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Household Investment under Violence—The Colombian Case

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Abstract

Households in rural Colombia are confronted with a variety of violent threats: attacks and displacement threats by guerrillas and paramilitaries, gang violence among drug traffickers, and high common delinquency. In this context, households have to adjust their day-to-day decisions, including saving and portfolio choices, in order to be less vulnerable. The authors test the hypothesis that households, when confronted with exogenous violence, reduce their investment and, moreover, shift it from fixed to mobile assets, which would be safer in the case of displacement, and choose the opposite strategy under higher common delinquency associated with property crimes. Empirical evidence from a rich Colombian micro-data set strongly supports the hypothesis. The results shed new light on the economic impact of violence. The immediate reduction in capital stock might be much less severe than more permanent damage via the savings function. This has implications for the appropriate political answer to chronic violence in Colombia as well as in other areas of chronic conflict.

This paper—a product of the Human Development Group, Middle East and North Africa Region—is part of a larger effort in the department 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.

Household Investment under Violence – The Colombian Case

Rebekka E. Grun[1]

INTRODUCTION

Many households in the developing world live in a chronically violent context. They have to adjust their decisions, from consumption and savings to family planning, to the daily risks of violence. A household confronted with chronic violent threats is economically more exposed than a household in a non-violent context. And different household assets are exposed differently. In the case of flight, heavy animals and furniture would have to be left behind, while easily mobile assets such as bicycles, jewellery and transportable household goods could be carried to a secure place. On the other hand, they could be stolen more easily as well. In other words, the household's assets and their returns are threatened, albeit to different degrees, and possibly by different kinds of violence. It is conceivable that a utility-maximizing household would re-optimize its investment compared to a peaceful situation, depending on the threats and their size.

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This paper examines the reaction of a household's portfolio to violence. It explores whether the differing robustness of assets to different kinds of violence plays a role in a household's portfolio decision. We want to examine for example whether the balance between fixed and likely less productive mobile assets shifts towards the latter in the presence of some kinds of violence, and towards the former for others. If yes, this would have implications for the discussion about violence. A change in household saving behavior in the form of a decline in total savings and a shift of the remaining savings towards less productive assets would constitute longer-term damage to the economy; i.e. a greater loss than the immediate measurable decline in the destroyed capital stock, which is often cited in the literature and discussed in the context of the Solow or related macro-models.[2] From a Solow perspective, a sustained downward shift in the savings rate would lower the steady state of the economy, whereas a loss in the capital stock would only be temporary, as savings could 'fill the gap'.

The economic literature has so far paid little attention to the impact of violence, especially in relation to household investment. Stewart and Venieris (1985) are the first to study the reaction of aggregate savings to socio-political instability. The authors use Sandmo's (1969) two-asset model to illustrate the effect of greater instability. Political instability is assumed to increase the perceived risk and to lower the future expected income and the expected value of the return from risky assets. As a consequence, domestic savings (i.e. the savings subject to instability) decline. The authors confirm their hypothesis from 1960s macro data. They do not examine the relative behavior of domestic and foreign assets or the consistency with individual level data. Bohn and Deacon (2001) show with macro-data that violence, via ownership risk, can lower

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2 'Modelling the impact of war in the Solow model' seems to be a preferred undergrad topic, compare for example www.glue.umd.ed/~mjpries or faculty.tcu.edu/jlovett/int_macro/exams. Also consider Brück (1997) who shows the destruction of capital stock as the most obvious cost of war.

investment in natural resources. Indeed, the threat of violence as we discuss it above can also be interpreted as limited enforcement of ownership rights. In this sense, the theoretical content of the literature examining the impact of property rights on investment, from Demsetz (1967) to e.g. Besley (1995a) and McMillan et al. (2002), all of which find a positive link between secure property rights and investment at the micro-level, is applicable to our question and can offer predictions about the possible impact of violence. Finally, Echeverry et al. (2001) provide a comprehensive brainstorming of various ways in which violence may hamper capital accumulation, including skewing portfolios towards less productive assets.

The literature still leaves significant space to breach. 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. Further, very few papers have looked at portfolio composition. Thus this paper is novel in various ways. First, it uses a unique Colombian micro-level dataset to examine the impact of violence on savings. Second, it analyzes the reaction of portfolio composition rather than absolute assets to violence.

The rest of this paper is structured as follows: the next section (2) gives some background on the history and types of violence present in Colombia, section 3 explains the conceptual framework, section 4 discusses the dataset in the context of this framework, section 5 presents the empirical results and section 6 concludes.

VIOLENCE IN COLOMBIA

Colombia has long battled with exceptionally high levels of various kinds of violence. Leftwing guerrilla movements, mainly the ELN (National Liberation Army) and FARC (Red Armed Forces of Colombia) have gathered strength since the mid 1980s and

experienced a veritable power surge in the early 1990s, when they took over part of the cocaine production after the police dismantled two major drug cartels. With this new source of finance, they have been able to attack communities and take over territory in various regions of the country, where they are now engaged in a civil war with the government army. At the same time, various rightwing paramilitary forces, united under the umbrella of AUC (United Auto-Defenses of Colombia) fight the guerrillas and anybody whom they suspect of collaboration. Paramilitaries, and to a slightly lesser extent the guerrillas, use displacement threats to civilians (in order to occupy corridors for drug and arms transport), as well as kidnappings and armed encounters with government forces to further their cause.

Moreover, despite the virtual dismantling of the two major drug cartels, various drug gangs are active throughout the country and engaged in gang wars, the externalities of which often affect civilians; especially as the smaller gangs are fairly widely diffused throughout the country. Also, the legal effort necessary to deal with a large amount of drug trafficking has congested law enforcement institutions and contributed to the dissemination of criminal know-how.[3]

As a result of the above, Colombia reports fairly high levels of common delinquency. The homicide rate is three times higher than in Brazil or Mexico, and ten times higher than in the US; the kidnapping rate is highest in the world.[4] Also, as Sanchez et al (2003) find, an attack by the guerrillas or paramilitaries on a community often precedes a general rise in common delinquency, so generally higher levels of crime are partially a by-product of the armed conflict.

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3 Gaviria and Velez (2001), Gaviria (1998), Gaitan (1995), Fajnzyöber et al. (1999)

4 60% of kidnappings in the World take place in Colombia, see Gaviria and Velez (2001).

This violence can largely be assumed exogenous to the individual household. Most analyses into the origin of violence in Colombia find that the strongest predictors are hysteresis and spatial dependence, weaknesses of the justice system and the development of the drug trade. [5] Armed activities are further facilitated by a difficult geography, such as high altitudes or dense forests, to the extent that this restricts the access of the state.[6]

There seems to be a weak role at best for poverty, inequality and social exclusion, at least in the current situation. Sanchez and Nunez (2001), with data from the 1980s and 1990s, find all three of these factors explain only a small fraction of the homicide rate, Medina and Martinez (2001), using data from the 1990s, find a weak role for poverty but none for inequality, Fajnzylber et al. (1999), using data since the 1970s, find one for inequality but none for poverty. Bourguignon et al. (2003), with data from the 1980s and 1990s, show that only a certain fraction of the income distribution, namely the percentage of people below 80% of mean income, is related to property crime. Rubio (2000a), analyzing a cross-section of Colombian municipalities for different yearly intervals since 1987, shows that traditionally important determinants of guerrilla presence at the community level, such as inequality, wealth and education, lose their explanatory power during the 1990s.

There is however some evidence of victimization patterns. Moser (1999) states that younger, lower income and less educated men are more at risk of being both victims and perpetrators of homicides, while women and their dependent children are most affected by forced displacement.

The analysis in this paper takes account of the different types of violence present in Colombia as far as available data allows. We record the incidence of a so-called public

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5 Levitt and Rubio (2000), Sanchez et al (2003), Sanchez and Nunez (2001).

6 Vargas, Restrepo and Spagat (2004)

order problem (guerrillas or paramilitaries present in a municipality), number of guerrilla attacks, and the homicide rate. Our conceptual framework (next section) follows this situation and classifies the different kinds of violence into two generic kinds: public order problems (guerrilla or paramilitaries and their activity - with an explicit mandate against the current public order), and common delinquency (gang violence without a mandate against the state).

CONCEPTUAL FRAMEWORK

A household suddenly confronted with violence is prompted to reconsider its consumption and savings decisions. Violence can erode saved assets and threaten or lower future returns. Other things equal, this is likely to lower the household's propensity to save.[7] If saving is spread across different assets, more threatened assets should receive less investment than less exposed ones. This exposure may well depend on the kind of asset and the kind of violence. In an attempt to do justice to the Colombian context we distinguish two kinds of violence: first, violence against the public order, typically by guerrillas or paramilitaries, which is directed at the state, and manifests itself through attacks on infrastructure, displacement threats and kidnapping, and second, common delinquency, without a political mandate, carried out by local street gangs, manifest in muggings, looting and homicides to ensure success or to adjust accounts. Consequently fixed assets should be more exposed to public order problems, which threaten with displacement, whereas mobile assets, which can be carried away, are likely more affected by the looting and mugging of common delinquents.

[7] However, violence can also have the opposite effect: it can be perceived as an increase in risk which would increase saving through the precautionary motive.

In order to illustrate the effects of violence on portfolio choice we choose a simple two-asset model. For the sake of simplicity we assume the returns of our two assets are independent in the absence of violence. Our representative individual is risk averse and lives over two periods. She receives a constant exogenous income y in the first period and can split it between consumption and investment into fixed and mobile assets, so that $c = y - f - m$. Fixed investment from period 1 earns a return R with probability p_f or stays with the original worth with a probability $(1-p_f)$. Mobile assets are also risky, earning return P with probability p_m.[8] As indicated before, we assume $R>P$, and $p_m > p_f$ in peace.[9]

Assuming a time preference rate of γ and intertemporally separable utility with CARA and elasticity of substitution $\frac{1}{\sigma}$, lifetime utility reads

$$U(c_1, c_2) = \frac{(y-f-m)^{1-\sigma}}{1-\sigma} + \gamma\left[\begin{array}{l} p_f p_m \frac{(fR+mP)^{1-\sigma}}{1-\sigma} + p_f(1-p_m)\frac{(fR+m)^{1-\sigma}}{1-\sigma} + \\ (1-p_f)p_m\frac{(f+mP)^{1-\sigma}}{1-\sigma} + (1-p_f)(1-p_m)\frac{(f+m)^{1-\sigma}}{1-\sigma} \end{array}\right]$$

The FOC for f and m are symmetrical in the peaceful state and read

$$\frac{\partial U}{\partial f} = \frac{-1}{(y-f-m)^{\sigma}} + \gamma\left[\frac{p_f p_m R}{(fR+mP)^{\sigma}} + \frac{p_f(1-p_m)R}{(fR+m)^{\sigma}} + \frac{p_m(1-p_f)}{(f+mP)^{\sigma}} + \frac{(1-p_f)(1-p_m)}{(f+m)^{\sigma}}\right] = 0$$

$$\frac{\partial U}{\partial m} = \frac{-1}{(y-f-m)^{\sigma}} + \gamma\left[\frac{p_f p_m P}{(fR+mP)^{\sigma}} + \frac{p_f(1-p_m)}{(fR+m)^{\sigma}} + \frac{p_m(1-p_f)P}{(f+mP)^{\sigma}} + \frac{(1-p_f)(1-p_m)}{(f+m)^{\sigma}}\right] = 0$$

8 For the sake of simplicity we refrain from modelling a wider variety of returns.

9 Note that the model is 'autarkic' in the sense of Besley (1995b), i.e. we abstract from financial intermediators.

We can explore these FOC with comparative statics based on the Implicit Function theorem. Examining for example the reaction of *f** to *y*, income, we obtain

$$f^{*\prime}(y) = -\frac{\frac{\partial U_f}{\partial y}}{\frac{\partial U_f}{\partial f}} = -\frac{\frac{\partial U_f}{\partial y}}{U_{ff}}$$

As we are maximizing *U* for *f*, we know that $U_{ff} < 0$ at the optimum. The numerator is

$$\frac{\partial U_f}{\partial y} = \frac{1}{(y - f - m)^{2\sigma}}$$

which is > 0 for $m \geq 0$ and $f \geq 0$. Therefore, $f^{*\prime}(y) > 0$, *f** reacts positively to income. Obviously, the same result applies symmetrically for m^*. - Note that a lower elasticity of substitution would dampen the effect.

Violence may disturb optimal investment in a variety of ways. We assume violence will primarily diminish the expected returns by making failure more likely, with the two kinds of violence affecting returns in different ways. Displacement threats would make the ownership of fixed assets more insecure. Further, the explicit aim to weaken the presence of the state may entail a general loss of law and order and thereby reduce the security of market transactions, necessary for entrepreneurial activity. – We assume violence against the public order threatens *y*. On the other hand, common delinquency is assumed to be a threat to the returns of mobile assets primarily, as these can be stolen and carried away. In line with our discussion above, we assume violence against public order to lower *y* and p_f but to leave the return and success probability for the mobile asset intact.

We have examined the reaction of assets to *y* before. A reduction in *y* would clearly reduce both *f** and $m*$. In order to explore the reaction of *f** to p_f, we again use the Implicit Function theorem:

$$f*'(p_f) = -\frac{\frac{\partial U_f}{\partial p_f}}{\frac{\partial U_f}{\partial f}} = -\frac{\frac{\partial U_f}{\partial p_f}}{U_{ff}}$$

The numerator is $\frac{\partial U_f}{\partial p_f} = \gamma\left[\frac{p_m R}{(fR+mP)^\sigma} + \frac{(1-p_m)R}{(fR+m)^\sigma} + \frac{-p_m}{(f+mP)^\sigma} + \frac{-(1-p_m)}{(f+m)^\sigma}\right]$

which is >0 for $m \geq 0$ and $f \geq 0$ (compare the position of R in the numerator and denominator of the two positive terms). Therefore, $f*'(p_f) > 0$ and a reduction in p_f will reduce the optimal demand for the fixed asset.[10] In the same way, the optimal demand for *m** can be shown to increase with a reduction in p_f. Combining these two effects, an increase in guerrilla violence (i.e. a decrease in p_f) will augment the share of the mobile asset in the overall portfolio. The same argument applies symmetrically for common delinquency, if we assume it to threaten returns on mobile assets. Mobile investments are predicted to decrease with higher common delinquency, whereas fixed asset investments become more popular.

In the remainder of this paper, we want to test the predictions of the above model empirically. This will entail exploring the extent of fixed and mobile investments as functions of anti public order and delinquent violence, as well as of income, and other municipal and individual variables that are likely to influence the cost or return of different investments. In this context it will be particularly important to control for all

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[10] Again, note that a lower elasticity of substitution (i.e. a higher σ) dampens the effect of a movement in p_f.

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'[11] in December 1999) and a questionnaire to the mayor in order to obtain municipality level variables.[12] 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).

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*. Please note that our results will therefore only have external validity for the lowest national welfare stratum in the area *excludin*g 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

11 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.

12 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.

limit of common delinquent activity. 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

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.)

As mentioned before, 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.[13] Regarding violence challenging the state,

[13] 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).

data assembled by the Medina et al. (2001) from National Police records and other municipal data allows us to measure guerrilla attacks directly. Through a 'public order problem' dummy in the *Familias* survey, we also pick up qualitatively whether paramilitaries or guerrillas are at all present in a municipality. To our knowledge, there is currently no source that quantifies the degree of paramilitary actions reliably. But 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. [14] 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)[15]. 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. 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

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14 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).

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

with a guerrilla or paramilitary militia present, 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 Table 1. Nonetheless, the literature agrees[16] 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 with a greater propensity for 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 income from the drug trade and are therefore indirectly a target of the Drug Act[17]. 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.

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16 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)

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

	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

Table 1: Correlation matrix of violence and welfare

We also assess to what extent violence is linked to other community characteristics. 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 household assets

Household variables from the *Familias* survey cover ownership of assets such as house, land, animals, household goods and vehicles. The survey only asks whether a certain asset is owned, not how much it is worth. We have therefore additionally collected prices for the assets in question through a survey among people belonging to the three lowest income sixtiles (SISBEN 1-3) in a rural province near Bogotá (Boyacá). These prices are estimates and not representative, but constitute a useful approximation in the absence of official price statistics.

We divide the surveyed range of household assets into *fixed*, i.e. impossible or difficult to move, and *mobile* assets. Empirically, more than 2/3 of displaced people flee more than

50km, mostly using existing transport provision, such as buses.[18] The goods left behind or carried on the flight vary by family and distance, but the usual choice is consistent with our classification into fixed and mobile. Often, a flight consists of various stages and also the mobile assets are sold at later stages. But at the first stage, and in most families' expectation[19], the following goods can be considered fixed and mobile respectively, as Table 2 shows.

Fixed Assets	Mobile Assets
house	manual sewing machine
other real estate	stereo equipment
fridge	fan
TV	mixer
boat/canoe	kerosene lamp
diesel generator	bicycle
horses	motorcycle
cows	chicken
donkeys	rabbits
pigs	ducks
goats	
sheep	

Table 2: Definition (1) of fixed and mobile assets

Source: based on Econometría (2003)

The definition of *fixed* and *mobile* may differ in different environments, and according to the means of transport. Therefore we will test the sensitivity of our empirical results with another, more basic, definition, as laid out in Table 3.

18 See Econometría (2003).

19 Compare Econometría (2003).

Fixed Assets	Mobile Assets
house	manual sewing machine
other real estate	stereo equipment
fridge	fan
	mixer
	kerosene lamp
	TV
	bicycle
	motorcycle
	boat/canoe
	diesel generator[20]
	horses
	cows
	donkeys
	pigs
	goats
	chicken
	rabbits
	ducks

Table 3: Definition (2) of fixed and mobile assets

Information about ownership is not enough to estimate valued demand functions. For our empirical analysis, we therefore value the assets with the prices listed in Table 4.

[20] Note that the diesel generators used in Colombia, so-called 'plantas', are typically portable generators as for example made by Honda.

Asset	Estimated Price in USD
bicycle	52
boat/canoe	140
chicken	4
cow	245
diesel generator	1,048
donkey	28
duck	17
fan	21
fridge	87
goat	35
horse	44
kerosene lamp	17
manual sewing machine	44
mixer	14
motorcycle	2,271
average piece of land for a house[21]	1,398
pig	26
rabbit	7
sheep	24
stereo equipment	70
television b/w	17
television colour	157

Table 4: Prices used for the valuation of assets

Source: Survey of people of SISBEN 1-3 in rural Boyacá

Note: the Familias database contains already house values as well as information about whether a TV is b/w or colour.

[21] The familias dataset contains the actual house value, so no external average prices have to be applied here.

Apart from assets, the *Familias* dataset also reports two kinds of debt held by the households: mortgages and cash debt. Only 244 households report a mortgage, ranging in size from 22,300 to 35m COP, but 7,496 households hold cash debts, ranging from 2,800 to 48m COP, with an average of 544,000 COP. Summing up assets and debt, households in our sample hold on average around 4.5m COP of net assets, or around 2,200USD, which corresponds to 37 months of salary. Estimated wealth[22] varies widely, however, from a 28m COP debt to net assets of 463m COP. A scatter plot relating estimated net wealth to the age of the household head shows a familiar pattern.

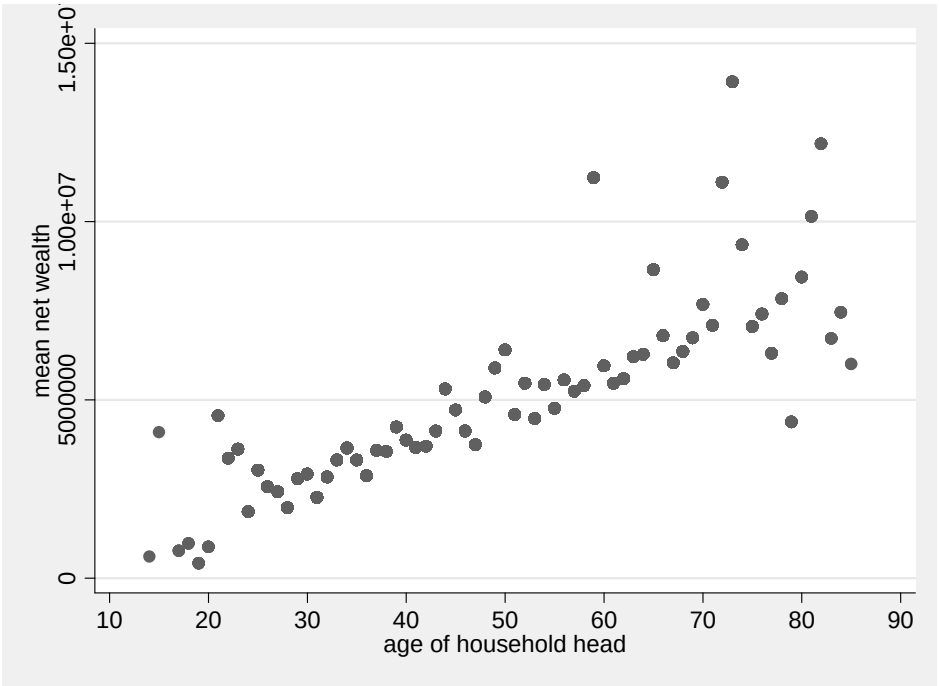

Figure 1: Asset holdings and age

If we explore the two asset classes, fixed and mobile, apart, another interesting relationship emerges. Table 5 and Table 6 show participation in fixed and mobile assets

22 We estimate asset holdings by multiplying the different assets, both fixed and mobile, with their respective prices and summing up, deducting any reported debt.

with and without a public order problem (guerrilla or paramilitary presence) for asset definition (1).

	Participation in mobile assets		Total
Participation in fixed assets	no	yes	
no	2%	3%	5%
yes	4%	92%	95%
Total	5%	95%	100%

Table 5: Fixed and mobile asset holdings without guerrilla/paramilitary presence

	Participation in mobile assets		Total
Participation in fixed assets	no	yes	
no	3%	3%	6%
yes	4%	90%	94%
Total	7%	93%	100%

Table 6: Fixed and mobile asset holdings with guerrilla/paramilitary presence

We observe that very few people do not hold either asset at all. An analysis of participation only detects the movement of investment at the very poorest fringe of the population. Note that holdings of both assets go down in the presence of guerrillas/paras. However, the single participations in fixed or mobile assets respectively do not seem to change much. A multivariate analysis is needed to shed light on the relationship.

Sample selection issues

There may be issues of sample selection in the database we use for our analysis. As explained earlier, we use the 2001 *Familias* survey as the backbone for our analysis and merge it at the municipality level with violence and municipal variables, also from 2001. The households in the *Familias* survey have been identified from the government's

register for the lowest income stratum (the so-called SISBEN register, last updated with the 1993 census). When confirming the addresses of the around 20,000 households in the SISBEN database, the surveyors found that nearly 40% had left their municipality. It is not likely that these 40% left at random. 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.[23] 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. 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.

23 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.

The first equation is the main regression we want to analyze from our dataset and the second equation models 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, i.e. the original SISBEN database from 1993, and the later *Familias* survey from 2001, we can attempt a correction for sample selection in some of our specifications. We have the original household population from which the *Familias* sample was drawn: the SISBEN register. 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 dataset 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 sample with those in the *Familias* sample. 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 register can be merged at the municipality level with some municipal variables from before 2000. This includes violence data on armed group and common delinquency actions. It also contains some municipality level wealth indicators for various years. We include the sum of all bank assets per head in the municipality. Although the above data is 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 population' as dependent variable. Given the limitations of the SISBEN register, 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 municipality level characteristics alone. We include pre-2000 data on 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[24]

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

[24] 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.

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 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.

EMPIRICAL APPROACH

Our task is to measure the impact of the two kinds of violence endemic in Colombia, guerrilla warfare and common delinquency, on a household's portfolio. In this context, any empirical specification has to consider three fundamental issues: the randomness of violence, the potential endogeneity of violence and the randomness of the sample.

First, violence, whether perpetrated by the paramilitaries, guerrilla or by street gangs, cannot be assumed to be a natural experiment ex ante. Rather, different municipalities face different risks of victimization. But controlling for potential drivers of victimization can deliver a natural experiment within groups. 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,[25] $R = \beta_0 + \beta_1 V + \beta_2 C + \varepsilon$.

Clearly, in our context violence is not assigned randomly. Some municipalities are at higher risk of violence than others, because of certain characteristics such as geographical

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

accessibility. 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.[26] 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. This 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 $E(R^0 \mid C, V) = E(R^0 \mid C)$. 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, in order to identify the effect of violence on the household response.[27] 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.[28]

Second, it is worth discussing whether, in the studied context, violence could be considered endogenous, in the sense that particular assets or asset constellations attract certain types of violence. This point could perhaps be made in the context of richer

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

27 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). In this context, the matching covariates are not given a causal interpretation for the household behaviour; nonetheless their association with the outcomes will be interesting to observe.

28 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.

households: there is evidence that absolute wealth levels attract certain types of crime.[29] However, the households in our sample come from the lowest strata of the Colombian income distribution and are unlikely to be targeted specifically because of their asset constellation. Further, there is no evidence that specific portfolio shares of certain assets attract crime. Third, we have to take into account that displacement and migration influence the household portfolios observed in a region. It is conceivable that people adjust their portfolio in order to migrate, and still hold a skewed portfolio once they reached the peaceful area. We therefore correct for potential sample selection by including the Inverted Mills Ratios calculated from the underlying SISBEN register.

For the actual choice of an econometric specification, we propose using various approaches to test the sensitivity of our predictions. Translating our model directly into a specification would suggest testing simultaneous OLS regressions of valued asset stocks on violence variables and controls. Given that many assets will be debt financed, it would also make sense to include the demand for debt as a third regression. We test this approach below in section A). Further, our model included a message about the share of fixed vs. mobile assets in the overall portfolio, which we examine through a Tobit in section B). Finally, our bi-variate analyses revealed an interesting dynamic at the very poorest fringe of the population. The mere participation in the two kinds of assets appeared to respond to violence. We therefore test this in section C) below.

A) Valued asset demands

We estimate the absolute asset demands, and the demand for debt (mortgage + cash debt) with a seemingly unrelated regression model. A seemingly unrelated regression (SUR) system is a set of regressions which seem to be unrelated, but which have

[29] Gaviria and Pages (1999) and Gaviria and Vélez (2001).

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[30]. The equations we estimate are

$$F_{in} = X_{in}\beta + C_n\gamma + V_n\delta + \nu_n + u_{in}$$
$$M_{in} = X_{in}\iota + C_n\phi + V_n\varphi + \omega_n + \varepsilon_{in}$$
$$D_{in} = X_{in}\mu + C_n\theta + V_n\lambda + \kappa_n + \eta_{in}$$

where F and M are valued holdings of fixed and mobile assets, respectively, and D is mortgage plus cash debt. Given our data, we need to measure stocks rather than flows of assets. We test both definitions of fixed assets, as discussed in Table 2 and Table 3, in order to ensure robustness. X is a matrix of the characteristics of household i in village n, including household head characteristics (education, age, gender and marital status) and a constant term. C is a matrix with community level indicators, including geographic variables[31] such as the region, the degree of sparseness of settlement, and the altitude; further 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 under the Drug Act.[32] Note that both household and community level controls are not given a causal interpretation under our framework, but they fulfill a 'matching' function for comparable communities and comparable households.

V is a matrix of violence variables including a public order problem dummy (=guerrilla or paramilitary presence), guerrilla attacks and homicides per 100,000 inhabitants, ν

30 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.

31 See Vargas, Restrepo and Spagat (2004).

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

respectively ω and κ are random village level factors; and u, ε and η are individual level error terms, with $E\left[\varepsilon_{in}, u_{in} \middle| X\right] = 0$, $Var\left[\varepsilon_{in} \middle| X\right] = \sigma_{\varepsilon}^{2}$, $Var\left[u_{in} \middle| X\right] = \sigma_{u}^{2}$; and

$E\left[v_n, \omega_n \middle| X\right] = 0$, $Var\left[v_n \middle| X\right] = \sigma_{v}^{2}$, $Var\left[\omega_n \middle| X\right] = \sigma_{\omega}^{2}$ and likewise for the relation between the assets and *D*.

Also, $Cov\left[\vartheta_{in}, \vartheta_{jn}\right] = \sigma_{\omega}^{2}$ where $\vartheta_{in} = \omega_n + \varepsilon_{in}$; $Cov\left[\upsilon_{in}, \upsilon_{jn}\right] = \sigma_{v}^{2}$ where $\upsilon_{in} = v_n + u_{in}$ and $Cov\left[\xi_{in}, \xi_{jn}\right] = \sigma_{\kappa}^{2}$ where $\xi_{in} = \kappa_n + \eta_{in}$. We allow for this latter correlation of household error terms at the village level with 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 (the average 'Departamento' stretches across c500km). Under this assumption standard errors clustered at the municipal level only are still valid. With SUR, also $Cov\left[\varepsilon, u\right] \neq 0$, $Cov\left[\varepsilon, \eta\right] \neq 0$ and $Cov\left[u, \eta\right] \neq 0$ as explained above.

We estimate the equations with OLS, controlling each time for sample selection by including the Inverted Mills Ratio calculated from the SISBEN sample. Results-Table 2 shows the results.

	Fixed asset definition (1)			Fixed asset definition (2)			Fixed asset definition (1)			Fixed asset definition (2)			
	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat	Coeff		z-stat	Coeff
Dependent Variable	**Fixed Assets**						**Mobile Assets**						**Debt**
Violence													
public order problem	- 638,513	*	- 1.47	- 724,637	*	- 1.81	154,496	**	2.32	126,481	**	2.31	- 131,352
guerrilla attack rate	6,186		0.11	- 6,649		- 0.14	1,722		0.22	21,997		0.54	13,087
homicide rate	3,854		1.34	3,512		1.30	- 601		- 1.43	848		-0.78	- 501
Municipality controls													
grouped settlement	- 35,373		- 0.12	- 599,277	**	- 2.42	48,789		0.79	116,764	***	4.85	- 23,267
rural sparse settlement	- 617,101		- 1.17	- 739,554	*	- 1.46	54,514		0.56	123,856		1.38	29,764
Oriental Region	2,406,933	***	3.45	1,936,905	***	3.16	- 27,679		- 0.25	217,592	*	1.83	241,508 **
Central Region	1,748,623	**	2.35	1,826,948	***	2.59	471,512	***	4.64	173,312	**	2.37	235,482
Pacific Region	168,410		0.33	378,194		0.75	102,217		1.19	124,770		-0.63	- 151,905
altitude	- 272		- 0.27	- 179		- 0.19	- 237	*	- 1.63	245	*	-1.67	111
altitude²	0		0.33	0		0.30	0		1.33	0		1.09	0
percentage of people in lowest two strata	- 528,271		- 0.49	- 190,712		- 0.19	316,483	*	1.93	307,492		0.01	176,605
index of quality of life	- 2,150		- 0.03	11,345		0.19	5,205		0.49	17,498		-0.47	- 12,388
capture rate	503		1.20	568		1.40	- 95		- 1.22	122		-1.31	66
Household/ head variables													
age	80,142		1.35	68,621		1.26	22,616	***	2.69	15,283	***	2.71	43,961 ***
age2	294		0.47	350		0.61	- 220	***	- 2.69	147	**	-2.34	- 405 ***
married	944,904	***	3.80	840,481	***	3.58	97,920	*	1.81	89,772	**	2.04	430,584 ***
female	- 349,135	*	- 1.55	- 100,430		- 0.47	- 245,439	***	- 5.61	68,722	***	-6.75	- 69,438 *
some or complete primary education	- 204,025		- 1.07	- 163,390		- 0.93	85,817	**	1.98	88,340		0.55	73,021 *
some secondary or more education	704,969	**	2.22	631,702	**	2.09	427,190	***	4.34	128,194	***	3.87	548,460 ***
Inverted Mills Ratio	- 3,853,922	*	- 1.69	- 2,900,246		- 1.32	627,837		0.65	1,294,539		-0.18	- 1,159,224 ***
constant	5,426,227		1.34	3,440,779		0.85	- 1,386,398		- 0.91	2,036,264		0.13	1,213,651 **
Wald test Inverted Mills Ratio (p value)	0.10			0.19			0.52			0.86			0
Wald test violence variables (p value)	0.38			0.26			0.12			0.12			0.39
Wald test welfare indicators (p value)	0.89			0.95			0.16			0.89			0.48
Wald test access of the state (p value)	0			0			0.0001			0			0.001
Adj R²	0.05			0.05			0.03			0.04			0.04
Number of obs	7,248			7468			7410			7,202			7,439

Results-Table 2: Coefficient estimates from a seemingly unrelated regression of fixed and mobile assets and the debt of Colombian households

Note: Dependent variables are valued fixed assets, valued mobile assets, and debt, respectively. The first and the third columns use the asset definition (1) of Table 2, the second and the fourth asset definition (2) of Table 3. Regressions are OLS, in a SUR system. 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) examine joint significance of groups of variables, 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.

The results largely confirm our conceptual framework, and are qualitatively robust to different asset definitions.[33] In the regressions for fixed and mobile assets, all violence variables have the sign predicted by our model, irrespective of the asset specification

33 They are also robust to excluding municipalities with very high violence levels as outliers, and different specifications, including consumption and employment status at the household level or excluding the capture rate (results not shown).

chosen. Significance varies. The incidence of a public order problem is significant at the 5% level for mobile assets, and at the 10% level for fixed assets. The lower significance for fixed assets may result from our data not measuring their value very precisely, especially for real estate, which respondents were asked to estimate. The homicide rate is just below significance for both assets. The attack rate is not significant. None of the violence variables is significant for the demand of debt, as far as we can measure it.

Regarding the municipality controls, we observe that only the regional dummies matter for all three demands. The Oriental and Central regions witness a significantly higher ownership of fixed assets, as would be expected. The other regions, Atlantic (default) and Pacific, are both poorer and geographically less accessible, thereby more vulnerable to rebel violence. For mobile assets, only the most accessible Central region shows higher investments. The capture rate is never fully significant for either asset or debt. However, the geographic variables and the capture rate together, proxying the access of the state to the municipality, are jointly highly significant in each regression, with p-values of near 0.

Variables describing the household paint a consistent picture. Age is associated with mobile assets and debt, showing an inverted U shape, which is consistent with the lifecycle-hump sometimes observed in both consumption and saving.[34] Judging from the coefficients on the household variables, debt is treated like a third asset. This may reflect that the households in *Familias* were more inclined to report official rather than informal debts, although they were asked about both, or that the level of debt primarily reflects creditworthiness. We observe higher debt for married household heads and lower for female heads. We further observe more education entails a higher debt, with secondary

[34] See for example Bütler (1997) for a comprehensive overview of empirical patterns of lifecycle decision-making on consumption and savings.

or higher education showing a much larger coefficient and more significance (1% level) than primary education (10% level).

We correct for sample selection with the Inverted Mills Ratio and find it marginally significant for fixed assets, and highly significant for debt. (The signs, negative throughout, have to be interpreted as their opposite, as we modeled the selection equation on leaving the base sample rather than being selected into the *Familias* sample.) There appears to be a correlation between the unobserved variables that influence the probability of staying on and the unobserved variables influencing investment in fixed assets and drawing of debt. The coefficients on the Inverse Mills ratios suggest that the factors that cause individuals to stay bias upward the investment in fixed assets and especially the drawing of debt. This makes sense in the context of our results. It is likely that the people who left were poorer in ways we cannot measure. Fixed assets and debt are more likely to be found in the possession of stayers rather than leavers.

We next explore how the share of fixed assets in the portfolio responds to different kinds of violence.

B) Portfolio shares for fixed and mobile assets

We estimate the choice of portfolio shares with a Tobit. This tests the actual portfolio composition and should pick up movements from fixed to mobile. We exclude debt. We estimate only one equation, as the share of one asset simultaneously determines the share of the other. The model reads

$$SF_{in}^{*} = X_{in}\beta + C_n\gamma + V_n\delta + v_n + u_{in}$$

$$SF_{in} = SF_{in}^{*} \text{ if } SF_{in}^{l} \le SF_{in}^{*} \le SF_{in}^{u}; SF_{in} = SF_{in}^{l} \text{ if } SF_{in}^{*} < SF_{in}^{l}; SF_{in} = SF_{in}^{u} \text{ if } SF_{in}^{*} > SF_{in}^{u}.$$

where SF is the share of fixed assets in the entire portfolio, and the other variables as in the previous regression. Likewise, $E[u_{in}|X]=0$, $Var[u_{in}|X]=\sigma_u^2$; $E[v_n|X]=0$, $Var[v_n|X]=\sigma_v^2$ and $Cov[\upsilon_{in},\upsilon_{jn}]=\sigma_v^2$ where $\upsilon_{in}=v_n+u_{in}$.

We estimate two econometric models, one as outlined above, and one approximating the Tobit with an OLS. The OLS regression includes Inverted Mills Ratios to control for sample selection. As before, we also test the sensitivity of our specification by excluding consumption and employment status. Results-Table 3 shows the results.

	Tobit				OLS			
	Fixed assets definition (1)		Fixed assets definition (2)		Fixed assets definition (1)		Fixed assets definition (2)	
Dependent Variable	**Coefficient**	**z-statistic**	**Coefficient**	**z-statistic**	**Coefficient**	**z-statistic**	**Coefficient**	**z-statistic**
Share of fixed assets								
Violence								
public order problem	- 0.044 ***	- 4.22	- 0.048 ***	- 3.09	- 0.040 **	-2.14	- 0.039 *	-1.54
guerrilla attack rate	- 0.001	- 0.46	- 0.005 **	- 2.19	- 0.001	-0.28	- 0.004	-1.38
homicide rate	0.0004 ***	4.21	0.0005 ***	3.95	0.0003 ***	2.90	0.0004 **	2.16
Municipality controls								
grouped settlement	- 0.040 ***	- 3.88	- 0.101 ***	- 6.70	- 0.033 **	-2.34	- 0.074 ***	-4.52
rural sparse settlement	- 0.004	- 0.29	- 0.024	- 1.06	- 0.003	-0.14	- 0.031	-1.17
Oriental Region	0.029 *	1.90	0.050 **	2.23	0.033	1.43	0.038	1.06
Central Region	0.02	1.29	0.14 ***	5.81	0.02	0.46	0.10 *	1.77
Pacific Region	- 0.014	- 0.70	0.087 ***	3.06	- 0.011	-0.36	0.064 *	1.68
altitude	2.13E-06	0.09	-1.12E-04 ***	- 3.04	-2.84E-06	-0.06	-7.22E-05	-1.22
altitude²	2.64E-09	0.26	3.08E-08 **	2.04	3.29E-09	0.19	1.96E-08	0.89
percentage of people in lowest two strata	0.010	0.40	0.076 **	2.11	0.000	0.01	0.053	0.98
index of quality of life	- 0.005 **	- 2.33	- 0.004	- 1.36	- 0.005	-1.44	- 0.003	-0.71
capture rate	1.96E-05 *	1.65	3.47E-06	0.20	1.92E-05	0.98	1.68E-06	0.06
Household/ head variables								
age	0.013 ***	6.29	0.021 ***	6.90	0.011 ***	7.02	0.013 ***	6.66
age2	- 0.0001 ***	- 3.63	- 0.0001 ***	- 3.92	- 0.0001 ***	-4.26	- 0.0001 ***	-3.32
married	0.053 ***	5.53	0.083 ***	5.85	0.052 ***	5.37	0.057 ***	4.78
female	0.031 ***	2.80	0.059 ***	3.61	0.028 ***	2.52	0.049 ***	3.89
some or complete primary education	- 0.010	- 0.98	- 0.014	- 0.93	- 0.008	-0.81	- 0.015	-1.17
some secondary or more education	- 0.005	- 0.34	- 0.028	- 1.31	- 0.003	-0.23	- 0.037 *	-1.92
Inverted Mills Ratio					- 0.1226	- 0.62	0.022	0.09
constant	0.405 ***	5.20	- 0.152	- 1.32	0.640	2.08	0.108	0.29
Replications	50		50					
Clusters	78		78					
Wald test Inverted Mills Ratio (p value)					0.53		0.93	
Wald test violence variables (p value)					0.01		0.06	
Wald test welfare indicators (p value)					0.35		0.46	
Wald test access of the state (p value)					0.13		0.0002	
Adj R^2					0.07		0.08	
Number of obs	7099		7099		7072		7072	

Results-Table 3: Regression of the share of fixed assets in the portfolio of Colombian households

Note: Dependent variable is the share (%) of fixed assets in the household portfolio. The first and the third columns use the asset definition (1) of Table 2, the second and the fourth asset definition (2) of Table 3. The first two columns report on a bootstrapped Tobit specification, the last two on an OLS approximation of the Tobit. Regressions are with robust standard errors, 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 (F-tests) examine joint significance of groups of variables, 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.

The results confirm the predictions of our model, and are consistent with the results of the simultaneous regressions above. A public order problem, signaling that guerrillas or paramilitaries are present in the municipality, significantly reduces the share of fixed

assets in a household's portfolio, whereas the homicide rate, a proxy for common delinquency, increases it. These results are robust to the econometric model (Tobit or OLS) and the asset definition (fixed assets only including house, land and fridge (definition 2) or also heavy animals and machinery (definition 1)).[35] Additionally, the guerrilla attack rate tends to decrease the share of fixed assets, but this result is not significant under asset definition (1). The violence variables are jointly significant.

At the municipality level, we observe that the Oriental and Central Region tend to have a positive association with the fixed share; however, the significance varies with the asset specification. The capture rate is usually insignificant, it only becomes marginally positive significant for the broader asset definition.

Variables describing the household behave largely as expected. Age shows a lifecycle hump, and married household heads have a higher share of fixed assets. Female heads, however, are also associated with a higher share of fixed assets. A possible explanation could be a male partner having left the household and taken some mobile assets with him - an avenue for future research to explore. Any education is seen with a lower share of fixed assets (a higher share of mobile ones), which may be due to the fact that fixed assets are related to farming enterprises, requiring less formal education than the service activities frequently undertaken by SISBEN 1 and 2 households (e.g. catering).

The OLS regression allows us to test for sample selection. We observe that the Inverted Mills Ratio is insignificant for each asset specification, p-values of a Wald test are 0.53 and 0.98 respectively. The selection effects observed for the SUR regression cancel themselves out when a ratio of fixed and total assets is observed. Our final section explores the participation in the two kinds of assets.

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35 We have also tested different specifications (excluding the capture rate or including employment status or total consumption) and excluding municipalities with very high violence levels and found our results robust.

C) Bi-variate Probit

An econometric analysis of household portfolios has to take into account that many households do not hold certain asset categories at all. Further, the decision process to hold assets may be different from the choice of shares.[36] Given the context we are studying, it is possible that households focus on whether to hold assets rather than choosing their respective portfolio shares. This is especially true for the poorest fringe of the population. From the bi-variate analyses we have seen that only about 10% of people do not hold both assets, with 3% holding none. - A bi-variate probit in this context picks up the responsiveness of the poorest to violent threats. Note, however, that this empirical set-up only measures participation without valuing the assets, and therefore misses a lot of the investment dynamic. Nonetheless, it may offer some hints as to whether the poorest react differently.

The estimated model reads:

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

where F and M are =1 if the household participates in fixed and mobile assets, respectively and 0 otherwise, and the other controls as before. v respectively ω is a random village level factor; and u and ε are at the individual level correlated error terms. $E\left[\varepsilon_{in}, u_{in} \middle| X\right] = 0$, $Var\left[\varepsilon_{in} \middle| X\right] = \sigma_\varepsilon^{\,2}$, $Var\left[u_{in} \middle| X\right] = \sigma_u^{\,2}$; and $E\left[v_n, \omega_n \middle| X\right] = 0$, $Var\left[v_n \middle| X\right] = \sigma_v^{\,2}$, $Var\left[\omega_n \middle| X\right] = \sigma_\omega^{\,2}$, as well as $Cov\left[\vartheta_{in}, \vartheta_{jn}\right] = \sigma_\omega^2$ where $\vartheta_{in} = \omega_n + \varepsilon_{in}$, and $Cov\left[\upsilon_{in}, \upsilon_{jn}\right] = \sigma_v^2$ where $\upsilon_{in} = v_n + u_{in}$. We allow for this latter correlation of

36 Also see Bertaut and Starr-McCluer 2002

household error terms by clustering. Using a bi-variate probit we assume also $Cov[\varepsilon, u] = \rho\sigma_\varepsilon\sigma_u$ as explained above.

We estimate the above model for both asset specifications. Note, that in this non-linear approach we cannot control for sample selection, because we do not have the proportions of asset choice in the underlying SISBEN population (cf. Boyes, Hoffman and Low (1989)). Results-Table 4 presents the regression results and the following table summarizes marginal effects.

	Fixed asset definition (1)				Fixed asset definition (2)			
Dependent variable = Participation in	**Fixed Assets**		**Mobile Assets**		**Fixed Assets**		**Mobile Assets**	
	Coefficient	z-statistic	Coefficient	z-statistic	Coefficient	z-statistic	Coefficient	z-statistic
Violence								
public order problem	- 0.120	-1.31	0.063	0.55	- 0.140	-1.41	0.120	0.90
guerrilla attack rate	0.036 **	2.02	0.020 **	1.97	0.016 *	1.59	0.018 *	1.54
homicide rate	0.0001	0.11	- 0.0011 **	- 2.00	0.0009 *	1.61	- 0.0005	- 0.80
Municipality controls								
grouped settlement	0.423 ***	3.67	0.415 ***	4.17	- 0.174 **	-1.98	0.295 ***	2.58
rural sparse settlement	0.451 ***	3.15	0.295 ***	2.97	- 0.045	-0.29	0.131	1.06
Oriental Region	0.091	0.58	- 0.166	-1.22	0.222 *	1.56	- 0.194	- 1.16
Central Region	0.176	1.31	- 0.086	-0.63	0.458 **	2.21	0.091	0.50
Pacific Region	0.210	1.08	0.108	0.58	0.414 **	2.04	0.323	1.36
altitude	-1.77E-04	-0.72	-6.35E-04 ***	-2.89	-2.36E-04	-0.98	-4.04E-04 *	- 1.50
altitude²	8.34E-08	0.75	2.57E-07 ***	3.26	1.68E-08	0.20	1.78E-07 *	1.83
percentage of people in lowest two strata	- 0.009	-0.04	- 0.240	-0.97	- 0.158	-0.68	- 0.235	- 0.90
index of quality of life	- 0.036 **	-2.09	- 0.034 *	-1.50	- 0.025	-1.44	- 0.016	- 0.62
capture rate	2.60E-05	0.24	-3.28E-05	-0.25	-4.58E-05	-0.33	-1.26E-04	- 0.83
Household/ head variables								
age	0.046 ***	2.79	0.042 ***	2.84	0.042 ***	4.10	0.041 **	2.06
age2	- 0.0002	-1.12	- 0.0003 **	-2.25	- 0.0002 *	- 1.45	- 0.0003 *	- 1.65
married	0.052	0.5	0.255 ***	2.67	0.249 ***	4.69	0.271 **	2.23
female	- 0.365 ***	-5.14	- 0.357 ***	-4.84	0.012	0.23	- 0.389 ***	- 4.90
some or complete primary education	- 0.009	-0.1	0.068	1	0.020	0.32	0.156 **	2.08
some secondary or more education	0.090	0.95	0.324 ***	3.09	0.086	0.93	0.512 ***	3.68
constant	0.981 *	1.35	1.550 **	1.94	- 0.076	-0.14	1.139	1.15
ρ	0.836 ***	8.35			0.387 ***	5.29		
Wald tests								
ρ	0				0			
violence variables (p value)	0.01				0.03			
welfare indicators (p value)	0.24				0.60			
access of the state (p value)	0				0			
Log pseudo likelihood	- 2,674.48				-5153.02			
Number of obs	7500				7500			

Results-Table 4: Coefficient estimates from bi-variate Probit model of ownership of fixed and mobile assets of Colombian households

Note: Dependent variables are the participation in fixed assets, and mobile assets, respectively. The first and the second columns use the asset definition (1) of Table 2, the third and the fourth asset definition (2) of Table 3. Regressions are Probit, allowing for individual error correlation across the two decisions. 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) examine 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(F=1,M=1)	0.94	Pr(F=1,M=0)	0.03	Pr(F=0,M=1)	0.02
	dy/dx	X	dy/dx	X	dy/dx	X
Violence						
public order problem	-0.002	0.71	-0.007	0.71	0.007	0.71
guerrilla attack rate	0.003	1.46	-0.001	1.46	-0.002	1.46
homicide rate	-7.10E-05	51.81	7.56E-05	51.81	-2.08E-05	51.81
Municipality controls						
grouped settlement	0.048	0.37	-0.020	0.37	-0.015	0.37
rural sparse settlement	0.035	0.09	-0.011	0.09	-0.015	0.09
Oriental Region	-0.008	0.25	0.015	0.25	-0.007	0.25
Central Region	0.002	0.16	0.010	0.16	-0.010	0.16
Pacific Region	0.017	0.06	-0.004	0.06	-0.008	0.06
altitude	-5.43E-05	466.97	4.13E-05	466.97	-6.21E-07	466.97
altitude²	2.26E-08	633,344.00	-1.65E-08	633,344.00	-3.95E-10	633,344.00
percentage of people in lowest two strata	-0.017	0.64	0.017	0.64	-0.003	0.64
index of quality of life	-0.004	25.81	0.002	25.81	0.001	25.81
capture rate	-8.71E-07	458.61	2.78E-06	458.61	-1.97E-06	458.61
Household/ head variables						
age	0.005	45.38	-0.002	45.38	-0.002	45.38
age²	-3.44E-05	2,227.94	1.97E-05	2,227.94	5.59E-06	2,227.94
married	0.019	0.28	-0.015	0.28	0.001	0.28
female	-0.052	0.26	0.020	0.26	0.016	0.26
some or complete primary education	0.004	0.54	-0.005	0.54	0.002	0.54
some secondary or more education	0.023	0.14	-0.017	0.14	-2.11E-04	0.14

Results-Table 5: Marginal effects after bi-variate Probit on holdings of fixed and mobile assets, definition (1) of fixed assets

Note: Table reports the marginal effects after the regression in the previous Table. Dependent variables are the participation in fixed assets, and mobile assets, respectively, using the asset definition (1) of Table 2.

Default household education level is 'none', default employment 'none or domestic worker'. Default region is Atlantic, default rurality degree is 'urban'.

For qualitative variables, dy/dx marks the percentage increase in participation after a discrete change from the default situation.

The dynamics are largely the same as observed previously, but we note some differences when the mere participation in assets, is considered. The public order dummy continues to have the sign predicted by our model, but stays below significance in every specification. Also the coefficient on the homicide rate behaves as predicted, but with varying significance. It reduces the participation in mobile assets (significant for definition (1)), and increases fixed participation (significant for definition (2)). The signs are robust to the asset definition, and can be shown robust to different combinations of control variables. All violence variables are jointly significant for both asset definitions.

The guerrilla attack rate now shows a new effect. More guerrilla attacks seem to make it more likely that people participate in both assets at all, independent of the asset definition. Given that the result is more pronounced for the broader definition, it could

result from guerrilla actions still serving some redistributive motive for the poorest fringe. Another possible explanation is that the poorest profit from abandoned property in the presence of an attack on law and order. Note however that this regression only looks at participation (yes/no) and not values, and therefore captures only the behavior of a very small fraction of the households we are looking at.

Correlation of error terms: The ρ's

The ρ's reported at the bottom of Results-Table 4 indicate the correlation between the individual error terms of both probits. We see that the errors are strongly and significantly correlated. We would expect this result to be picking up omitted variables in the decision for fixed and mobile assets, such as ability, regional traditions etc. Idiosyncratic measurement error in the survey is another possibility. Other things equal, people with fixed assets are also likely to have mobile assets. So, the ρ may be picking up the complementarity between both kinds of assets. If you have a house, a mixer and other small household goods are useful. Likewise, if you have cattle, you might want to have a bike or motorbike to look after them.

CONCLUSION AND POLICY IMPLICATIONS

This paper presented a theoretical model for investment in two kinds of assets, fixed and mobile, which predicted that the assets would react differently to different kinds of violence. Fixed assets would go down to the benefit of mobile assets in the presence of the guerrilla and paramilitaries, because they cannot be carried away in case of displacement – a favorite weapon of the aforementioned, and the reverse would happen in the presence of common delinquency, which is associated with theft. Empirical results from Colombian micro-data largely confirm this model. Tobit and OLS regressions

examining the share of fixed assets in the portfolio confirmed all findings with high significance, robust to different asset definitions and empirical specifications. A Seemingly Unrelated system of valued demands of the two assets and debt returned the expected signs on all violence variables, however with varying significance. Selection correction with the Inverted Mills Ratio showed that the sample of stayers captured in the survey data is more likely to hold value in both kinds of assets and debt than the base population but not a higher share of fixed assets.

An investigation of mere participation in both assets, i.e. asset movements happening at the poorest fringe of the population, confirmed our model for the homicide rate, but brought the controversial finding that participation in both assets may rise with more guerrilla attacks. This raises the question of whether the guerrilla occasionally still engages in redistribution, or the poorest benefit from abandoned property. In any case, the analysis of participation should be taken with a grain of salt as it only registers the asset movements of about 10% of the population and has to work with small cell sizes.

To the extent that violence falls under the definition of socio-political risk, our findings confirm Stewart and Venieris (1985). In general, however, our paper answers a new research question and to our knowledge the results have no parallels in the established literature. They add a violence perspective to a model of savings in two assets and show how violence can influence portfolio composition, skewing it to an economically sub-optimal combination. Violence is shown to incentivize people to hedge against it. It would be interesting for future research to explore whether this effect can shift some fundamental parameters of a community or a country, such as the savings rate or risk aversion. Our results for portfolio choice suggest this may be likely.

Some conclusions bear relevance to policy makers. First, both guerrilla and common violence have consequences that reach beyond their immediate destructive effect. The

mere threat of displacement (measured by the presence of paramilitaries or guerrillas) appears enough to skew portfolios to prepare for flight. An adequate policy response to violence should therefore not only focus on curbing it but also seek to attenuate people's behavioral responses, e.g. by promoting savings and favoring certain kinds of assets, e.g. within an asset-based welfare program. Further, to the extent that the recurrent empirical importance of the Central Region in Colombia for investment in both types of assets reflects its better transport connections, this encourages enhancing accessibility, especially terrestrial, of areas; also in order to increase the presence of the state. This finding confirms various studies on the Colombian armed conflict, e.g. Rubio (1999b) and Sánchez et al. (2003).

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