Policy Research Working Paper 4918

Exit and Save

Migration and Saving under Violence

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The World Bank
Middle East and North Africa Region
Human Development Division
April 2009

Policy Research Working Paper 4918

Abstract

This paper examines how households trade off migration and savings when subject to exogenous violence. The authors propose that households under violence decide jointly on migration and saving, because a higher asset-stock is more difficult to carry to a new place. When confronted with exogenous violence, households are expected to consider migration, and reduce their assets, both in order to reduce their exposure to violence, and to make migration easier. In some cases, after a migration decision has been taken, savings can increase as a function of violence to ensure a minimum bundle to carry. Empirical evidence from rich Colombian micro-data supports the conceptual framework for violence that carries a displacement threat, such as guerrilla attacks.

This paper—a product of the Human Development Division, Middle East and North Africa Region—is part of a larger effort in the region to understand the impact of violence on household decisions. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at rgrun@worldbank.org.

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Exit and Save: Migration and Saving under Violence

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INTRODUCTION

Violence shapes people's daily lives in many countries. Colombia is but one prime example of a country where many households are exposed to exogenous violence, in the form of guerrilla attacks and paramilitaries in some rural areas as well as common delinquency in many cities. A household confronted with such exogenous violence is exposed at various levels: its physical investments may be destroyed or removed, returns on savings may become riskier and, at high levels of violence, people's own life may be in danger. Depending on the grade and type of violence, households may therefore take different decisions in order to protect themselves or their assets: reduce investments, to limit exposure, or to prepare for migration; procure that the most mobile household members leave; and finally choose to emigrate completely.

It is conceivable that in the presence of violence, the amount people save depends on their envisaging migration or not; but the decision to migrate also depends on the amount of assets held (some of which may be difficult to move). This paper tests whether violence spurs migration and lowers savings, while lower savings again make migration easier. If yes, this would have implications for the political discussion about violence. A negative change in household saving behavior would mean a greater loss than the immediate measurable decline in the destroyed capital.

Few papers have examined the joint character of savings (or consumption) and migration decisions. Dustmann (1997) analyzes precautionary savings in a return migration framework where future income is uncertain. In another paper (1995) he provides a theoretical analysis of the savings behavior of migrant workers where the simultaneity of savings and return plans is taken explicitly into account. He simulates a lifecycle-model including migration and duration of stay and shows that different saving paths, peaking at various times during the stay abroad, are consistent with utility-maximizing behavior. Saving and return timing depend on the wage and price relations between host and home country and the dependent marginal utilities. In a descriptive paper, the same author (2000) analyzes simultaneous decision-making on human capital investment and migration, concluding that investments undertaken into human capital are conditioned on intentions at that point in the migration history and not on final realizations of returns. In a very recent study, Ibañez and Vélez (2004) examine displacement in Colombia and its relation to various factors, among others asset ownership. They find that asset ownership as well as the general improvement of welfare at the origin site tends to deter migration.

The literature still leaves significant space to breach. First, among the above there is a virtual absence of papers analyzing within-country variation. Most empirical studies are cross-country and therefore susceptible to omitted variable bias and endogeneity. Second, while recent papers recognize both violence and asset ownership as determinants of migration, there has been no empirical study into the joint nature of savings and migration decisions. This is an important gap, which the present paper attempts to fill.

Our analysis is novel in various ways. First, to our knowledge it is the first empirical test of simultaneous migration and saving, and it is the first test of these decisions in a violent context. Second, it exploits within-country, rather than cross-sectional variation of migration, savings and violence data. And last but not least it makes use of a unique set of household and municipal data from Colombia.

We have structured our paper as follows. The next section (2) explains how violence, migration and savings can be linked through a simple model of simultaneous decision-making. Section 3 describes the data and some key statistics for the relevant variables, and section 4 tests the findings of the model with Colombian data. Finally, section 5 summarizes the main conclusions.

CONCEPTUAL FRAMEWORK

As laid out in the introduction, we want to explore two household decisions in the context of violence, which we assume are made jointly: savings and migration. In the presence of violence, the amount people save depends on their envisaging migration or not; but the decision to migrate may also depend on the amount of assets held. [1]

Our conceptual framework attempts to capture both decisions in a joint savings and migration model. The representative individual is risk averse and lives over two periods. She receives a constant exogenous income w in the first period and can split it between consumption and savings, so that $c = w - a$. Our model is 'autarkic' in the sense of Besley (1995b), i.e. we abstract from financial intermediators. Savings from period 1 earn a return R in a peaceful environment or P in a violent environment, $R>P$. Violence not only lowers the prospective return, it also can eat away part of the savings with a probability p, so that from savings a in period 1 only $a\ (1-pv)$ earns a return in period 2, with violence $v \in [0,1]$. We do not assume any violence to impact w. A salaried employment that contributes to household income, such as admin work in the public or private sector is not immediately exposed to violence. Violence with a displacement threat will eventually threaten salaried income. Yet, the knowledge to carry out the salaried job will not be lost and can possibly be applied elsewhere.

1 Note that Disney et al (2003) discuss another possible link between assets and short distance migration: people move in order to sell assets, especially real estate, in order to realize capital gains. In other words, asset value changes can prompt moves. This connection may obviously be present in the Colombian context as well. It will, however, likely be dominated by violence considerations, see Moser and McIlwaine (2000).

Supported by the data in the next section, we categorize two kinds of violence for the Colombian context: guerrilla warfare, which carries an explicit mandate against the state, and manifests itself through attacks on infrastructure, combat, kidnappings and displacement; and common delinquency, characterized through muggings and gang vendettas without a political interest. For the question of our model, we assume both kinds of violence can be a threat to the saved assets. They are also a threat to *R*, by challenging the institution of property rights as such (guerrilla), making market transactions more dangerous (guerrilla and delinquency) and occasional stealing of returns (delinquency). Guerrilla violence is assumed to have a more severe impact on assets and *R*, through its explicit attack on current institutions of law and order and the threat of displacement, so $pv_G > pv_D$ and $R>P_D>P_G$. The predictions of the model therefore apply to both kinds of violence, with guerrilla violence assumed to generate a more pronounced effect. For the sake of simplicity, below we present our model for one kind of violence only.

The individual can choose to migrate or not to migrate with $m = \begin{cases} 1 & \text{if migration} \\ 0 & \text{if staying} \end{cases}$. If the individual decides to migrate, it will incur migration costs proportional to the assets accumulated in period 1. If the assets have been reduced by violence, the costs will be accordingly lower. Assuming a time preference rate of γ and intertemporally separable utility with CARA and elasticity of substitution $\frac{1}{\sigma}$, lifetime utility reads

$$U(c_1, c_2) =$$

$$(1-m)\left[\frac{(w-a)^{1-\sigma}}{1-\sigma} + \gamma\frac{(a(1-pv)P)^{1-\sigma}}{1-\sigma}\right] + m\left[\frac{(w-a-\delta a(1-pv))^{1-\sigma}}{1-\sigma} + \gamma\frac{(a(1-pv)R)^{1-\sigma}}{1-\sigma}\right]$$

We can see that the migration decision depends on which environment will procure the higher utility: the present, but violent one, or the further one, where assets will have to be carried, but which is peaceful. In other words, *m* is a function of the difference between the second and the first square brackets. This difference will be the greater, the smaller $\delta a(1-pv)$ and the bigger *R-P*. In other words, we can predict that migration is a function of migration costs and return differences. Both drivers are influenced by violence: violence, by asset destruction, lowers the migration cost, and makes 'peaceful' returns more attractive. We should therefore expect any violence to increase migration, with guerrilla violence having a more pronounced effect. We also see that migration depends on the amount saved, *a*, as this increases migration costs.

a in turn depends on whether a decision to migrate has been made or not. If yes, the FOC reads $\frac{\partial U^M}{\partial a} = (1+\delta(1-pv))(-a-\delta a(1-pv)+w)^{-\sigma} - \gamma(1-pv)R(a(1-pv)R)^{-\sigma} = 0$

If not, it reads $\frac{\partial U^{Stay}}{\partial a} = (-a+w)^{-\sigma} - \gamma(1-pv)P(a(1-pv)P)^{-\sigma} = 0$

We can explore these FOC with comparative statics based on the Implicit Function theorem. Examining for example the reaction of a^* to *v*, violence, we obtain

$$a^*'(v) = -\frac{\frac{\partial U_a}{\partial v}}{\frac{\partial U_a}{\partial a}} = -\frac{\frac{\partial U_a}{\partial v}}{U_{aa}}$$

Calculating and simplifying this expression for the case of migration yields

$$\frac{-p\left[\gamma R(1-\sigma)(aR(1-pv))^{-\sigma} + \delta\left(a(1-\sigma)(1+\delta(1-pv))-w\right)\left(a(-1-\delta(1-pv))+w\right)^{-1-\sigma}\right]}{\sigma\left[\frac{\gamma\left(aR(1-pv)\right)^{-1-\sigma}}{a^2}\right] + (-1+\delta(-1+pv))^2\left(a(-1+\delta(-1+pv))+w\right)^{-1-\sigma}}$$

The denominator can be discerned as positive. The sign of the numerator depends on the size of the various parameters. Through simulation it can be shown to be negative for most parameter values. However, for a low γ and a low *R* (i.e. parameters that lower future utility), it can become positive. This makes sense in the light of our previous discussion: in most circumstances, higher violence will lower savings. If however, a decision to migrate has been taken, migration costs can be lowered through violence. Therefore, if savings do not play a big role in the future, violence may actually increase saving, as it offsets some of the resulting (current) migration costs. Note that a lower elasticity of substitution would dampen the effect. In a similar way, *a** can be shown to increase with *w* under migration.

In the case where the individual stays in the violent region, the Implicit Function Theorem yields, after some simplifications:

$$-\frac{\left[\gamma p P a(1-\sigma)(-a+w)^{1+\sigma}\right]}{\sigma\left[\gamma P(1-pv)(w-1)(-a+w)^{\sigma}+a(aP(1-pv))^{\sigma}\right]}$$

This expression is always <0, i.e. an increase in violence always dampens savings[2]. As above, it can be shown that without migration, an increase in *w* increases savings. - Note that a lower elasticity of substitution would dampen the effect.

In summary, we can make the following predictions for savings behavior: savings will depend positively on income and negatively on violence (in the absence of migration); the effect of an interaction between a positive migration decision and violence is ambiguous. It can also be shown that individuals who discount the future more strongly save less. Also note that according to the model people living in the second period do

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2 Note that we abstract from an influence of violence on risk perception, i.e. an interaction between violence and σ. If violence increases risk, savings from the precautionary motive may rise.

not invest but consume everything. Migration is predicted to always increase with violence, and to decrease with higher savings.

In the remainder of this paper, we want to test the predictions of the above model empirically. This will entail exploring the extent of migration and savings as functions of guerrilla and delinquent violence, as well as of income, and other individual and variables that are likely to influence the cost of migration or investment. In this context it will be particularly important to control for all factors that may influence the occurrence of violence, in order to avoid the violence variable picking up the effect of other, correlated, features.

DATA

The main dataset used comes from the baseline survey to evaluate the *Familias en Acción* program in Colombia ('*Familias* dataset'), conducted in 2002 with approximately 11,500 households in 122 municipalities. Two types of surveys were applied: an extensive questionnaire for households of the lowest income stratum (i.e. registered with 'SISBEN 1'[3] in December 1999) and a questionnaire to the mayor in order to obtain municipality level variables.[4] We merge this dataset at the municipal level with two further databases, a violence database assembled by Medina et al. (2001), and a database of municipality characteristics compiled from different official sources, like the Colombian Institute for Family Welfare (ICBF), the Planning Ministry (DNP), and the Administration of Courts (CSJ).

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3 SISBEN 1-6, sixtiles of the population income distribution, is a basic welfare indicator routinely collected for all families in Colombia. Its level determines welfare entitlements and utility prices.

4 Familias covers the first income sixtile exhaustively. It is therefore not representative for Colombia as a whole, but covers the poorest households in their entirety.

The municipalities in the violence dataset do not completely match those in the *Familias* dataset, so that close to 3,000 household observations are lost through matching. *Familias*, while covering households in the lowest national welfare stratum near exhaustively, does not reach all municipalities. And the violence database misses the departments of Antioquia, Choco and Guajira, which are nonetheless included in *Familias*. Our results will therefore have external validity for the lowest national welfare stratum in the area excluding the above departments. While excluding Choco and Guajira should not have a noticeable effect on the average and median prevalence of violence in the sample, excluding Antioquia may miss the upper limit of common delinquent activity alone. However, we still prefer this violence dataset, assembled by Colombian violence historians and economists, to geographically more complete official sources, because it contains vital control variables, such as the rate of captures under the drug act by the police.

Household level variables from the *Familias* survey cover day-to-day decision-making, the socio-economics of members and consumption information. The dataset also covers whether and how many family members have left the municipality. It also covers the political activity of the household expressed as membership in groups such as parties, religious groups, pro-peace and other groups.

At the municipality level, we chiefly have two sets of variables: violence variables, which are discussed in more detail in the next section, and other municipality characteristics - some of which may facilitate violence. Here, the empirical literature on Colombia has pointed to geography, judicial efficiency and welfare, respectively. Regarding geography, from *Familias* we obtain the altitude in meters, a dummy for three different degrees of rurality and a dummy for one of four regions. In our context, geography is important for two reasons. First, a municipality with difficult physical access will naturally enjoy less governmental protection against armed groups such as guerrillas and paramilitaries (compare Vargas, Restrepo and Spagat (2004) and Reynal-Querol (2005)). Access in Colombia can be difficult through dispersion of settlement (rurality), rainforest/mangrove swamps (Pacific region), or mountainous terrain (intermediate to high altitudes). Second, coca plants, a major source of income for the armed groups as well as common delinquents, are best planted in certain areas. While the actual plantations are endogenous to the protection by armed groups, the geography apt to their cultivation, i.e. Andean altitudes between 1,000 and 2,000m, is exogenous. Regarding judicial efficiency, our municipal database contains the arrests under the Drug Act per million inhabitants. This is related to both the incidence of drug crime and police efficiency. Previous studies, e.g. Martinez, Medina and Steiner (2001) and Martinez and Medina (2003) use arrests under the Drug Act as a proxy of local law and order enforcement. Regarding welfare and wealth, the database provides the official Indicator for Quality of Life. This indicator combines different variables about access to services. The dataset further covers the sum of assets held by banks in the municipality, as recorded by Financial Regulation. Finally, we can approximate inequality through the percentage of people in the two lowest income strata, in line with Bourguignon (2003).

Measuring Violence in Colombia

As the introduction showed, the country is suffering from various kinds of violence. These can roughly be divided into first, violence that explicitly challenges the state, such as that proceeding from the guerrillas and paramilitaries, and second, common delinquency, proceeding from organized small gangs and unorganized crime. (A third force, drug cartels, in their original form belong largely to the past, since the Cali and Medellin cartels have been dismantled and much of the drug business has been picked up by both guerrillas and paramilitaries, and smaller fractionalized gangs.)

The perpetrators of the two kinds of violence use different means. Guerrillas and paramilitaries rely on displacement threats, kidnappings, extortion, massacres, and combat, the common delinquents prefer muggings, carjacking, and vendettas to adjust accounts, mostly among themselves. Not all of this violence is officially, let alone exhaustively, measured.[5] Regarding violence challenging the state, data assembled by the Medina et al. (2001) from National Police records and other municipal data allows us to measure guerrilla actions directly. Through a 'public order problem' dummy in the Familias survey, we also pick up qualitatively whether paramilitaries are active in a municipality. To our knowledge, there is currently no source that quantifies paramilitary actions reliably. Also the official statistics can be challenged, as the National Police records only actions they have been notified of, which might not always be the case. [6] Regarding common delinquency, our data sources pick up the homicide rate. There are obviously further activities by the perpetrators of homicides, such as muggings, and some of these will be committed in conjunction with a homicide. But of the available statistics, homicides are the most reliable, as they are certified and tracked by the Forensic Medecine (Medicina Legal)[7]. All other indicators of common delinquency are likely to be strongly under-reported. From the above, we can detect two issues that will affect the interpretation of our empirical results. First, the uncertain measurement of some violence variables may entail an attenuation effect on the corresponding covariates. This may especially be an issue for common delinquency, given that we miss the department of

5 Because of this there have been efforts to measure the actions of the armed groups more precisely. Vargas, Restrepo and Spagat (2004) have recently put together a dataset of guerrilla, paramilitary and other militia actions and their victims, carefully handpicking from NGO and church databases and local press articles. However, their database relies on the judgment of the authors, and for example consciously leaves out armed encounters that cannot be attributed to actors in the armed conflict. We therefore prefer to rely on Medina et al. (2001).

6 For example, National Police statistics on paramilitaries appear less complete than for guerrillas; and the overwhelming majority of empirical studies on Colombia relies on guerrilla and homicide figures alone. Also, as the paramilitaries avoid combat situations, they have fewer encounters with the police, and are less likely to be tracked, compare Vargas et al (2004).

7 Levitt and Rubio (2000) for example consider only the homicide rate a reliable violence indicator in Colombia.

Antioquia. Second, as we possibly do not pick up all relevant variables, such as muggings, there will likely be some Omitted Variable Bias in the coefficient of the homicide rate. - In the light of this, let us examine the variation and correlation of the observed violence variables.

According to our data, the incidence of the different types of violence is high. All municipalities reporting data experience arrests under the Drug Act, varying from 29 per million to over 1,500 per million. About 75% of the households live in municipalities with an active guerrilla or paramilitary militia, and 40% experience guerrilla attacks. More than 80% live in municipalities with a measurable homicide rate.

From the definition of our variables we know that the measurement of the homicide rate and guerrilla attacks must overlap: some guerrilla actions result in deaths. Indeed, although the correlations appear quite low, we detect some link between a public-order problem or guerrilla attacks on the one hand and the homicide rate on the other hand, see Data Table 1. Nonetheless, the literature agrees[8] that most of the homicides are not a product of the armed conflict, but rather of common delinquency. If we observe a certain correlation, it probably reflects the findings of Sanchez, Diaz and Formisano (2003) that a first-time guerrilla strike in an area is subsequently followed by an increase in common delinquency. This is consistent with guerrilla type violence eroding law and order, and creating a climate more propense to common delinquency.

It is worth pointing out that the capture rate is negatively associated to all other violence measures, which suggests that it might be a good indicator of police responsiveness. As mentioned previously, both the armed groups and the common delinquency derive

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8 See Moser (1999) for an overview, and Vargas, Restrepo and Spagat (2004). The Ministry of Defence believes as much as 80% of homicides have nothing to do with the guerrilla, Ministerio de Defensa Nacional (2001)

income from the drug trade and are therefore indirectly a target of the Drug Act[9]. - Note that our database measures the capture rate at departmental level (more aggregate), but violence at municipal level, which provides some control for potential endogeneity of the capture rate to violence.

	Public order problem	Guerrilla attack rate	Homicide rate	Capture rate	People in 2 lowest income strata (%)	Quality of Life Index
Public order problem	1					
Guerrilla attack rate	0.16	1				
Homicide rate	0.24	0.43	1			
Capture rate	-0.09	-0.17	-0.12	1		
People in 2 lowest income strata (%)	0.28	0.28	0.11	-0.19	1	
Quality of Life Index	-0.31	-0.15	-0.10	0.31	-0.40	1

Data Table 1: Correlation matrix of violence and welfare

We also assess to what extent violence is linked to other community characteristics. – Data Data Table 1 shows that correlations between welfare and violence indicators are small, but significantly different from zero and with signs as expected. There may be a weak positive link between inequality and violence, and a negative one between Quality of Life and violence. Likewise, better access to basic services (measured in the Quality of Life indicator) goes hand in hand with a higher capture rate.

Measuring Migration and Savings

Our data allows us to measure how many people have already emigrated from each household and the characteristics of the remaining household members. From a second wave of data in 2003 we can also identify households, which eventually left completely.

9 Also see Fajnzylber, Lederman and Loayza (1998) for evidence of the reaction of violence to deterrence in Colombia.

Households in violent regions are more affected than those in peaceful municipalities. About 10% of households in peaceful areas have lost at least one member, compared to 14% in those with a public order problem. Neither education nor asset wealth appears to be correlated with migration. However, we do observe a positive relationship between migration and violence at the municipality level.

The measurement of savings with the Familias survey is not straightforward. Of the income measures available, only the salary is reliable, as most enterprises in SISBEN 1 do not have any form of accounting. This obviously does not capture the full household income: 20% of the households do not report a salary, but conduct a revenue generating enterprise. And of the 80% waged, 38% run a business on the side. However, we have comprehensive data on the asset stocks held by households, including real estate, vehicles and durables, and their respective prices from 2001. Additionally, we have enquired the productive lives of the different assets, with people from SISBEN 1 and manufacturers/breeders. They are reported in Data Table 2.

Given the price and the productive life, we can estimate the annual net benefit proceeding from an asset with the asset pricing formula[10] $P = \sum_{i=0}^{n} \frac{D_i}{(1+r_i)^i}$, where *P* is the price of the asset in the current period, n is the productive lifetime in years, D_i is the net benefit proceeding from the asset, and r_i the cost of capital in year i from now, all real terms. We assume a constant real payoff from the asset, as well as a constant real cost of capital, and approximate the latter with the Colombian average real credit interest in 2001. This formula is used for assets with an estimable productive life. Bank deposits are assumed to earn the average real 2001 deposit interest. The estimated yearly payoffs are

10 See e.g. Ross, Westerfield and Jaffe (1996)

reported in Data Table 2. This is a crude approximation of the business and self-production income a household is enjoying. Given the risks under which the households in our sample are operating, the assumption of a real cost of capital of 14%[11] - while being a reasonable assumption for corporate Colombia - for private households is probably on the conservative side. We will therefore test the sensitivity of our results, first, with the total income measure derived above, and second, using only reported salary as income.

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11 Average real credit interest of Colombian banks, Banco de la República, 2001.

Asset	Productive lifetime (years)	Estimated yearly payoff (USD)
bicycle	6	9.80
boat/canoe	10	37.50
chicken	2	2.90
cow	5	90
portable diesel generator	10	250
donkey	12	5.20
duck	10	4.20
fan	8	5.60
fridge	10	21
goat	9	7
horse	12	8.20
kerosene lamp	5	6.30
manual sewing machine	8	12
mixer	8	4
motorcycle	5	820
pig	9	6.60
rabbit	5	2.50
stereo equipment	5	25
television b/w	8	5
television color	8	57

Data Table 2: Asset lifetimes and yearly payoffs

Note:

1) productive lifetimes are average lifetimes for assets in a SISBEN 1 environment, i.e. below average quality and frequent use.

2) Values (and therefore payoffs) of real estate differ for each household and are therefore not reported.

Sources:

Productive lifetimes: personal survey of people in SISBEN 1; Honda, Ontario Ministry of Agriculture and Food, Goodman (1997);

Yearly payoffs: own calculations, assuming constant real cost of capital of 14% (average Colombian banks' real credit interest rate, Banco de la República 2001)

The Data Table below reports the basic statistics for savings calculated from both income measures, salary + estimated asset returns (1), and salary only (2). While considering salary and the waged households only generates negative mean savings, the fuller accounting for household income produces positive mean savings, of around 130

USD per month. Both measures are distributed normally around their means, but the savings from income (1) with a higher variation, as can be expected. Note that negative savings rates are by no means unusual for the income strata we are studying. Poterba (1994) reports negative savings rates in the lowest income quintiles of Germany and Canada.

Savings statistics	Savings (1) in COP	Savings (2) in COP
Mean	306,708	-213,658
Standard Deviation	1,386,227	248,167

Data Table 3: Some basic savings statistics

Note: Savings (1) are calculated as head monthly salary + sum of monthly payoffs of the assets in the household's portfolio – total consumption. Savings (2) are calculated as head monthly salary – total monthly expenditure (not including household self production for food), for waged households only.

Households that accumulate savings rarely store the money in a bank (only 232 households report saving in a bank), but invest the money immediately in consumer durables and other assets. When relating household savings to the age of the household head, we observe rising savings with age.

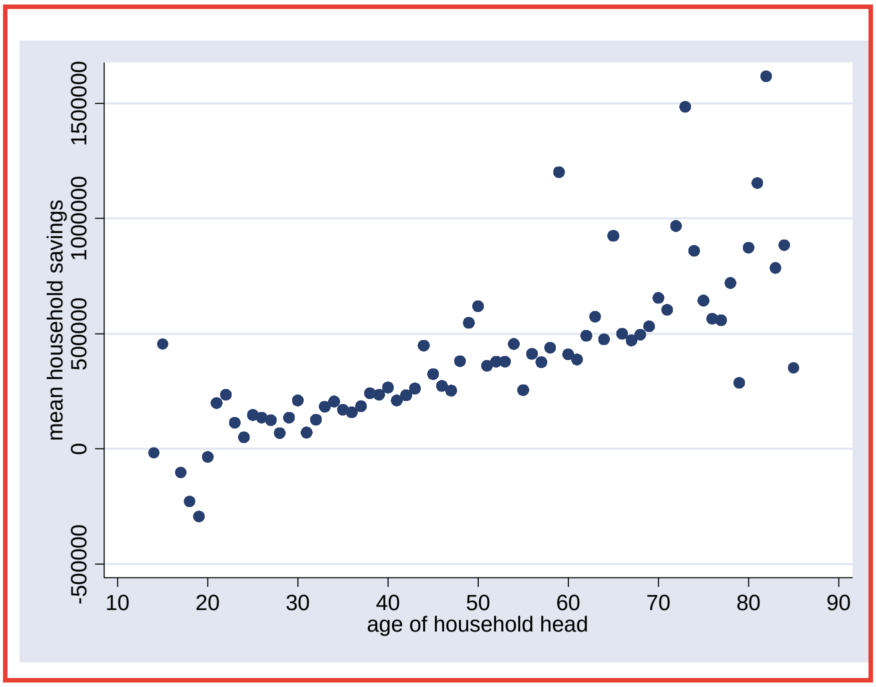

Figure 1: Savings and age of household head

Sample Selection Issues

There may be issues of sample selection in the database we use for our analysis. As explained earlier, we use the Familias survey as the backbone for our analysis and merge it at the municipality level with violence and municipal variables.

The households in the Familias survey have been identified from the government's register for the lowest income stratum (the SISBEN dataset). When confirming the addresses of the around 20,000 households, the surveyors found that about 40% had left their municipality. It is not likely that these 40% left at random. Given that our work examines migration patterns and links them to violence, we need to test the assumption that the leavers censored the sample we ultimately use. In other words, we observe a sample of 'stayers' in municipalities that experienced (potentially systematic) displacement already. The reduced sample may be different from the original sample censored by out-migration, and display a stratification that is not representative. Therefore, our regression results may be different than with a complete sample. Likewise, peaceful locations will have experienced immigration of people marked by violence elsewhere.[12] Therefore, controlling for violence at the municipality level, rather than the personal history level may also bias our results.

There are various ways to remedy the bias in the empirical specification, depending on the specification used. If the specification is linear, and the selection process from the original sample is known, the standard remedy is Heckman's (1979) two-step procedure.

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12 In this context, the findings of Glaeser and Shapiro (2001) are interesting, which suggest that (terrorist) violence shapes the choice of settlement form, e.g. a dense urban setting allows more mutual protection and short transport times. In this sense the fairly urban structure of our sample (50% urban settlers) is likely to have been shaped by years of violence.

This involves calculating the non-selection hazard (inverse Mills ratios) in a first step, and including the ratio in the principal regression in a second step. The basic Heckman model involving sample selectivity can be summarized as

$$\begin{bmatrix} y_t^* \\ z_t^* \end{bmatrix} = \begin{bmatrix} X_t\beta \\ W_t\gamma \end{bmatrix} + \begin{bmatrix} u_t \\ v_t \end{bmatrix}, \begin{bmatrix} u_t \\ v_t \end{bmatrix} \sim NID\left(0, \begin{bmatrix} \sigma^2 \rho\sigma \\ \rho\sigma 1 \end{bmatrix}\right)$$

where $y_t = y_t^*$ if $z_t^* > 0; y_t = 0$ otherwise; $z_t = 1$ if $z_t^* > 0; z_t = 0$ otherwise.

The first equation is the main regression we want to analyze from our dataset and the second equation the process by which data get selected into (or out of) our dataset. The selectivity problem arises when u and v are correlated. In other words, when people's observed behavior depends on how they have been selected into the sample. For example, it could be that stayers are more conservative generally and therefore save more and invest more in traditional assets. Equally, it could be that stayers are generally not very impressed by violence and therefore adjust their investment decisions to violence in a way that is different from leavers. If we allow u and v to be correlated we can derive an expression that helps us to correct potential sample selectivity. The first equation above can be rewritten as $y_t^* = X_t\beta + \rho\sigma\frac{\phi(W_t\gamma)}{\Phi(W_t\gamma)} + residual$ where $\frac{\phi(W_t\gamma)}{\Phi(W_t\gamma)}$ is the inverse Mills ratio (IMR). Note that for identification, selection needs to be driven by at least one variable not present in the main equation (exclusion restriction). Further, the principal specification needs to be linear.

If the specification is non-linear, there are other remedies available from the literature. Boyes, Hoffman and Low (1989) and Greene (1992) offer a remedy for the bi-variate Probit model. They deal with the non-random stratification of the selected sample by applying a weighted exogenous sample ML estimator. The weights, which are those present in the original population, are then used to adjust the selected sample to the 'true' proportions. This procedure can be extended to a Tobit specification. Greene (1997) offers a procedure for sample selection correction if the principal specification is a Tobit model. However, given that often a Tobit can be approximated by OLS, see Greene (2001), in most cases it will be more practicable to use a linear specification and Heckman's method.

Given the data we have available, we can attempt a correction for sample selection in some of our specifications. We have the original dataset from which the *Familias* sample was drawn, the SISBEN register of households. This is a c20,000 household register of all beneficiaries of the national welfare system, which are in the lowest income stratum, 'SISBEN 1'. The register identifies some basic characteristics, such as age, gender and education. However, information on these is missing for about half of the households. We can identify, which people stayed in and which left the original SISBEN population by comparing the households in the SISBEN register with those in the Familias dataset. Although Familias and SISBEN do not share the same household identifier, we can link the households up via the National ID number of the head. (A National ID number is unique and stays with the bearer for life, no matter where they move. That means, those SISBEN households which we no longer find in Familias did not just move from one place to another within the same sample. They are definitely not picked up anywhere in the Familias sample.)

The SISBEN dataset can be merged at the municipality level with some municipal variables which are available for the entire country, such as violence data from before 2000 on armed group actions, as well as municipality level wealth indicators for various years. We include the sum of all bank assets per head in the municipality.

Although the data are obviously limited, we can use it to attempt a sample selection correction. We can model the selection process according to Heckman and calculate the IMRs. This will allow us to correct the linear approaches and linear approximations in our work. However, we cannot control for selection in the non-linear specifications. This is because we cannot calculate the stratification weights in the original population which are needed for the approaches for Boyes et al (1989) and Greene (1992). This is because the variables in the SISBEN sample are not the same as in Familias, and very rudimentary.

We estimate the equation for z in the basic Heckman model explained above, taking 'migration out of the SISBEN register' as dependent variable. Given the limitations of the SISBEN register's data, we are somewhat restricted in the choice of possible out-migration determinants. Including household level variables would reduce the sample too much, so that we have to rely on pre-2000 municipality level characteristics alone. We include the number of guerrilla fighters, landmine incidents, kidnappings and the homicide rate as right hand side variables. We also include the sum of all bank assets per head as an attempt to proxy for wealth at the municipality level. We include a squared term of each variable in order to be less restrictive in the functional form. The results are given below.

Dependent Variable		**Coefficient**			**z-statistic**
Migration out of the SISBEN sample					
municipality level variables					
no of guerrilleros	-	0.00002	*	-	1.49
no of guerrilleros²		2.24E-11			0.30
landmine incidents	-	0.562		-	0.45
landmine incidents²		0.831			0.95
kidnappings		0.107			1.05
kidnappings²	-	0.009	*	-	1.53
homicide rate		0.055	*		1.48
homicide rate²	-	0.001		-	1.28
capitalisation/head		-2.58E-06		-	1.34
capitalisation/head²		4.31E-12	*		1.73
constant	-	0.581	***	-	3.29
F-test violence var (p value)		0.01			
Pseudo R²		0.17			
Log pseudo likelihood	-	6,208.72			
Number of obs		11,380			

Results Table 1: Estimation of the determinants of drop-out out of the SISBEN sample[13]

Note: The regression presents the Probit coefficients of available past violence, and welfare indicators on the probability to leave the SISBEN sample. Stars mark significance at the 10% (*), 5% (**) and 1% or lower (***) levels. Regressions are with robust standard errors, adjusted for clustering on municipality. The F-test examines joint significance of the violence variables.

A higher number of guerrilleros appears to reduce emigration, while kidnappings and homicides encourage it until a certain level. People from very poor, as well as from very wealthy municipalities, as measured by the bank assets per head, seem to emigrate more. When interpreting the results, we need to remember that various motives can prompt emigration. Displacement through violence is only one of them; improvements in wealth, 'upgrading' from one neighborhood to the next is also common. To the extent that our limited data reflects both motivations, we observe out-migration rising with kidnappings and the homicide rate (the turning points of the parables are at the very upper end of our sample) on the one hand, and declining with a higher number of guerrilleros and

13 The drop in observations is due to an imperfect merge with the *Familias* dataset. We merge with the National ID number of the household head, which is not reported for all households.

intermediate wealth levels on the other hand. From this regression, we calculate the IMRs. Note these are only identified at the municipality level as all our right hand side variables are measured at the municipality level. We will include the IMR in all linear empirical specifications.

ESTIMATION STRATEGY

An estimation strategy for our framework needs to register both savings and migration adequately, while allowing for a joint perspective and potential non-linear effects of violence. Regarding savings, we need to account for a number of households who do not save at all. Also, the savings rate will by definition be upper-censored at 1. We therefore estimate different empirical specifications of OLS and Tobit.[14] Our empirical specification further needs to integrate our predictions for migration. We can measure whether anyone from a household emigrated at all, and also the total share of family members that migrated, reaching 1 if the entire household left. The former measurement can be picked up in the dependent variable of a Probit, and the latter in a Tobit. Given this, there are two logical approaches to examine migration and savings together. First, a bi-variate Probit, where the dependent variables measure whether or not the household saves at all, and whether or not somebody from the household emigrated. This approach also allows us to test whether the error terms of both Probits are significantly correlated, indicating joint decision-making. Second, taking advantage of the fact that we can measure the degree of migration of a household, as well as the savings rate, we can run a simultaneous regression model with a Tobit for migration and a Tobit for the savings rate.

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14 For a similar approach see for example Bauer and Sinning (2005).

All empirical tests need to ensure the ex-post randomness of violence, the exogeneity of violence and the randomness of the sample. We can think of the incidence of violence in our framework as a treatment effects model in the sense of Rosenbaum and Rubin (1983), where the households are 'treated' with violence in different degrees, or not. To put it formally, the household's response *R* depends on their dose of violence *V*, control variables C (at both household and municipality levels) and a random error term,[15] $R = \beta_0 + \beta_1 V + \beta_2 C + \varepsilon$. Clearly, in our context violence is not assigned randomly ex ante. Some municipalities are at higher risk of violence than others, because of certain characteristics such as geographical accessibility. We have discussed this at length in our data section. However, in line with Rosenbaum and Rubin (1983) we make the assumption that violence assignment is strongly ignorable if we control for the covariates that determine its assignment. Formally, $E(\varepsilon \mid C, V) = E(\varepsilon \mid C)$ where *C* is a matrix of control variables that are relevant for incidence of violence.[16] The above assumption states that the expected value of error terms is the same under treatment and non-treatment with violence, given the relevant controls. In other words, if we control for the groups with different risks of victimization, violence is a natural experiment within group. For our empirical approach, we assume that the controls we have identified exhaustively control for the assignment of violence and deliver the needed randomization within group.

The above assumption can be extended to the response *R*. For ease of diction let us assume there are only two states of violence, yes/no; and R^1 the response of the household with violence, and R^0 without. Then also $E(R^1 \mid C, V) = E(R^1 \mid C)$ and

15 For ease of diction, here we abstract from indicating individual and community levels.

16 The controls need to be at the level where violence is measured, so in our case, at the municipality level.

$E\left(R^0 \middle| C, V\right) = E\left(R^0 \middle| C\right)$. Treatment assignment V and average response (R^1, R^0) are conditionally mean independent, given C. The role of the relevant covariates C is to 'match' those treated and not treated with violence, in order to identify the effect of violence on the household response.[17] In this context, the matching covariates are not given a causal interpretation for the household behavior; nonetheless their association with the outcomes will be interesting to observe. It is important that none of the control variables are caused directly by violence, because this would take away from the 'pure effect' in the coefficient on the violence variables. When specifying our approach below, we discuss for each selected variable why it fulfils this criterion. However, including variables that are potentially endogenous to the response (but not violence) will not bias the coefficients on the violence variables, as long as the assumption of conditional independence holds.

Regarding exogeneity of violence, we do not find any support in the Colombian literature that households of SISBEN 1 (poorest sixtile) may be attractive to criminals because of their savings. There is a link from household wealth to property crime, as shown by Gaviria and Pages (1999) and Gaviria and Vélez (2001) for urban households, but it is unlikely to hold for the poor rural households of our sample. As we assume that migration is relevant for savings we also have to take into account that displacement and migration may already have influenced the mix of households we observe in the Familias survey, and thereby their savings preferences. We apply Heckman's method for selection correction in the OLS approach. Unfortunately our data does not allow us to apply a weighted likelihood after Boyes, Hoffman and Low (1989) to correct the non-linear

17 Other papers using the matching assumption for identification are for example Heckman, Ichimura and Todd (1997) and Blundell, Costa Dias, Meghir and Van Reenen (2004).

approaches, but we will see that the results from the OLS suggest that sample selection is not relevant for this analysis. Below we explain all estimation strategies.

OLS and Tobit of the Savings Rate

Our dataset allows us to measure the savings rate as discussed in the previous section. We can linearly regress this measure on the two kinds of violence, controlling for heterogeneity at the household and municipality levels. Formally, the estimated model reads: $S_{in} = X_{in}\beta + C_n\gamma + V_n\delta + v_n + u_{in}$ As the savings rate is by definition truncated at 1, and many households do not save at all, OLS estimations might result in inconsistent estimates of β, γ and δ. To take the censored nature of the dependent variable into account, we also estimate the above equation using a Tobit model, which can be written in the form of an index function model (Tobin 1985): $S^*_{in} = X_{in}\beta + C_n\gamma + V_n\delta + v_n + u_{in}$

with $S_{in} = S^*_{in}$ if $S^l_{in} \leq S^*_{in} \leq S^u_{in}; S_{in} = S^l_{in}$ if $S^*_{in} < S^l_{in}$; $S_{in} = S^u_{in}$ if $S^*_{in} > S^u_{in}$.

S_{in} is household current monthly income minus consumption, as a share of the income. X_{in} refers to education, gender, age and marital status of the household head. Discussions in Moser (1999), Moser and McIlwaine (2001), Gaviria and Vélez (2001) and Gaviria and Pages (1999) suggest these characteristics can be relevant for victimization. At the same time they can safely be assumed exogenous to current period violence.

C_n is a matrix with municipality level indicators, including geographic variables[18] such as the region, the degree of sparseness of settlement, and the altitude. It also includes proxies for poverty and inequality: the Index for Quality of Life and the percentage of people in the lowest two income strata, and, as a proxy of law and order, the capture rate

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18 See Vargas, Restrepo and Spagat (2004).

under the Drug Act.[19] V_n is a matrix of violence variables including guerrilla or paramilitary presence (dummy), guerrilla attacks and homicides per 100,000 inhabitants. As suggested by our model, we also include a quadratic term of both the guerrilla attack rate and the homicide rate. We test against linearity with a Wald-test.

v is a random village-level factor; and u is an individual level error term, with $E[u_{in}|X]=0$, $Var[u_{in}|X]=\sigma_u{}^2$ $E[v_n|X]=0$ $Var[v_n|X]=\sigma_v{}^2$ and

$Cov[\upsilon_{in},\upsilon_{jn}]=\sigma_v^2$ $\upsilon_{in}=v_n+u_{in}$.

We allow for this latter correlation of household error terms by clustering. Note that the capture rate is measured at the departmental level. We can assume that individual errors, although correlated at the municipal level, are not correlated at the departmental level beyond municipalities. Under this assumption the standard errors clustered at the municipal level only are still valid. We test the sensitivity of our results with different approaches, including: (i) two definitions of income, income (1): salary + asset income, and income (2): salary only; and (ii) two samples: one including every household that reports some kind of income, i.e. households with asset income only, salary only, or both; and one sample including only households that report a salary, i.e. households with a salary only or a salary + asset income. This allows a better comparison of different income measures.

Results-Table 2 shows the results. OLS allows us to test for sample selection issues and we note that the IMR is insignificant.

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19 See Martínez and Medina (2003) and Martínez, Medina and Steiner (2001).

Dependent variable is Savings Rate												
Model	Tobit						OLS					
Income definition	(1)		(1)		(2)		(1)		(1)		(2)	
	Coeff	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**
Violence												
public order problem	-0.530	-0.96	0.150	0.65	0.467	1.41	-0.556	-1.01	0.151	0.66	0.464	1.39
guerrilla attack rate	-0.419 **	-2.18	-0.122 ***	-3.19	-0.270 ***	-3.32	-0.424 **	-2.25	-0.123 ***	-3.17	-0.270 ***	-3.29
(guerrilla attack rate)²	0.017 *	1.78	0.007 ***	3.50	0.016 ***	3.75	0.018 *	1.85	0.007 ***	3.50	0.016 ***	3.74
homicide rate	0.031 ***	2.63	0.001	0.37	-0.004	-0.80	0.031 ***	2.65	0.001	0.36	-0.004	-0.83
(homicide rate)²	-1.17E-04 **	-2.18	9.98E-07	0.08	7.29E-06	0.27	-1.19E-04 **	-2.20	1.30E-06	0.10	7.94E-06	0.29
Municipality controls												
grouped settlement	-0.180	-0.35	-0.287 ***	-4.20	-0.406 **	-2.13	-0.135	-0.26	-0.291 ***	-4.22	-0.408 **	-2.13
rural sparse settlement	0.496	0.86	-0.059	-0.52	-0.062	-0.24	0.474	0.84	-0.059	-0.52	-0.067	-0.26
Oriental Region	-0.860	-1.09	0.177	1.00	0.745 **	2.49	-0.778	-1.00	0.181	1.02	0.757 ***	2.51
Central Region	-0.786	-0.53	0.467	1.42	0.737 *	1.64	-0.843	-0.57	0.464	1.40	0.737 *	1.64
Pacific Region	-0.386	-0.37	0.051	0.19	-0.800 *	-1.80	-0.478	-0.45	0.046	0.17	-0.809 *	-1.81
altitude	-0.001	-0.66	-0.0004	-0.86	-0.0007	-0.90	-0.001	-0.61	-0.0004	-0.85	-0.001	-0.88
altitude²	4.29E-07	0.89	9.00E-08	0.45	6.98E-08	0.21	3.95E-07	0.81	9.06E-08	0.45	6.88E-08	0.21
percentage of people lowest 2 strata	3.497 ***	2.90	0.185	0.65	0.209	0.38	3.403 ***	2.82	0.185	0.64	0.197	0.36
index of quality of life	-0.232 *	-1.76	0.030	0.83	0.109 *	1.64	-0.236 *	-1.79	0.029	0.81	0.108 *	1.62
capture rate	-0.001	-1.00	-1.80E-05	-0.11	2.55E-04	0.75	-0.001	-0.95	-1.79E-05	-0.11	2.58E-04	0.75
Household/ head variables												
age	0.187	1.28	0.007	0.55	-0.006	-0.23	0.179	1.21	0.007	0.53	-0.006	-0.21
age2	-0.002	-1.34	3.19E-05	0.22	-0.0004	-1.25	-0.002	-1.27	3.32E-05	0.23	-4.29E-04	-1.26
married	0.571 **	2.28	-0.050	-0.69	-0.478 ***	-3.26	0.600 **	2.41	-0.051	-0.70	-0.482 ***	-3.29
female	-4.556 ***	-6.03	-0.831 ***	-7.45	-2.450 ***	-9.19	-4.403 ***	-5.77	-0.831 ***	-7.32	-2.455 ***	-9.10
some or complete primary education	1.046 **	2.07	-0.072	-1.09	-0.014	-0.08	0.991 *	1.91	-0.075	-1.11	-0.015	-0.09
some secondary or more education	0.562	0.85	-0.049	-0.60	0.271 *	1.48	0.491	0.73	-0.052	-0.64	0.268 *	1.46
Inverted Mills Ratio							3.536	1.27	0.058	0.05	0.403	0.22
constant	-1.918	-0.34	-1.544 *	-1.49	-3.727 **	-1.98	-7.012	-1.02	-1.599	-0.66	-4.308	-1.10
<u>*Wald tests*</u>												
Inverted Mills Ratio							0.21		0.96		0.83	
guerrilla attack rate (p-value)	0.03		0		0		0.03		0.02		0.002	
guerrilla attack rate² (p-value)	0.08		0		0		0.07		0.01		0.0003	
homicide rate (p-value)	0.01		0.71		0.42		0.01		0.72		0.41	
homicide rate² (p-value)	0.03		0.94		0.79		0.03		0.92		0.77	
violence variables (p value)	0.02		0.03		0		0.03		0.03		0.01	
welfare indicators (p value)	0.002		0.64		0.25		0.003		0.65		0.26	
access of the state (p value)	0.28		0		0		0.42		0.0002		0.03	
Adj R²							0.03		0.02		0.06	
Log likelihood	-30,366.60		-14430.36		-18253.63							
Number of obs	7500		6,173		6173		7386		6,140		6,136	
Sample	all		waged only		waged only		all		waged only		waged only	

Results-Table 2: Coefficient estimates from clustered Tobit and OLS regressions of the savings rate of Colombian households

Note: Dependent variable is the savings rate calculated as (income – consumption) as a % of income, regression models are Tobit and OLS as indicated. Income definition (1) is salary + estimated asset income, income definition (2) is salary only. Columns 1 and 2 come from a dull sample, columns 3-5 come from a sample with waged people only. Standard errors are robust, adjusted for clustering on municipality. Default household education level is 'none'. Default region is Atlantic, default rurality degree is 'urban'. Stars mark significance at the 10% (*), 5% (**) and 1% (***) levels.

The Wald-tests (chi² for Tobit, F for OLS) examine first whether simple or squared terms of the two main violence variables can be excluded, and then the joint significance of groups of variables in both specifications, in this order of the violence variables: public order problem, attack rate, homicide rate; of the welfare indicators: the index of quality of life and the share of population in the lowest two income sixtiles; of the variables indicating access of the state: rurality, region, altitude and capture rate, respectively.

We see that the results are consistent with our framework. Guerrilla attacks enter significantly, in the simple and the quadratic term, both of which should not be excluded (Wald-Test p between 0 and 0.07)[20]. This result is robust to different income definitions,

20 Note that Brück (1997) finds that the impact of violence on savings depends on the duration of the conflict. A shock perceived as temporary will cause dissaving, whereas a longer term impact may leave the savings rate unaltered.

samples and models[21], and is consistent with our theoretical model in the presence of migration. Guerrilla violence makes it 'cheaper' to migrate as it destroys assets, but assets pay off if carried to a safe place, so it makes sense to compensate for destroyed assets if a decision to migrate has been taken. The turning point of the U depends on whether we consider a sample of people who report a salary, or a sample that includes people with only asset income as well. With the sample of the waged only, the tip of the U ranges between 8 and 9 attacks, and with the bigger sample, it is at about 11 attacks per year per 100,000 inhabitants, which means about 200 people in any sample experience a rising relationship. This means that in any case for the majority of households, the relationship between violence and savings is indeed negative.[22]

The behavior of the homicide rate is independent of model and specification, but dependent on the sample. In a sample with waged people only (but irrespective of whether only their salary or also their asset income is regarded), the homicide rate is insignificant. A full sample, however, including people who report only asset income, sees an inverted U shape of the homicide rate, peaking at about the 8th decile of our sample. However, in every specification, the effect of common delinquency is more than outweighed by the effect of guerrilla violence; the coefficients on the guerrilla attack rate are about ten times or more the size of the coefficients on the homicide rate. An additional guerrilla attack (be it kidnapping or a thrown gas canister) per 100,000 inhabitants has more than ten times the effect of an additional murder (in 80% of the cases committed by common delinquents[23]). In summary, the key result of our theoretical model is supported. - Note that this regression did not account for migration

21 The results are actually also robust to considering only positive savings as savings, i.e. setting all negative 'savings' to zero, and to specifications excluding the capture rate or including further household controls, as well as excluding municipalities with the top 5% of guerrilla or delinquent violence as outliers.

22 This suggests that, with the same controls, the impact of violence on consumption should be in a hump-shape and positive for most households. This is indeed the case; we do not report results for reasons of space.

23 Ministerio de Defensa (2001)

decisions. A bi-variate Probit allows us to measure migration and saving decisions at the same time.

Bi-variate Probit

We are interested in the households' joint decision on migration and assets; more specifically, the joint decision about whether or not to save and whether or not to emigrate in a violent context. The decision to save at all may well be different from the decision how much to save, which is the principal focus of our theoretical model. We regress the decision of household members to migrate (at least one household member left=1) and the decision of whether or not to save (positive savings=1), on the same r.h.s. variables as the OLS and Tobit above. The estimated model reads:

$$P(M_{in} > 0) = \Phi\left(X_{in}\beta + C_n\gamma + V_n\delta + v_n + u_{in}\right)$$
$$P(S_{in} > 0 = \Phi\left(X_{in}\phi + C_n\varphi + V_n\eta + \omega_n + \varepsilon_{in}\right)$$

where S_{in} and M_{in} are =1 if the household saves and is affected by migration, respectively and 0 otherwise, and the other variables as before. In line with our conceptual framework, we will measure the effect of the two kinds of violence with a second order polynomial, testing against linearity with a Wald-test. We will include the same controls as before at the municipality and household levels, to ensure independence of the violence variables. v respectively ω is a random village level factor; and u and ε are at the individual level correlated error terms.

$E\left[\varepsilon_{in}, u_{in} | X\right] = 0$, $Var\left[u_{in} | X\right] = \sigma_u^2$, $Var\left[\varepsilon_{in} | X\right] = \sigma_\varepsilon^2$ and $E\left[v_n, \omega_n | X\right] = 0$, $Var\left[v_n | X\right] = \sigma_v^2$, $Var\left[\omega_n | X\right] = \sigma_\omega^2$.

As well as $Cov[\vartheta_{in}, \vartheta_{jn}] = \sigma_{\omega}^2$ where $\vartheta_{in} = \omega_n + \varepsilon_{in}$ and $Cov[\upsilon_{in}, \upsilon_{jn}] = \sigma_{v}^2$ where $\upsilon_{in} = v_n + u_{in}$. We allow for this latter correlation of household error terms by clustering. Using a bi-variate Probit we assume also $Cov[\varepsilon, u] = \rho\sigma_{\varepsilon}\sigma_{u}$ as explained above. Note, that in this non-linear approach we cannot control for sample selection.

As before, we test two income definitions. However, now we always use the full sample of all income-reporting households for our more comprehensive income definition (1). [24] Results-Table 3 presents the regression results.

[24] We do not present the results for income definition (1) with a sample with waged only; they are qualitatively the same as with the full sample.)

Dependent Variable	Household has positive savings				At least one household member migrated			
Income definition	(1)		(2)		(1)		(2)	
	Coeff	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**	**Coeff**	**z-stat**
Violence								
public order problem	-0.005	-0.05	0.377 ***	3.45	0.086	1.08	0.068	0.83
guerrilla attack rate	-0.007	-0.26	-0.042 *	-1.57	-0.015	-0.41	-0.014	-0.37
(guerrilla attack rate)²	1.64E-04	0.12	0.005 ***	3.68	0.002	0.91	0.002	0.92
homicide rate	-0.001	-0.33	-4.67E-05	-0.02	0.004 **	2.26	0.004 *	1.89
(homicide rate)²	7.52E-06	0.80	-6.86E-06	-0.62	-2.55E-05 ***	-2.93	-2.28E-05 **	-2.45
Municipality controls								
grouped settlement	-0.097 **	-1.99	-0.090	-1.34	0.023	0.48	0.075 *	1.50
rural sparse settlement	-0.136 *	-1.45	0.203 **	2.47	-0.008	-0.15	0.015	0.26
Oriental Region	0.131	0.88	0.014	0.11	-0.168 **	-1.93	-0.170 *	-1.84
Central Region	0.225	0.97	-0.318 *	-1.76	-0.106	-1.27	-0.056	-0.64
Pacific Region	0.125	0.67	-0.388 **	-2.37	-0.198 **	-2.09	-0.255 ***	-2.71
altitude	2.21E-06	0.01	5.96E-04 **	2.48	5.57E-05	0.36	7.34E-05	0.46
altitude²	-2.73E-08	-0.29	-2.74E-07 ***	-2.69	-5.13E-09	-0.08	-7.01E-09	-0.11
percentage of people lowest two strata	0.008	0.04	-0.554 **	-2.04	0.287 **	1.95	0.212	1.31
index of quality of life	-0.012	-0.55	0.002	0.06	-0.010	-0.71	-0.017	-1.16
capture rate	-5.04E-06	-0.04	-9.00E-05	-0.76	-1.29E-04 *	-1.50	-1.00E-04	-1.08
Household/ head variables								
age	0.023 ***	3.23	-0.046 ***	-3.26	0.039 ***	3.28	0.028 **	1.99
age2	-0.0001	-1.08	0.0004 **	2.36	-0.0003 ***	-2.57	-0.0001	-0.9
married	0.132 ***	3.32	-0.174 ***	-2.74	0.090 **	2.06	0.012	0.26
female	-0.139 ***	-3.76	-0.461 ***	-5.72	0.257 ***	5.25	0.346 ***	5.69
some or complete primary education	-0.026	-0.62	-0.252 ***	-4.02	-0.085 *	-1.60	-0.057	-0.94
some secondary or more education	-0.091 *	-1.58	-0.176 **	-1.90	-0.162 **	-1.93	-0.132	-1.39
constant	-0.479	-0.77	0.339	0.42	-2.294 ***	-5.17	-1.957 ***	-4.21
ρ	0.039	1.60	0.045	1.12				
Wald tests								
ρ	0.1		0.26					
guerrilla attack rate (p-value)	0.77		0.11		0.64		0.64	
guerrilla attack rate² (p-value)	0.85		0		0.34		0.34	
homicide rate (p-value)	0.71		0.98		0.02		0.02	
homicide rate² (p-value)	0.41		0.54		0.003		0.003	
violence variables (p value)	0.69		0		0.03		0.03	
welfare indicators (p value)	0.82		0.08		0.05		0.05	
access of the state (p value)	0.33		0		0.16		0.16	
Adj R²								
Log likelihood	-7,461.44		-3,922.31		-7,461.44		-3922.31	
Number of obs	7399		6,149		7399		6,149	
Sample	full		waged only		full		waged only	

Results-Table 3: Coefficient estimates from bi-variate Probit model of migration and savings of Colombian households

Note: *Dependent variables are whether or not a household had a member emigrating, and whether or not it has positive savings. Regressions are Probit, allowing for individual error correlation across the two decisions. Standard errors are robust, adjusted for clustering on municipality. Income definition (1) is salary + estimated asset income, income definition (2) is salary only. Columns 1 and 3 come from a full sample, columns 2 and 4 from a sample with waged people only. Default household education level is 'none'. Default region is Atlantic, default rurality degree is 'urban'. Stars mark significance at the 10% (*), 5% (**) and 1% (***) levels.*

The Wald tests (chi²) examine first whether simple or squared terms of the two main violence variables can be excluded, and then the joint significance of groups of variables in both specifications, in this order of the violence variables: public order problem, attack rate, homicide rate; of the welfare indicators: the index of quality of life and the share of population in the lowest two income sixtiles; of the variables indicating access of the state: rurality, region, altitude and capture rate, respectively.

	Pr(m=1, p=1)	0.06	Pr(m=1, p=0)	0.05	Pr(m=0, p=1)	0.47
	dy/dx	**X**	**dy/dx**	**X**	**dy/dx**	**X**
Violence						
public order problem	0.008	0.66	0.007	0.66	-0.010	0.66
guerrilla attack rate	-0.002	1.22	-0.001	1.22	-0.001	1.22
(guerrilla attack rate)²	0.0002	10.61	0.0002	10.61	-0.0001	10.61
homicide rate	0.0004	49.28	0.0004	49.28	-0.0006	49.28
(homicide rate)²	-2.25E-06	5,433.77	-2.47E-06	5,433.77	5.24E-06	5,433.77
Municipality controls						
grouped settlement	-0.002	0.40	0.006	0.40	-0.037	0.40
rural sparse settlement	-0.007	0.09	0.005	0.09	-0.048	0.09
Oriental Region	-0.011	0.26	-0.018	0.26	0.063	0.26
Central Region	-0.002	0.16	-0.017	0.16	0.091	0.16
Pacific Region	-0.014	0.09	-0.019	0.09	0.064	0.09
altitude	5.71E-06	579.22	4.60E-06	579.22	-4.83E-06	579.22
altitude²	-1.68E-09	862,343.00	7.32E-10	862,343.00	-9.20E-09	862,343.00
percentage of people lowest two strata	0.029	0.66	0.024	0.66	-0.026	0.66
index of quality of life	-0.001	26.02	-0.0003	26.02	-0.0033	26.02
capture rate	-1.33E-05	482.72	-1.07E-05	482.72	1.12E-05	482.72
Household/ head variables						
age	0.005	44.78	0.002	44.78	0.004	44.78
age2	-3.46E-05	2,167.12	-2.30E-05	2,167.12	4.39E-06	2,167.12
married	0.015	0.33	0.002	0.33	0.037	0.33
female	0.021	0.19	0.032	0.19	-0.076	0.19
some or complete primary education	-0.010	0.57	-0.006	0.57	-0.001	0.57
some secondary or more education	-0.018	0.14	-0.010	0.14	-0.018	0.14

Results-Table 4: Marginal effects after bi-variate Probit on migration and saving, income definition (1)

When considering the mere participation in savings, the guerrilla attack rate maintains the shape, but varies in significance with the income definition, being insignificant for income definition (1), but highly significant for income definition (2). A public order problem appears to increase participation in savings for the narrower income definition.

Concerning migration, the homicide rate shows a bell-shaped influence, consistent with the physical impact of violence encouraging migration, and with the findings of Schultz (1971). The capture rate shows a negative effect. Both results are in line with Ibañez and Vélez (2004) who find that homicides spur migration, while police activity prevents it. However, we miss the displacing effect predicted for guerrilla violence and also found by Ibañez and Vélez (2004). For migration, the capture rate shows a negative sign, as do the Oriental and Pacific regions. Inequality, as far as measured by the share in the two lowest strata, appears to spur migration.

Correlation of error terms: the ρ's

The ρ's reported at the bottom of Results-Table 3 indicate the correlation between the individual error terms of both Probits. We see that the errors are marginally significantly correlated, and the significance breaks down for the narrower income definition. A positive correlation between both decisions can be related to unobservables which affect both decisions, such as proactiveness, or a general forward-looking attitude. It can also allude to a certain complementarity of the decisions, especially in the case where our model predicts higher savings under guerrilla violence. If saving needs to ensure a minimum-bundle to carry on to a safe place, migration and savings are complementary at a certain degree of violence. - An investigation of the relationship between the *degree* of migration as well as the savings *rate* rather than *either-or* decisions should be able to shed light on the issue.

Savings Rate and Share of Household Migrating

We use a seemingly unrelated regression model to estimate the joint decision-making on the savings rate and the share of the household to emigrate. A seemingly unrelated regression (SUR) system is a set of regressions which seem to be unrelated, but which have contemporaneous cross-equation error correlation. The SUR estimator therefore allows the error matrix U to be normally distributed $U \sim N(0,\Sigma)$ where Σ is a $(m+1)\times(m+1)$ singular covariance matrix[25]. The equations we estimate are two Tobits

$$S^*_{in} = X_{in}\beta + C_n\gamma + V_n\delta + v_n + u_{in}$$
$$M^*_{in} = X_{in}\varphi + C_n\phi + V_n\eta + \omega_n + \varepsilon_{in}$$

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25 We use the stata estimator *suest* which combines the estimation results (parameter-estimates and associated (co)variance matrices) stored from previous separate regressions into a single parameter-vector and simultaneous (co)variance matrix of the sandwich/robust type. This (co)variance matrix is appropriate even if the estimates where obtained on the same or overlapping data.

where $S_{in} = S^*_{in}$ if $S^l_{in} \le S^*_{in} \le S^u_{in}$; $S_{in} = S^l_{in}$ if $S^*_{in} < S^l_{in}$; $S_{in} = S^u_{in}$ if $S^*_{in} > S^u_{in}$.

$M_{in} = M^*_{in}$ if $M^l_{in} \le M^*_{in} \le M^u_{in}$; $M_{in} = M^l_{in}$ if $M^*_{in} < M^l_{in}$; $M_{in} = M^u_{in}$ if $M^*_{in} > M^u_{in}$.

S_{in} is the savings rate and M_{in} the share of the household to emigrate, and the other variables as in the previous regressions. As before, the effect of the two kinds of violence is tested with a second order polynomial. Also,

$$E[\varepsilon_{in}, u_{in} | X] = 0; Var[\varepsilon_{in} | X] = \sigma_\varepsilon{}^2; Var[u_{in} | X] = \sigma_u{}^2;$$
$$E[v_n, \omega_n | X] = 0; Var[v_n | X] = \sigma_v{}^2, Var[\omega_n | X] = \sigma_\omega{}^2$$

And $Cov[\vartheta_{in}, \vartheta_{jn}] = \sigma^2_\omega$ where $\vartheta_{in} = \omega_n + \varepsilon_{in}$; as well as $Cov[\upsilon_{in}, \upsilon_{jn}] = \sigma^2_v$ where $\upsilon_{in} = v_n + u_{in}$. We allow for this latter correlation of household error terms at the village level with clustering. With SUR, also $Cov[\varepsilon, u] \neq 0$ as explained above. Results-Table 5 shows the results.

Dependent Variable	Savings rate				Share of emigrated household members			
Income definition	(1)		(2)		(1)		(2)	
	Coeff	z-stat	Coeff	z-stat	Coeff	z-stat	Coeff	z-stat
Violence								
public order problem	-0.530	-0.96	0.467	1.41	0.026	0.91	0.016	0.55
guerrilla attack rate	-0.419 **	-2.18	-0.270 ***	-3.32	-0.005	-0.39	-0.005	-0.42
(guerrilla attack rate)²	0.017 *	1.78	0.016 ***	3.75	0.001	0.9	0.001	1.02
homicide rate	0.031 ***	2.63	-0.004	-0.80	0.002 **	2.45	0.001 **	2.06
(homicide rate)²	-1.17E-04 **	-2.18	7.29E-06	0.27	-9.81E-06 ***	-3.26	-8.76E-06 ***	-2.62
Municipality controls								
grouped settlement	-0.180	-0.35	-0.406 **	-2.13	0.002	0.14	0.021	1.12
rural sparse settlement	0.496	0.86	-0.062	-0.24	-0.008	-0.42	0.0001	-
Oriental Region	-0.860	-1.09	0.745 **	2.49	-0.055 *	-1.75	-0.056 *	-1.70
Central Region	-0.786	-0.53	0.737 *	1.64	-0.039	-1.24	-0.023	-0.73
Pacific Region	-0.386	-0.37	-0.800 *	-1.80	-0.075 **	-2.19	-0.099 ***	-2.81
altitude	-0.001	-0.66	-0.001	-0.90	0.00003	0.46	0.00004	0.73
altitude²	4.29E-07	0.89	6.98E-08	0.21	1.99E-10	0.01	-5.97E-09	-0.26
percentage of people lowest two strata	3.497 ***	2.90	0.209	0.38	0.115 **	2.01	0.082	1.29
index of quality of life	-0.2322 *	-1.76	0.109 *	1.64	-0.004	-0.88	-0.007	-1.35
capture rate	-0.0007	-1.00	0.0003	0.75	-4.44E-05 *	-1.45	-3.75E-05	-1.14
Household/ head variables								
age	0.187	1.28	-0.006	-0.23	0.015 ***	3.54	0.010 **	2.11
age2	-0.002	-1.34	-0.0004	-1.25	-0.0001 ***	-2.77	-0.00005	-0.94
married	0.571 **	2.28	-0.478 ***	-3.26	0.034 **	2.21	0.005	0.33
female	-4.556 ***	-6.03	-2.450 ***	-9.19	0.107 ***	6.14	0.135 ***	5.97
total consumption								
total consumption²								
some or complete primary education	1.046 **	2.07	-0.014	-0.08	-0.031 *	-1.66	-0.025	-1.12
some secondary or more education	0.562	0.85	0.271 *	1.48	-0.051 *	-1.72	-0.051 *	-1.54
employed								
self-employed or employer								
constant	-1.918	-0.34	-3.727 *	-1.98	-0.834 ***	-5.24	-0.692 ***	-4.28
Wald tests								
guerrilla attack rate (p-value)	0.03		0		0.7		0.68	
guerrilla attack rate² (p-value)	0.08		0		0.37		0.31	
homicide rate (p-value)	0.01		0.42		0.01		0.04	
homicide rate² (p-value)	0.03		0.79		0.001		0.01	
violence variables (p value)	0.02		0.0002		0.01		0.09	
welfare indicators (p value)	0.02		0.25		0.03		0.07	
access of the state (p value)	0.28		0.001		0.09		0.04	
Log likelihood	-30,366.60		-18,253.63		-1,954.42		-1,538.53	
Number of obs	7500		6173		7500		6173	
Sample	full		waged only		full		waged only	

Results-Table 5: Coefficient estimates from a seemingly unrelated regression of migration and savings, specification excluding employment status and total consumption

Note: *Dependent variables are the % of emigrated household members, and the savings rate calculated as (income – consumption) as a % of income. Both regressions are Tobit, allowing for individual error correlation across the two decisions in a SUR. Standard errors are robust, adjusted for clustering on municipality. Income definition (1) is salary + estimated asset income, income definition (2) is salary only. Columns 1 and 3 come from a full sample, columns 2 and 4 from a sample with waged people only. Default household education level is 'none'. Default region is Atlantic; default rurality degree is 'urban'. Stars mark significance at the 10% (*), 5% (**) and 1% (***) levels.*

The Wald tests (chi²) examine first whether simple or squared terms of the two main violence variables can be excluded, and then the joint significance of groups of variables in both specifications, in this order of the violence variables: public order problem, attack rate, homicide rate; of the welfare indicators: the index of quality of life and the share of population in the lowest two income sixtiles; of the variables indicating access of the state: rurality, region, altitude and capture rate, respectively.

We recognize most results. Savings react to guerrilla violence in a significant U-shape, while the homicide rate counteracts the decision to a small degree, reflecting the investment shift towards higher paying fixed assets under common delinquency. The result is robust to income definition, and to defining very high violence municipalities as outliers, but the role of the homicide rate is only fully seen with a sample admitting asset-income-only households. [26]

Migration reacts in an inverted U to the homicide rate and negatively to police arrests. The bell-shape in the homicide rate is consistent with an extreme rate of physical violence deterring migration, possibly because this kind of violence hampers the very process of migrating and leads to people 'locking themselves in'. The municipality and household controls relate to migration as before, and our interpretation still applies.

CONCLUSION AND POLICY IMPLICATIONS

This paper presented a model on simultaneous household decisions on migration and savings in a violent context. The model predicted that migration would rise with any violence, and more starkly with guerrilla violence. It also foresaw that, if no migration decision had been taken, and the household stayed in a violent place, further violence would always trigger a reduction in savings. If however a migration decision had been taken, violence would usually diminish savings, but could in some circumstances increase them because households compensated for some lost assets to carry to their new dwelling place. Common delinquency and guerrilla warfare are expected to influence the decisions in the same direction, but guerrilla violence more strongly so.

Empirically we found the model's predictions confirmed for guerrilla violence and savings. The guerrilla attack rate usually diminishes the savings rate, but spurs it at very high levels of attacks (covering about 200 people in our sample). This finding is robust to different income definitions, samples and econometric specifications. When we consider

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[26] For reasons of space we only test income definition (1) with the full sample. The results for a sample with waged people only reflect exactly the results presented in the Tobit, see Results-Table 2 ff.

The results can also be shown robust to additional household controls, or to excluding the capture rate.

a full sample (including people with asset income only, rather than one restricted to people who have a wage), we also observe that the homicide rate influences savings in a bell-shape, with the peak at the 8^{th} decile. However, in any case the effect from guerrilla violence outweighs the effect from homicides more than tenfold.

We further find evidence that the decisions on saving and migration are joint: a bi-variate probit of participation in savings and migration in the household returns a positive marginally significant ρ, the correlation of the individual error terms. This may reflect underlying unobservables such as proactiveness, or it may be due to the two decisions being complementary.

Although our findings support the key result from our model for guerrilla violence, and shed light on household factors that influence savings and migration, it needs to be noted that they do not proceed from ideal data. Both income measures that we test are not fully satisfactory but an approximation in the absence of better data. They likely underestimate the true income. An avenue for further research would therefore be the quantification of formal and informal non-wage income for Colombian households, especially from service activities entailing few fixed assets. Further, it would be helpful to obtain more precise and disaggregate data on different violent shocks for the household.

Our findings add to evidence by Stewart and Venieris (1985) who show that socio-political instability uniformly decreases saving, and Bohn and Deacon (2000) who show that guerrilla violence uniformly decreases investment. We challenge their findings to the extent that we provide a rationale and evidence that savings might actually increase under violence. Some of our findings make a modest addition to policy makers' evidence base. Our results on guerrilla violence and common delinquency suggest the construction of differentiated 'cost of crime' measures for the two. The earlier cost of crime studies for

Colombia, such as Rubio (1998) and Londoño and Guerrero (1999) do not make this distinction. The most recent cost estimate by Pinto et al. (2005) concentrates on the armed conflict only. Further, our paper highlights an indirect cost of violence to be reckoned with: households are deviated from their optimal savings and settling behaviors.

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