⁶ Here the idea is that given the presence of diminishing returns the rich will have to spend so much to completely deter criminals that they will often decide to leave themselves exposed (see the appendix for a formal model along these lines).

In the second model, criminals engage in an active search for good victims, thus causing a concentration of all victimizations among wealthier individuals. Here the idea is that the poor turn so few criminal heads that they are usually able to avoid victimization whereas the rich are so intensely sought out by criminals that effective protection becomes very difficult even in the absence of diminishing returns.

Presumably, the first model applies to those crimes where the matching between criminals and citizens is mainly a matter of chance. Examples may include street crimes (including muggings and arm robberies) and larcenies. The second model applies to those crimes where criminals carefully select their victims so as to maximize expected gains. Examples may include here burglaries and kidnappings. The empirical results presented above are likely to be driven by a combination of these two forces. Although we lack the information to discriminate between these two alternative models, the evidence doesn't seem to support the widespread idea that the rich are usually more sought out by criminals in more unequal societies.

5. Victimization and City-Size

that people only reported serious incidents (encouragingly, for Colombia the homicide rate inferred from the responses corresponds closely to the overall homicide rate calculated using police records).

¹⁶ There are several reasons why private investments in crime protection can exhibit sharp diminishing returns in Latin America. A possibility is that private and public investments in protection are complements. Alarms, for example, are usually connected to police stations and they will be rather ineffective if the police regularly ignore the calls. Likewise, private guards can capture criminals but cannot arrest them and so they will also be ineffective in the absence of efficient law enforcement institutions.

Crime has become a preeminently urban problem, not only in developing countries but in developed countries as well.¹⁷ In the United States, for example, there is a well-documented connection between city size and criminal incidence. Little is known, however, about this connection in Latin America, which is unfortunate given this region's high rates of urbanization and urban concentration.¹⁸

Column (1) of Table 3 shows how victimization rates vary with city size in Latin America. Victimization rates are substantially higher in larger cities. Thus, a household living in a city of more than one million inhabitants is almost twice as likely of being victimized as a household living in a city of less than 20,000 inhabitants (the baseline group in the regression). Surprisingly, victimization rates do not change much once the one million threshold is surpassed. The evidence suggests, indeed, a natural division of cities in three groups: a first group composed by cities of less than 100,000 inhabitants that exhibit relatively lower crime rates, an intermediate group composed by cities between 100,000 and one million inhabitants, and a high-crime group composed by cities with more than one million inhabitants.¹⁹

Interestingly, the pattern of victimization across city-size categories in Latin America is similar to that of the United States. Thus, while in the United States a household living in a city of one million inhabitants or more is 57 percent more likely of being victimized than a household living in a city between 50,000 and 100,000 inhabitants (Glaeser and Sacerdote, 1996), the corresponding figure for Latin America is 71 percent.

To explore the channels through which city size affects crime rates, we add household and city characteristics to the specification studied in column (1). The results are summarized in column (2). The implied elasticity between city size and crime drops by about 7.4 percent in this case, suggesting that in

¹⁷ See Archer and Gartner (1984) for an overview of the international evidence on city size and crime rates and Glaeser and Sacerdote (1996) for a study of the link between city size and crime in the United States.

¹⁸ Mega cities are much more common and are growing faster in Latin America than everywhere else in the world (Gaviria and Stein, 1999).

¹⁹ Table 4 shows that, with the exception of Brazil, crime peaks in the largest cities in all countries of the sample.

Latin America only a small fraction of the effects of city-size on crime can be accounted for by cross-city differences in household characteristics.²⁰ By contrast, Glaeser and Sacerdote (1996) find that in the United States a much larger fraction of the city-size effects on crime (33 percent) can be accounted for by household characteristics. So although the magnitude of city-size effects is similar in Latin America and in the United States, the main driving forces underlying this effect may differ substantially in both regions.

Column (3) explores the interaction between income and city-size effects. We reduce the number of city-size dummies to the three city groups described above in order to facilitate the interpretation of the results. The interactions are negative for the most part, and they are statistically significant only for intermediate cities. These results suggest that the patterns of victimization do not consistently vary with city size; rich households do not fare comparatively worse in large cities than in small towns.

As mentioned earlier, the Latinobarometer does not permit us to study the connection between city size and the intensity of victimization. Therefore, on the basis of this survey alone it is impossible to determine whether city-size effects are limited to property crimes or whether they also apply to violent crimes.

Figure 5 addresses some of these issues for the case of Colombia. In this country all forms of victimization increase with city size. The connection is not always linear, however. While robberies are more common in Bogotá (Colombia's largest city), homicides and assaults are more common in mid-size cities (especially in Medellín and Cali). Further, perceptions regarding the immediacy of crime problems –the fraction of households for which crime is their main concern– grow monotonically with city size.

What explains the connection between city size and crime? Several economic factors can be mentioned. First, the returns to crime are perhaps higher in larger cities. Larger cities, for example, usually have wealthier potential victims and more developed markets for second-hand goods. Second, the probability of

²⁰ See Glaeser and Sacerdote (1996) for a detailed explanation of how to compute these elasticities.

arrest and conviction is perhaps lower in larger cities. This may be in turn caused by diseconomies of scale in the production of arrests (similar police-citizen may yield fewer arrests or convictions in large cities), by lower police-citizen ratios, or by lower levels of community cooperation with the police²¹.

Crime may also be higher in larger cities due to social factors. In particular, individuals at risk (i.e., those with a higher predisposition to commit crimes) may be over-represented in larger cities. Obviously, if the fraction of idled males (not at work, not in school), distressed migrants, street children or children from broken families is larger in larger cities, criminal rates will be, all else being equal, larger in larger cities.

Can we discriminate among the different causes mentioned above? Although not completely, some clues emerge from the previous analysis. First, city-size effects cannot be explained by the presence of more affluent victims in larger cities. If that were the case, one would expect that, contrary to the evidence, city-size effects would decline substantially after we control for wealth and other household attributes. Second, city-size effects cannot be explained by the fact that the rich (arguably the best victims) are easier targets in larger cities. If that were the case, one would expect that, again contrary to the evidence, the rich would be relatively more victimized as city size grows. So we are left, by elimination, with two possible explanations: larger cities have lower probabilities of arrests or they have a higher proportion of individuals with a greater inclination toward criminal activities (or both).

Table 5 casts some doubts on the latter hypothesis. This table shows the relationship between city size and a few variables often deemed as strong predictors of criminal behavior. These variables are the fraction of households where at least one parent is absent, the fraction of idled men, the fraction of households that migrated to the city during the previous five years, and the fraction of community leaders that perceived drug consumption as a serious problem in their communities. With perhaps the exception of the latter variable, nothing in this table appears to suggest that larger cities in Colombia contain disproportionate fractions of crime-prone individuals. If anything, the opposite is true.

²¹ Some of all these factors are also analyzed in Glaeser and Sacerdote (1996).

So, at least for the case of Colombia, the greater criminal prevalence in larger cities may have a lot to do with lower probabilities of arrest and conviction and much less to do with either the over accumulation of social problems or the characteristics of the victims. Of course, additional evidence is needed to generalize this conclusion.

6. Victimization and City Growth

In the previous section, we show the existence of a strong connection between criminal prevalence and city size. In this section we tackle a related issue; whether or not crime is more prevalent in rapidly growing cities. In theory, rapid urban growth may raise crime for many reasons, including congestion of law enforcement and social services, massive unemployment, and increasing poverty. In practice, however, there are few studies making the connection between these two variables. In what follows, we attempt to do this using data from the Latinobarometer.

The Latinobarometer has information on city of residence for about 75 percent of the respondents, but it doesn't have information on population growth. Our main source of information in this respect is the United Nations data set of urban agglomerations. We measure city growth using average annual population growth from 1985 to 1995. For some cities not included in the UN data set, we resort to different sources, mainly country-specific statistical abstracts. For a few other cities, however, we could not get reliable estimates of population growth. All in all, adding population growth entails the loss of many observations. While this clearly hampers comparisons with our earlier results, it should not impede us to study the effects of population growth on victimization rates, the main goal of this section.

Table 6 presents the main results concerning city growth and crime. Column (1) reports the effects of population growth on victimization rates once we control for country and year effects. As shown, city

growth has a positive and statistically significant effect on crime rates. On average, one percentage point of population growth is associated with an increase in victimization of almost 1.5 percentage points.

Column (2) reports the effects of city growth on victimization rates once we add household wealth and household characteristics to the previous specification. City growth effects are even larger once we take into account differences in wealth and household characteristics between rapidly and slowly growing cities. Column (3) adds city size to the specification of column (2). As shown, city growth effects remain practically unchanged in this case.

On the whole, the estimates presented above suggest that rapid urbanization is associated with a substantial increase in crime. Moreover, these estimates are likely to underestimate the effect of city growth on crime for at least one reason. High criminal rates may actually reduce population growth, either because they curtail migration rates or because they cause people to leave the cities.²²

What explains the connection between city growth and crime? Various factors were already mentioned. Rapid urban growth may be accompanied by increasing poverty, unemployment and joblessness, which in turn may give rise to higher crime rates. Further, urban growth may, at least under some circumstances, trigger a self-reinforcing process between rising crime rates and increasingly ineffective law enforcement institutions. Population growth may overload law enforcement institutions, diminishing their effectiveness. Ineffective institutions may in turn lead to higher criminal rates, as criminals perceive that the police and prosecutors are not keeping up. Finally, higher crime may in turn exacerbate institutional ineffectiveness, all resulting in a negative spiraling of bad institutions and high crime.²³

We offer some evidence in favor of the latter mechanism. The evidence is indirect because we have information related not to the effectiveness of law enforcement institutions but to public confidence in

²² Cullen and Levitt (1996) show that in the United States each additional reported crime leads to one fewer resident in the city in question

²³ See Sah (1996) for a model along these lines and Gaviria (2000) for an application of these ideas to

them. Insofar as the latter variable correctly reflects the effectiveness of law enforcement, our analysis is valid. Needless to say, perceptions may stray far from reality, at least in the short-run.

Table 7 shows that, at the city level, rapid urban growth tends to be associated with lower levels of confidence in the police and the judiciary.²⁴ This evidence is consistent with our presumption that population growth may lead to an overloading of the existing law enforcement institutions, presumably reducing its effectiveness to fight crime. The evidence presented in Table 8 reinforces the latter claim. This table shows that even after controlling for household attributes and city size, lower levels of confidence in the police are associated with much greater victimization rates at the city level. On average, going from no confidence to full confidence would be associated with an increase in the probability of victimization of 17 percentage points.

In contrast, confidence in the judiciary is not associated with lower victimization rates. Various reasons can explain this divergence. Perhaps city dwellers are more capable of assessing the effectiveness of the police than that of the judiciary, implying that confidence indicators provide better measures of the effectiveness of the police. Alternatively, self-reported confidence may not necessarily be measuring the effectiveness of the police and the judiciary, but rather the extent to which urban dwellers are willing to cooperate with these institutions. In such case, our results could be interpreted as saying that cooperation with the police is more important for crime reduction than cooperation with the judiciary.

Needless to say, the effectiveness of the police (as well as the confidence people bestowed in it) is likely to be greatly affected by the incidence of crime. This implies that no causal conclusions can be drawn from the previous results. We attempt to remedy this problem by instrumenting confidence in the police using confidence in other institutions (national congress and political parties). Table 7 shows that the

account for the escalation of violence in Colombia.

²⁴ We constructed the variable confidence in the police (as well as the other confidence variables) from the answers to the question “How much do you trust [institution] very little, little, not much, much”. The four answers were grouped into two: Trust, no trust. We assigned to each person the within-sample mean trust of his city of residence, excluding from that computation his own answer. We eliminated all the

correlation between confidence in the police and confidence in political parties and the congress is high. On the other hand, confidence in political parties and the congress depend on many factors different from crime that they are less likely to be correlated with the error term in the crime equation.

Columns (3) to (5) of Table 8 show the 2SLS estimation results. The coefficient on confidence in the police becomes more negative and more significant if we use confidence in the congress as an instrument. Instead, this coefficient becomes smaller and not statistically significant if confidence in political parties is used. Finally, when both variables are used as instruments the coefficient is negative and statistically significant.²⁵

Thus, the former results provide some support for a story in which the link between population growth and crime is, at least partly, caused by institutional overload along with declining confidence in law enforcement institutions.

7. Concluding Remarks

In this paper we draw a profile of the victims of crime in Latin America. We show that –at least for the case of property crime– the typical victims of crime in Latin America come from rich and middle class households and tend to live in larger cities. We also show that households living in cities experiencing high population growth are more likely to be victimized than household living in cities with more stable populations. We offer various explanations to these facts, and while we cannot yet provide definite answers to some of the questions raised by this paper, we are at least able to reject some plausible hypotheses.

observations belonging to cities with less than 30 individuals in the sample.

²⁵ It could be argued that computing mean trust levels in cities with close to 30 observations could introduce lots of sampling error in our results. However, repeating the above estimations for cities with 50 observations or more does not alter our results. The coefficients are similar, but since we lose a substantial amount of cities, they are estimated with lower precision.

We have not attempted here to explain why crime is more prevalent in Latin America than in other areas of world. However, our analysis suggests that rapid urbanization and high urban concentration may explain a substantial share of the level and escalation of crime in many Latin American countries. Of course, several other factors not mentioned in this paper are also very important. Drug trafficking, for example, is conspicuously absent throughout, as are social capital and other cultural considerations.²⁶

References

Becker, G. (1968). "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76: 169-217.

Bourguignon, F., (1999). "Crime, Violence, and Inequitable Development". Paper prepared for the Annual Bank Conference on Development Economics. The World Bank

Cruz, J.M. (1999) "La victimización por violencia urbana: niveles y factores asociados en ciudades de America Latina y España". *Pan American Journal of Public Health* 5(4/5).

Cullen, J. and Levitt, S., (1996), "Crime, Urban Flight, and the Consequences for Cities" National Bureau of Economic Research. Working Paper 5737.

Ehrlich, I. (1973). "Participation in Illegitimate Activities: A Theoretical and Empirical Investigation." *Journal of Political Economy* 81: 521-565.

Fajnzylber, Lederman and Loayza (1998). "Determinants of Crime Rates in Latin America and the World: An Empirical Assessment". World Bank Latin American and Caribbean Studies, November, Washington, DC.

²⁶ Lal (1999), for example, argues that urbanization has not been so disruptive in Muslim countries because Islam has provided a social glue that somehow other religions have failed to provide (Teheran, to

Filmer, D. and L. Pritchett (1998). "Estimating Wealth effects Without Income or Expenditure Data: Educational Enrollment in India." Mimeo, DECRG, the World Bank. Washington, DC.

Gaviria, A. (2000) "Increasing Returns and the Evolution of Violent Crime: The case of Colombia". Forthcoming in *Journal of Development Economics*

_____and Stein, E. (1999) "Urban Concentration in Latin America and the World ". Mimeo, Inter-American Development Bank.

Glaeser, E., and Sacerdote B. (1996). "Why is there More Crime in Cities?" NBER, Working Paper 5430.

IDB (1998/9). *Facing up to Inequality*. Inter-American Development Bank. Washington D.C. 1998

Lal, D. (1998). *Unintended Consequences: The Impact of Factor Endowments, Culture, and Politics on Long-Run Economic Performance*. MIT Press, Cambridge, Massachusetts.

Londoño and Guerrero (1998) *Epidemiología y costos de la violencia en America Latina*. Inter-American Development Bank. Forthcoming.

Sah, R., (1991), "Social Osmosis and Patterns of Crime," *Journal of Political Economy*, 99:6, 169-217.

Table 1: Summary Statistics
Latinobarometer 1996-1998

Variable	Obs.	Mean	Std. Dev.	Min	Max
----------	------	------	-----------	-----	-----

give one example, is a city of 10 million people with very low crime incidence). This argument suggests an interaction between urbanization and religion worth exploring in the future

Crime	46926	0.3773	0.4847	0.0	1.0
Household Size	47465	4.9669	2.1965	1.0	10.0
Education of H. Head	44618	8.5492	4.5722	0.0	16.0
H. Head Employed	44917	0.8103	0.3920	0.0	1.0
Own a House	46749	0.7314	0.4432	0.0	1.0
Own a Car	45727	0.2990	0.4578	0.0	1.0
Marginal household	47730	0.0690	0.2535	0.0	1.0
City Size:					
< 20,000 inhabitants	31790	0.0888	0.2845	0.0	1.0
20,001-50,000	31790	0.0911	0.2877	0.0	1.0
50,001-100,000	31790	0.0816	0.2738	0.0	1.0
100,001-300,000	31790	0.1587	0.3654	0.0	1.0
300,001-700,000	31790	0.1355	0.3422	0.0	1.0
700,001-1,000,000	31790	0.0797	0.2708	0.0	1.0
1,000,001-2,000,000	31790	0.1424	0.3495	0.0	1.0
>2,000,000	31790	0.2222	0.4157	0.0	1.0
Trust in police	46149	0.3405	0.4739	0.0	1.0
Trust in judiciary	46019	0.3476	0.4762	0.0	1.0
City Population growth	17522	2.30521	1.611412	0	4.98

Table 2: Wealth Effects
(Dependent variable: Probability of being victimized)

	(1)	(2)	(3)	(4)
Constant	0.358 (0.011)	0.321 (0.015)	0.171 (0.019)	0.32 (0.18)
Second Quintile	0.0003 (0.009)	0.002 (0.009)	-0.003 (0.009)	-0.074 (0.11)
Third Quintile	0.033 (0.009)	0.033 (.010)	0.019 (.01)	0.159 (.151)
Fourth Quintile	0.064 (0.009)	0.063 (0.010)	0.043 (0.01)	0.278 (.113)
Fifth Quintile	0.080 (0.009)	0.073 (0.012)	0.053 (0.012)	0.337 (.137)
Household Size		0.006 (.001)	0.006 (.001)	0.009 (.002)
Education of head		0.003 (.0007)	0.0029 (.0007)	0.0017 (.001)
Head of household Employed		0.005 (0.008)	0.008 (0.007)	0.02 (0.011)
Own a house		-0.037 (.006)	-0.034 (.006)	-0.037 (.0089)
Own a car		0.004 (.008)	0.007 (.008)	0.0003 (.008)
Marginal Household		0.021 (.013)	0.015 (.013)	0.026 (.021)
Gini				-0.001 (0.003)
Gini*Second Quintile				0.001 (0.002)
Gini*Third Quintile				-0.0024 (.0031)
Gini* Fourth Quintile				-0.0043 (.0021)
Gini*Fifth Quintile				-0.0052 (.0028)
City Size dummies	NO	NO	YES	YES
Number of Observations	27127	27127	27127	25996
Adj R-Squared	0.021	0.023	0.035	0.02

Notes: Unless otherwise mentioned regressions include year and country dummies. Standard errors are reported in parenthesis. Column (4) estimated without country FE. For this column we report Hubard-White standard errors allowing for clustering within countries.

Table 3: City-Size Effects
(Dependent variable: Probability of being victimized)

	(1)	(2)	(3)
Constant	0.214 (0.016)	0.171 (0.019)	0.173 (0.019)
20,001-50,000	0.034 (0.014)	0.029 (0.014)	
50,001-100,000	0.025 (0.015)	0.016 (0.015)	
100,001-300,000	0.115 (0.014)	0.101 (0.014)	
300,001-700,000	0.131 (0.014)	0.115 (0.014)	
700,001-1,000,000	0.135 (.016)	0.113 (0.016)	
1,000,0001-2,000,000	0.196 (.015)	0.179 (0.015)	
>2,000,000	0.211 (.015)	0.189 (0.015)	
Second Quintile		-0.003 (0.009)	0.001 (0.016)
Third Quintile		0.019 (.011)	0.049 (.017)
Fourth Quintile		0.043 (0.011)	0.063 (.018)
Fifth Quintile		0.053 (0.012)	0.087 (.022)
Size2			0.131 (.017)
Size3			0.171 (.018)
Second Quintile* Size2			-.018 (.022)
Third Quintile* Size2			-.059 (.022)
Fourth Quintile*Size2			-.054 (.023)
Fifth Quintile* Size2			-.068 (.026)
Second Quintile* Size3			.008 (.023)
Third Quintile* Size3			-.017 (.023)
Fourth Quintile*Size3			.003 (.023)
Fifth Quintile* Size3			-.017 (.026)
N	27127	27127	27127
Adj. R-Squared	0.029	0.033	0.033

Notes: Standard errors are reported in parenthesis. All regressions include country and year fixed effects. In regressions reported in columns (2) and (3) we also control for household characteristics like size of the household, education of head, owning a house, owning a car and living in a marginal area.

Table 4: Percent of Crime Victimization across Quintiles and City Size

	Income Quintiles					City Size		
	q1	q2	q3	q4	q5	Small	Medium	Large
Argentina	34.13	37.67	34.5	40.42	41.17	19.37	30.75	40.29
Bolivia	33.01	32.92	37.83	37.69	30.72	NA	33.94	35.48
Brazil	34.14	34.48	31.99	40.47	45.82	42.2	43.7	40.19
Colombia	29.4	34.26	34.89	39.43	42.18	NA	35.5	44.38
Costa Rica	33.65	35.47	35.96	43.22	34.98	35.4	45.53	**
Chile	27.75	32.18	27.19	33.22	33.55	11.59	28.56	33.18
Ecuador	41.95	39.68	45.45	42.62	43.04	40.05	45.32	62.28
El Salvador	45.32	38.52	47.51	41.62	59.8	42.83	52.22	**
Guatemala	54.8	50.86	52.47	58.86	58	50.27	51.5	**
Honduras	28.36	27.83	39.67	44.27	41.41	38.46	53.51	**
Mexico	40.26	39.06	44.48	48.22	47.57	29	43.64	53.39
Nicaragua	29.69	32.85	34.85	40.89	42.17	35.46	45.34	**
Panama	25.92	26.35	34.14	29.6	26.11	26.07	38.86	**
Paraguay	27.15	32.09	37.5	38.89	32.93	29.37	36.91	36.57
Peru	34.85	33.77	35.42	43.99	39.3	25.63	32.81	41.93
Uruguay	20.06	17.48	23.85	31.49	31.79	20.03	30.13	36.91
Venezuela	37.89	42.33	47.02	45.81	53.77	38.1	46.97	54.68
Spain	9.37	13.31	15.22	17.28	18.03	NA	NA	NA

Source: Latinobarometer (1996-1998)

Table 5: Crime Risk Factors and City-Size in Colombia

City-Size	Broken families	Idleness Rates	Percent of Migrants	Communities with Drug Problems
<20	21.3%	30.1%	14.2%	14.9%
20-50	22.0%	33.6%	8.5%	8.1%
5-200	25.3%	30.3%	11.3%	14.2%
200-500	25.1%	33.7%	10.6%	22.8%
>500	25.4%	33.6%	6.3%	21.1%
Bogota	20.1%	26.8%	5.2%	18.5%

Source: Encuesta Nacional de Calidad de Vida (Colombia, 1997)

Table 6: City Growth and Crime Victimization

(Dependent variable: Probability of being victimized)

	(1)	(2)	(3)
Coefficient on city growth	0.0141	0.0187	0.0182
(Standard Error)	(.0054)	(.006)	(.007)
Other variables	.	Wealth, household characteristics	Wealth, City Size, hh. Characteristics
# of Observations	17088	14961	12950
# of Cities	69	69	67
Adjusted R-Squared	0.02	0.027	0.028

Note: Besides population growth, these regressions include country and year fixed effects and the variables specified in each column.

Table 7: Correlations between Crime, Population Growth and Trust in Law Enforcement

(Correlations at the city level)

	<i>Crime</i>	<i>Population Growth</i>	<i>Confidence in Police</i>	<i>Confidence in Judiciary</i>	<i>Confidence in Congress</i>	<i>Confidence in P. Parties</i>
<i>Crime</i>	1.0000	0.2267	-0.4667*	-0.2759*	-0.4277*	-0.2740*
<i>Pop Growth</i>		1.0000	-0.3985*	-0.3469*	-0.3093*	-0.3066*
<i>C. Police</i>			1.0000	0.5889*	0.7250*	0.5345*
<i>C. Judiciary</i>				1.0000	0.5338*	0.5699*
<i>C. Congress</i>					1.0000	0.7467*
<i>C. P. Parties</i>						1.0000

Note: Correlations marked with (*) are significant at the 5% level.

Table 8: Crime Victimization and Trust in the Police and Judiciary

(Dependent variable: Probability of being victimized)

	OLS	OLS	IV (Congress)	IV (Political Parties)	IV (Congress, PP)
Confidence in police (Standard Error)	-.173 (.084)	.	-.372 (.163)	-.093 (.205)	-.347 (.160)
Confidence in judiciary (Standard Error)	.	-.080 (.0.095)	.	.	.
# of Observations	17097	17018	16735	16870	16618
# of Cities	151	151	151	151	151
Adjusted R-Squared	.034	0.033	0.033	0.034	0.033

Note: All regressions include country and year fixed effects, as well as controls for household attributes and city size. We report Hubard-White standard errors that allow for residual clustering within cities. Cities with less than 30 observations were excluded from the sample.

Appendix

A Simple Model of Crime Victimization

Are wealthy individuals more likely to be victims of property crime? The answer to this question depends on the relative strength of two opposing forces. The wealthy are, on the one hand, more desirable targets for criminals and, on the other, they have greater incentives to invest in private protection against crime. Here we investigate the circumstances under which the first force dominates the second, thus making wealthier individuals more likely to fall prey of criminals.

The structure of the model is simple. There are two actors (citizens and criminals) and two stages. In the first stage, citizens (that differ only in their wealth holdings) decide how much to spend in private protection. In the second stage, citizens are matched with criminals who in turn decide whether or not to commit a crime upon observing their prospective victims' wealth (w) and investments in private protection (e). Criminals make their decisions on the basis of mere pecuniary factors. They weigh in two factors: a successful criminal attempt will mean enjoying a bounty of α times w ($\alpha \geq 1$), and a failed criminal attempt –that occurs with probability p – will mean incurring in fine F .

Three additional assumptions are made. First, the probability of apprehension is assumed to increase monotonically with the expenses in private protection (i.e., $p = p[e]$, where $p' > 0$). Second, victims and criminals are assumed to be risk neutral. And last, criminals are assumed to have complete information in that they observe their victim's wealth and are able to correctly infer their chances of being apprehended.

Thus, a criminal will attempt to victimize citizen i who possess a wealth of w_i and have invested e_i in private protection as long as the following inequality holds

$$(1 - p[e_i])\alpha w_i - p[e_i]F > 0. \tag{1}$$

Because all citizens are paired with criminals, citizen i can avoid being victimized only by investing at least h_i in private protection, where h_i corresponds to the expenses in private protection that would make a criminal indifferent between attempting to steal from i or not doing it because poses too high of a risk. In short,

$$h_i = \mathbf{p}^{(-1)}\left[\frac{\mathbf{a}w_i}{\mathbf{a}w_i + F}\right] \quad (2)$$

where $\mathbf{p}^{(-1)}$ is the inverse of the function \mathbf{p} that links private expenses in protection to the probabilities of punishing a criminal.

Equation (2) gives, for each level of wealth, the minimal expenses in private protection required to scare criminals away: any amount below h_i is insufficient and any amount above it is superfluous. Citizens face thus a binary decision; they either invest h_i in private protection or do not invest at all. Obviously, they will invest h_i only if it doesn't exceed the prospective losses of being victimized. That is,

$$h_i \leq \alpha w \quad (3)$$

Wealthier individuals would need, all else being equal, greater investments in private protection to avoid victimization. This is immediately apparent from the first derivative of expression (2) with respect to w ,

$$\frac{dh}{dw} = \frac{\mathbf{a}F}{(F - \mathbf{a}w_i)^2 \mathbf{p}'[h]} > 0. \quad (4)$$

But are wealthier individuals willing to incur in the higher costs of private protection? Or will they instead prefer to bear some crime? As we shall see below, the answer to this question depends on the second derivative of h with respect to w .

Figure 6 depicts the two types of relevant solutions of the model.²⁷ In the first case, equation (2) is concave, h is below αw for higher values of w , the wealthy invest in private protection, and the poor are victimized. In the second case, equation (2) is convex and the conclusion switches: the poor are the ones who invest in protection and the wealthy the ones who bear the brunt of crime. In short, all depends on the concavity of equation (2).

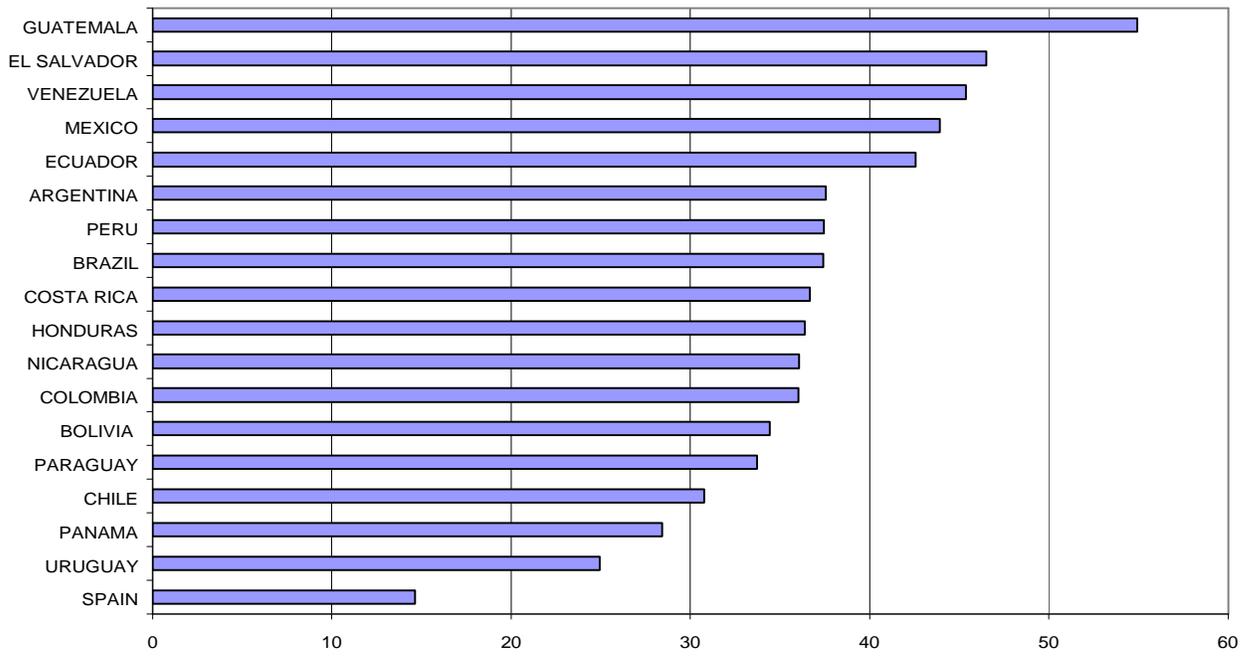
What determines the concavity of (2). The answer is evident by looking at the second derivative of h with respect to w ,

$$\frac{d^2 h}{dw^2} = - \frac{\mathbf{a}^2 F (2(F + \mathbf{a}w) \mathbf{p}'[h]^2 + F \mathbf{p}''[h])}{(F + \mathbf{a}w)^4 \mathbf{p}'[h]^3}. \quad (5)$$

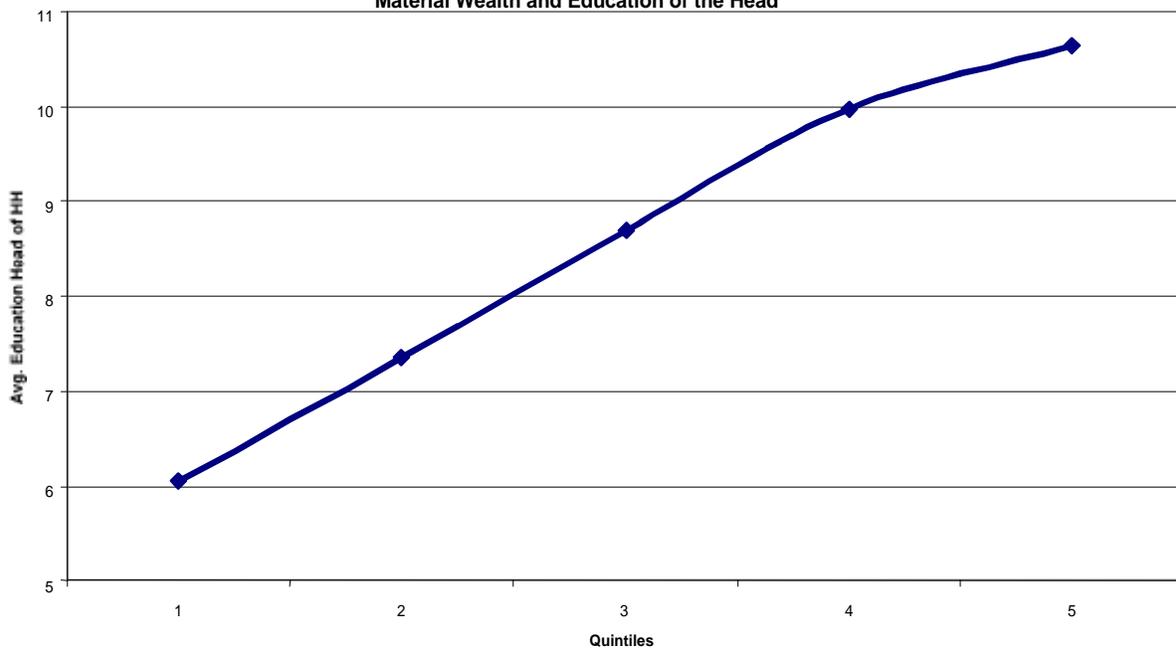
Clearly, equation (5) will be negative unless the second derivative of \mathbf{p} is both negative and large in absolute value. So the wealthy will routinely invest in private protection in order to avoid victimization unless \mathbf{p} exhibits sharp diminishing returns to scale. The intuition is straightforward; if the marginal returns of an extra peso spent in private protection against crime are *very* low, the wealthy will find it extremely expensive to reach the level of protection needed to avoid victimization and will rationally decide to bear some crime. Otherwise, they will invest the necessary amount to escape victimization.

²⁷ Figure 6 summarizes all cases of economic interest. For some parameter values, the two curves in the graph never intersected, meaning that all citizens are victims of crime or no citizens are victims of crime. These extreme cases are, obviously, of little interest.

**Victimization Rates by Country
Figure 1**

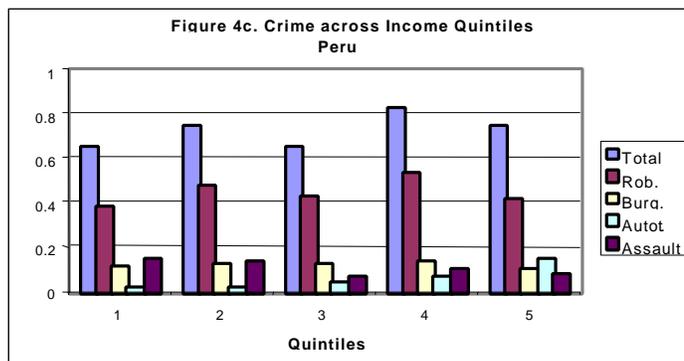
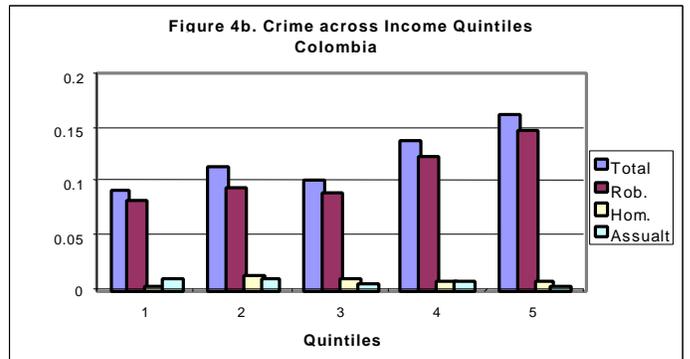
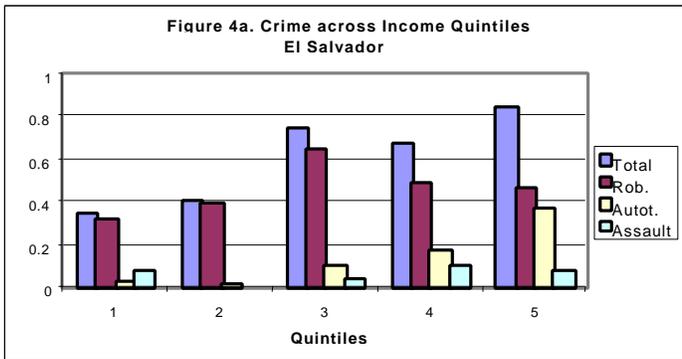
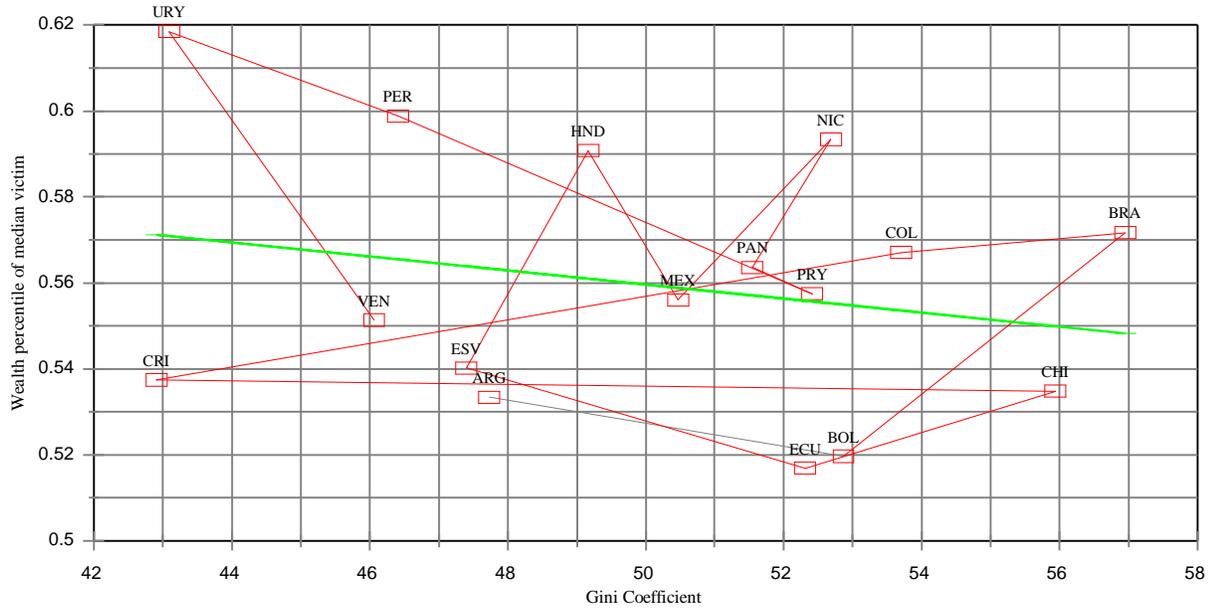


**Figure 2
Material Wealth and Education of the Head**



Source: Latinobarometer 96-98

Income Inequality and Median Victim
Figure 3



Data for Colombia includes only serious incidents. Robberies include thefts, car thefts and burglaries in Colombia and thefts and burglaries in El Salvador.

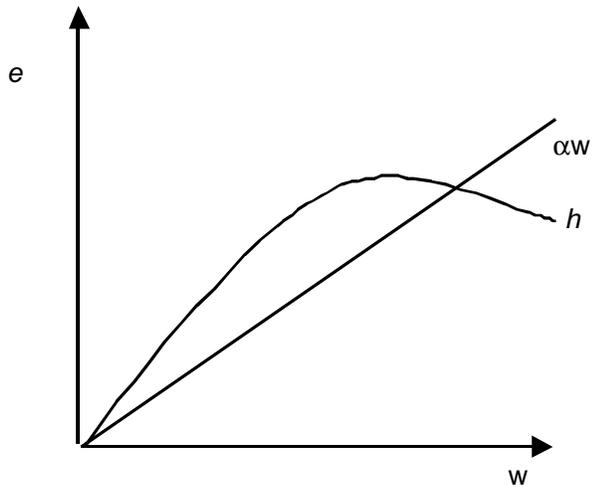
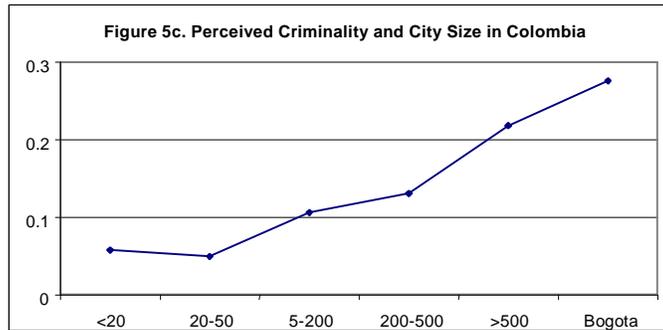
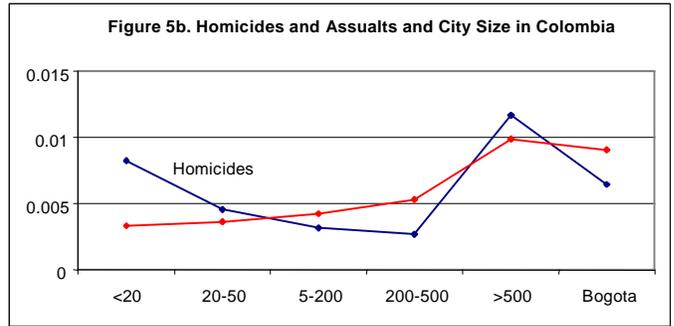
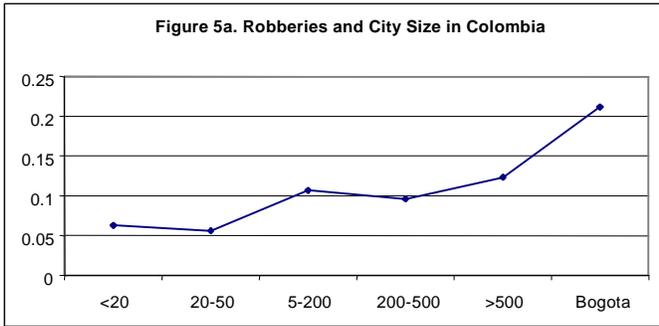


Figure 6a

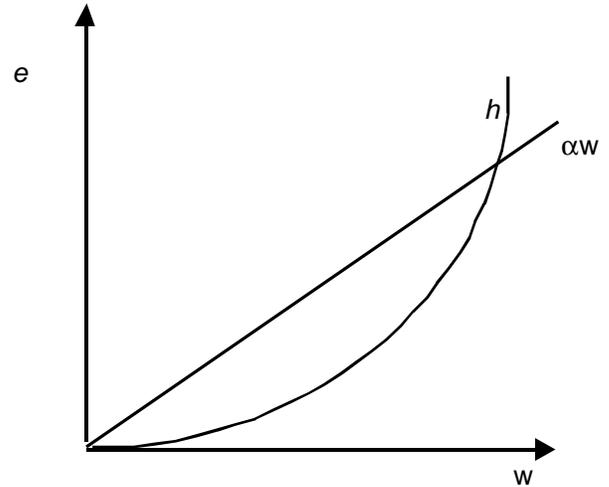


Figure 6b