

Violence and Growth in Colombia: A Brief Review of the Literature[†]

Alvaro J. Riascos and Juan F. Vargas[‡]

Introduction

This is a brief review of the specialized economic literature on the consequences on growth of criminality and conflict in Colombia. It has been guided by at least three points. First we focus on economic growth. That is, we leave aside studies that have had as their variable of interest the level of output. Second we do not distinguish among works using conflict or criminality variables, nor we differentiate between forms of criminality or ask about their origins. The majority of the papers we refer to, focus on criminality figures. Still, some of them also use data on the internal conflict. These are two different phenomena although there is a strong relationship between them. When presenting the literature we will stick to the concepts used in the corresponding paper by the different authors, otherwise –in the rest of this introduction as well as the conclusions- we will use the word ‘violence’ to refer to both criminality and conflict. As for criminality, it is sometimes associated with the homicide rate, manslaughter, street crime, crime against property, drug trafficking, kidnapping or a mixture of some or all of these actions. Again, we will use ‘violence’ although we believe that a clear distinction of the different activities and their impact on the economic growth should be at the top of any research agenda on the topic. The third and foremost is that we focus on quantitative studies that using diverse methodologies have tried to identify the effects of violence.¹

In a sense, rather than just writing a survey, we contribute to the literature by making a constructive critique of the different methodologies. We conclude with a short summary of what we have learned from these studies and point out to what we think should be the focus of future research on the subject. Additional to the referred studies, at the end we also offer a long list of references on criminality and conflict which not necessarily fit to our three criteria but that can be of some use for those who want to learn about the Colombian literature on this topic.

Finally, we apologize for not having been exhaustive in the review. We recognize that there might be a few influential studies missing. However, our objective has been to review a few but nevertheless important studies and to start documenting the state of knowledge of what we think is an important research for Colombian economists and other social scientists. In any case, it is for them to help us complete this survey and contribute in constructing a quantitative view of the relation between growth

[†] We apologize for having written this review in English. Both authors started writing independently and for different reasons on the subject for an English speaking audience. Later we joint efforts and decided to improve upon our previous work rather than spending time translating it to Spanish. We also hope this would help to diffuse Colombian technical literature on this subject which we perceive as rather relevant. We are grateful with Ana Maria Iregui, Maria Teresa Ramirez, Carlos Esteban Posada and Paulina Restrepo for several comments and corrections. All remaining errors are our own responsibility.

[‡] Contact information: ariascvi@banrep.gov.co; J.F.Vargas@rhul.ac.uk.

¹ For a short review on the determinants of violence in Colombia, see Martinez (2001).

and violence in Colombia based on the existing studies that meet the three previously mentioned guidelines. Therefore, all comments and suggestions are welcome to enhance this review.

Violence and Economic Growth

The review is organized chronologically, from the earliest study to the most recent. Colombian economists started adopting quantitative approaches to assess the relationship between violence and the economy quite recently. A controversial study², published in 1988³ by a multidisciplinary group of social scientist known as the *violentólogos* generated such reaction. Among other hypotheses, *violentólogos* related the Colombian growing record of violence to a number of causes including economic deprivations. In 1995, three independent quantitative studies by Gaitán, Rubio, and Montenegro and Posada questioned this issue which by the time was already part of ‘conventional wisdom’. Whilst Gaitán focuses on the explanation of violence, Rubio and Montenegro and Posada do tackle the problem of its economic consequences on growth. Our review starts then with these two papers.

In ‘**Crimen y Crecimiento en Colombia**’⁴ (‘Crime and Growth in Colombia’), Mauricio Rubio (1995) calculates the annual value of illegal activities in Colombia by estimating the value of:⁵

- Crimes against private property: \$544. Source: National Police Department.
- Crimes against the public sector: \$1470.
 - Fiscal trials: \$452. Source: Contraloría General de la Nación.
 - Stealing from public sector enterprises: \$146.
 - Tax evasion: \$685. Source: Sánchez and Gutierrez (1994).
 - Contraband: \$188. Source: Steiner and Fernandez (1994).
- Terrorism: \$81 (energy infrastructure and pipeline reparations). Source: National Police Department and ECOPETROL.
- Crimes against people: \$716.
 - Kidnapping: \$222 (assuming \$220 millions of average rescue fee). Source: DAS.

² Comisión de Estudios sobre la Violencia, (1988). *Colombia: Violencia y Democracia*. Conciencias. Universidad Nacional, Bogotá.

³ A note on references. Because of the structure of this review we will present the references as follows. The studies reviewed will be referred to in order of appearance (i.e. chronologically according to the date of publication). Within the review of each of these, there might be some of the original references used by the authors to support their ideas (marked with bullets below the paper reviewed). We refer to it as it is in the paper we comment, not checking the accuracy of the reference. References not belonging to the reviewed studies are listed as ‘Additional References’. Finally we include a long list of non referred bibliography towards the end of the document.

⁴ Rubio, M. (1995). “Crimen y Crecimiento en Colombia”. *Coyuntura Económica*. Vol. XXV, No. 1, March.

⁵ Figures in billions (American thousand millions) of pesos.

- Homicide: \$494 (present value of non earned future income assuming 50% probability of being employed, an annual income equal to the GDP per worker, 7% discount factor).

Source of homicide rate: National Police Department.

- Drug traffic: \$1500. Source: Thoumi, F. (1994).
- Public and private expenditures in defense and justice (public) and security and insurance (private): \$2016.

Total annual cost of illegal activities: \$6 trillion⁶ approximately that is, 15.1% of GDP.

After this first accounting approach, Rubio finds a simple correlation between the aggregate homicide rate and the GDP growth and concludes that the high homicide rates,⁷ which have been persistent from the late eighties, have had an annual negative impact on growth of 2%, and that an increase in the homicide rate of 10 points implies a reduction of 1 point in economic growth.

In the framework of these results Rubio criticizes the results reported by Armando Montenegro and Carlos Esteban Posada in '**Criminalidad en Colombia**'⁸ ('Criminality in Colombia') (1995), by pointing out that the positive relationship they find between criminality (homicide and theft rates from the National Police Department) and regional growth does not mean what they hypothesize, that violence is the result of the rapid economic growth of some regions.

Montenegro and Posada's explanation is that economic growth, generates an increase in criminality if it is not complemented with stronger institutions. Nevertheless, the authors recognize that when criminality reaches some critical level the argument is not longer true since the usual claims of violence impeding economic growth apply. Montenegro and Posada estimate an equation for the period 1975-1980 in which the annual growth rate of each region of Colombia depends on the crime rate per 10.000 inhabitants (homicide or theft) of the region, and the square of such rate. The coefficients are both significant and positive and negative respectively; what they interpret as an empirical confirmation of their hypothesis.

Instead, Rubio argues that their result is not robust to the different time spans. In fact, Rubio analyzes the correlation of both variables for different time periods and finds consistently that the more violent periods coincide with a low economic growth and that the years of faster growth are those with low homicide rates.

After this second simple-correlation approach Rubio investigates the relationship between criminality (he keeps using the homicide rate as the best proxy) and the decrease in Total Factor

⁶ One trillion is the equivalent to one million of millions in USA.

⁷ The homicide rate is usually understood as the number of killings over 100,000 inhabitants.

⁸ Montenegro, A., Posada, C. E. (1995). "Criminalidad en Colombia". *Coyuntura Económica*. Vol. XXV, No. 1, Mach.

Productivity (TFP) since the early 1980s (he does the estimation by decomposing the growth of the economy represented by a constant returns to scale Cobb-Douglas production function with capital and labor as inputs). Rubio, estimates a linear equation with TFP as dependent variable, on criminality and its variation, and controlling for the inflation rate. He finds a negative coefficient for both the level and the growth of criminality and concludes that the increase of the homicide rate during the 80s and 90s would have cost annually 2 percentage points of GDP.

Finally, Rubio calculates the relationship between criminality and investment (OLS regression) and, after controlling for the traditional determinants of investment (capacity utilization, capital stock, financial access and openness of the economy), he finds that if, in 1995, Colombia had the homicide figures of the seventies (20 per 100 thousand), the capital stock would have been 17% larger and this would have implied 0.7 percentage points of additional economic growth.

So, Rubio concludes that in a counterfactual situation in which criminality had not increased so much in the 80s and 90s, economic growth would have been 2.5% higher during the eighties and 3% during the nineties.

A couple of years later, in a work entitled '**Los Costos Económicos de la Criminalidad y la Violencia en Colombia: 1991-1996**'⁹ ('Economic costs of Criminality and Violence in Colombia: 1991-1996'), Edgar Trujillo and Martha Elena Badel deepen in the accountancy approach used by Rubio in the first part of his study. According to them, criminal activities generate two types of costs: the gross cost, which is the one paid by the victim of a particular crime (e.g. the value of a stolen or destroyed object or ransom for kidnaps) and the net cost, which is the macroeconomic one (value added of the economy). The underlying assumptions for such distinction are that some gross costs don't have macroeconomic consequences since they are a transference of resources from one agent to another (rescue fees, stolen objects, etc.) and that productivity is equal in both the formal and the criminal sectors.

Another distinction is the one they stress between direct and indirect costs. Direct costs refer to the destruction of capital: physical, human and natural resources. Indirect costs refer to second order costs of crime like wrong allocation of resources, decrease in investment rates and increase in transaction costs.

The paper estimates the gross and net direct costs of major crime forms from which it was possible to get information. It begins calculating the costs of urban criminality (meaning crime activities non related to the armed conflict) and then it estimates the cost of the conflict.

Urban Criminality

⁹ Trujillo, E., Badel, M. E. (1997). "Los Costos Económicos de la Criminalidad y la Violencia en Colombia: 1991-1996". *Planeación y Desarrollo*. Vol. XXVIII, No. 4, October-December.

- Human Capital loss. The authors calculate the human capital cost as the sum of the present value of the future income of killed individuals weighted by the probability of being employed according to their socioeconomic characteristics.
 - The information they use for this are homicide statistics from the National Police Department and Forensic Department. The average income and the unemployment rate of each socioeconomic group (stratum) is taken from the National Household Survey. The age of retirement (62) was assumed the same for all the victims.
 - The results of this calculation are those from 1991 to 1996. The loss in human capital was 9.08% of the GDP.
- Kidnapping. According to the National Police Department and the Fundación País Libre 4,624 people were kidnapped (by groups different from the guerrilla) between 1991 and 1996 in the urban areas (the guerrilla kidnappings will be calculated as part of the cost of the armed conflict). According to the same sources the average cost of the rescue fee was \$82 millions in 1995. Thus, the total revenue for kidnapers between 1991 and 1996 was \$322,725 millions of 1995, 0.5% of GDP.
- Crimes against private property. The Police Department values the economic loss of crimes as: theft (general theft and car theft), roguery, “voleteo”, hold-up to financial institutions, street piracy. These crimes added up to \$2,646,700 millions of 1995, 5.06% of GDP.
- Other costs. i) Between 1991 and 1996 the attention of victims of violent and terrorist actions cost the National Health System \$109,000 millions, 0.98% of GDP. ii) While average economic growth was 4%, the growth of the number of workers involved in private security activities’ was 10% between 1980 and 1996. This means that violence has created for the private sector an over cost related to the rapidly increasing private security. This cost was estimated in \$2,933,700 millions, 4.3% of GDP.

The total costs of urban criminality between 1991 and 1996 were \$11,095,400 millions, 16.32% of GDP (46% was due to human capital destruction, 26% to private security expenditures, 24% to crimes against private property and 4% to costs of kidnappings and violent-health attention). Taking out the transferences of resources between different economic agents (gross costs: kidnappings and crimes against private property) the net costs of urban criminality turned out to be 12% of GDP during the whole period, 2% of GDP every year.

Costs of the armed conflict

- Terrorist attacks against the power infrastructure. According to ECOPETROL, the reparation costs of the pipeline from 1992 to 1996 were approximately \$4,000 millions. According to INTERCOR, terrorist actions in 1996 were about US\$17 millions. According to ISA and EPM, the costs of terrorism against the electric infrastructure were \$1,500 millions to ISA and \$821 millions to EPM (1995 prices).

- Kidnapping. According to the National Police Department, between 1991 and 1996 kidnapping by guerrilla groups (mostly FARC and ELN) represented \$1,773,500 millions of 1995 in revenues for the rebels.
- Health. According to the Hospital Militar, the attention of injured soldiers and policemen in clashes between guerrilla and public forces cost \$22,500 millions of 1995.
- Life Loss. The estimation is the same they make to calculate the human capital loss of urban homicide, that is, the weighted present value of the future income of the 9500 individuals assassinated during clashes and attacks between 1991 and 1995. It added up to \$296,000 millions of 1995, 0.44% of GDP.
- Military expenditure. Compared to the Latin-American average, the excess of Colombian military expenditure in 1991-1996 was estimated in \$3,740,300 millions.

The total costs of the internal conflict between 1991 and 1996 were \$6,100,000 millions, 9% of GDP (1.5% each year). Taking out the inner-country transferences to get the net costs (i.e. kidnapping, theft, etc.) the costs were \$4,400,000 millions, 6.5% of GDP (1.1% each year).

Thus, adding up the urban and the armed conflict costs, Trujillo and Badel conclude that the gross costs of violence between 1991 and 1996 were \$17,200,000 millions of 1995, 23.5% of GDP (4.2% annual): 31% of this cost was due to life loss; 22% to excess of military expenditure; 17% to private security expenditures; 15% to crime against private property, 12% to kidnapping, theft and extortion and; 2% to terrorism. Urban criminality participation is 64.5% of the total costs and the internal conflict represents the remaining 35.5%.

In 1998, Clara Elena Parra's paper '**Determinantes de la Inversión en Colombia: Evidencia sobre el Capital Humano y la Violencia**'¹⁰ ('Determinants of Investment in Colombia: Evidence for Human Capital and Violence') considered the statistical analysis relating violence with the rate of domestic investment and, through it, to economic growth. Parra's paper estimated a model of the determinants of investment adding to the traditional explicative variables (aggregate demand, growth rate, variables of cost of capital, etc.) two additional independent variables: a human capital measure and a proxy of violence.

Parra's dependent variable is the total private investment (1950-1996 annual data, source: National Accounts –Banco de la República and DANE) and the independent variables are aggregate demand (source: DANE); real interest rate, relative prices of capital goods, and tax pressure (the last three variables are the proxies of cost of capital calculated by Cárdenas and Olivera (1995)); a human capital measure (growth rate of average years of education from the National Household Survey, or growth rate

¹⁰ Parra, C. E. (1998). "Determinantes de la Inversión en Colombia: Evidencia sobre el Capital Humano y la Violencia". *Archivos de Economía* 84. Departamento Nacional de Planeación.

of secondary enrolment rate from DANE and DNP); and a proxy of violence (lagged growth rate of the homicide rate from the National Police Department).

According to the results, the coefficient of the aggregate demand is positive and significant and the three variables of costs of capital have also the expected (negative) sign. As for the 'new' variables, education measures show a positive coefficient and violence a negative one.

If the homicide rate could be reduced to Latin-American standards (a reduction of 75%) the investment rate will increase 50% of its actual value. Parra found that a reduction of 10% in the homicide rate would have an impact of an additional 1.24% in the annual rate of economic growth.

At the end of the nineties many interesting studies were done, new quantitative techniques were applied, new and better quality datasets were used and research teams, centers and observatories specialized on violence were established. However, researchers and social scientists focused, once more, on the causes of violence. Towards the beginning of the current decade its relationship with economic growth was again stressed by Mauricio Cárdenas (2002) in his paper **'Economic Growth in Colombia: A Reversal of "Fortune"?'¹¹** where he uses standard growth decomposition regressions to study structural changes in the rate of RGDP growth (i.e. Real Gross Domestic Product) in Colombia and the role of Colombia's civil conflict and the drug trafficking business in its economic performance for the postwar era.

Cardenas' paper begins with a comparative and mostly narrative description of Colombia against a rich data set of countries in terms of size, macroeconomic performance, trade and indebtedness, geography and health, distribution and population fragmentation, political institutions and conflict and violence. The comparative analysis is based on mean and standard deviation measures of each of these variables. Colombia is an "average" country but there are at least two facts that emerge from this comparison: 1. Colombia is a very unequal country in terms of income and land distribution. Its population is also extremely fragmented: The Gini coefficient for income is 0.51, higher than the world average. The Gini coefficient for land is 0.86, only six countries from the sample have a higher coefficient. Fragmentation has the maximum possible value based on Knack and Keefer (1995). Rather than reflecting ethno-linguistic factors it reflects racial tensions. 2. Colombia is well above the average in terms of violence. Using the homicide rate as a proxy (source: U.N. Demographic Yearbooks), Colombia ranks first among 80 countries in 1995 with 80 per 100,000 inhabitants. In 1985 the rate was much lower (37.4 per 100,000) but still it ranked second among the 66 countries in the sample.

¹¹ Cárdenas, M. (2002). "Economic Growth in Colombia: A Reversal of 'Fortune'?". Center for International Development, Harvard University. Mimeo (version March 7).

Such comparisons motivated Cardenas' hypotheses on the role of inequality and violence in Colombia's economic performance. Therefore, in the second part of the paper the author reports measures of structural changes in the RGDP growth rate. Simple averages per decade over the past 50 years reveal that the growth rate of RGDP or RGDP per capita has substantially slowdown since 1980 (RGDP growth rate fell from an average of 5% between 1950-80 to an average of 3% since 1980). To formalize, the author runs the following regression to uncover structural changes in the rate of growth of RGDP (the data set covers the period 1950-2000):

$$\Delta y_t = \mathbf{m} + \mathbf{q}D_t + \sum_{j=1}^4 c_j \Delta y_{t-j} + e_t,$$

where y_t is the log of RGDP. D_t is a dummy variable that is zero before a date T_B and one afterwards. T_B stands for the year of structural change in the rate of growth of RGDP. Since the objective is to pin down T_B , the author runs 30 regressions moving T_B between 1960 and 1990. For each one of the regressions he tests the null hypothesis $\mathbf{q} = 0$. He then chooses the highest t-statistic among the different \mathbf{q} which allows him to identify 1979 as the year of structural change (the p-value for of the null in 1979 is 0.002). The result is the same if per capita RGDP is used.

Cardenas's next step is a 'sources of growth' exercise using a neoclassical production function with constant return to scale of the form:

$$\Delta y_t = \frac{\mathbf{a}}{1-\mathbf{a}} \Delta \ln \left(\frac{K_t}{Y_t} \right) + \Delta \mathbf{f}(E_t) + \Delta \ln A_t,$$

where $y_t, \frac{K_t}{Y_t}$ are output per worker and the capital/output ratio respectively, \mathbf{a} is the capital rent share of income (calibrated to 0.3), $\mathbf{f}(E_t)$ is some function of the years of schooling and A_t is the total factor productivity ($\Delta \ln A_t$ is calculated as the residual). Using two different measures of the function \mathbf{f} , the *return to schooling*¹², the results show that an implosion of total factor productivity accounts for the slowdown in RGDP growth since 1980. Between 1955-1979, TFP was on average 1.01%. Between 1980-2000 was -0.95%. For the same periods, per capita RGDP was 1.55% and 0.66% on average. Results are similar regardless of the function \mathbf{f} considered.

Cardenas then attempts to explain this productivity slowdown arguing that the huge increase in crime and drug trafficking since 1980 might play a special role. Production of cocaine, he argues, rose

¹² One measures uses return to education in Colombia (Nuñez-Sanchez, 2000). The other one uses return to education from Psacharopoulos (1994).

from less than 100 tons around 1980 to more than 500 tons in 1999. Ilicit crops increased from 20,000 hectares to 140,000 hectares in the same period. Homicides rate increased monotonically from 19 (per 100,000 inhabitants) in the 60's to 23 in the 70's, 41 in the 80's and 62 in the 90's. Kidnappings increased from an annual average of 44 in the 80's to 3,706 in 2000. These phenomena, Cardenas argues, feed back into each other. The relation between drug trafficking and crime has been analyzed by Gaviria (2000), the bottom-line being the use of huge rents from drug trafficking to finance rebels activities. Furthermore, since 1980 the Gini coefficient has increased steadily, from 0.46 in 1982 to 0.53 in 2000, breaking with a downward trend that started at the beginning of the 60's.

But, what is the link between crime and productivity? The main argument along the paper is that crime and violence destroy "social capital" or "social infrastructure" and hence they affect productivity in a negative way. The lack of social infrastructure encourages predatory behavior, diverting capital and labor to unproductive activities.

In order to test the link among crime, violence, income distribution and productivity, the author starts by running a linear regression of the log of TFP (obtained as the Solow residual from the reported regression model) on the log of the homicide rate (*hrate*), the Gini coefficient and Latin America's GDP growth rate (*LAGRGDP*):

$$\Delta \ln(TFP_t) = 5.24 - 0.04 \ln(hrte) + 0.99 Gini_t + 0.004 LAGRDP_t$$

The coefficients have the expected sign.

To push the argument further he looks for cross-country evidence by running the following regression:

$$\ln(dependent) = a + b(Institutions_t) + d(Geography) + e_t,$$

where the *dependent* is RGDP or TFP, *Institutions* is either the risk of confiscation and forced nationalization of property, the homicide rate, or the Gini coefficient; and *Geography* is infant mortality rate. The author controls for endogeneity among the different explanatory variables and the dependent variables by using different instruments.¹³

The author estimates eight models, using different dependent and explanatory variables. We just report two results (though not very encouraging) that seem to be the most important in line with the paper's argument. Using TFP as dependent variable and infant mortality and homicide rates as

¹³ Mean temperature, the portion of land within 100km of the sea coast and the absolute value of latitude are instruments for infant mortality rates. Following Acemoglu, Johnson and Robinson [2000], institutions measured as the risk of confiscation and forced nationalization is instrumented using a measure of 19th century mortality rates.

explanatory variables, his estimated coefficients have the right signs but the homicide rate is not significant. Dropping homicides rates and adding the Gini coefficient, the estimated coefficients turn out to be zero for the infant mortality rate and -0.02 for the Gini coefficient, which is significant.

Cardenas' paper has been very controversial among Colombian academics being this one of the reasons that encouraged young economists to study the impact of Colombian violence on the economic performance using different empirical approaches and data. Pablo Querubin's (2003) very recent paper '**Crecimiento Departamental y Violencia Criminal en Colombia**'¹⁴ ('Regional Growth and Criminal Violence in Colombia'), is especially important since it is one of the few papers in the Colombian literature that address' quantitatively the impact of violence on regional growth. It also provides some interesting data on the intensification of the Colombian conflict in the last twenty years as well as data on regional (departments) RGDP growth rates, central government transfers to the regions and different measures of the crime and civil conflict disaggregated by region¹⁵.

After reviewing the Colombian literature, the author proposes a 'differences in differences' methodology to study the impact of conflict on regional RGDP growth rates. The starting point for arguing in favor of it is the following relation:

$$\Delta y_{kt} = \mathbf{a} + \mathbf{d}_k X_k + \mathbf{g} + \mathbf{b}(\Delta Viol_{tk}) + \mathbf{e}_{tk},$$

Where Δy_{kt} is per capita RGDP growth rate of region k at time t , $\Delta Viol_{tk}$ is the rate of growth of different measures of regional conflict and X_k is a vector of specific regional variables that affect regional growth but that is invariant in time. The author points out two main problems with this specification. On the one hand, it is very likely that important determinants are omitted especially if one considers the difficulties of obtaining regional data for important economic variables. On the other hand, there is always an endogeneity problem which is very hard to solve using instruments. The author was not able to find good instruments to run a regression of this type. Therefore, he proposes to take first differences, getting rid of the specific regional effects and therefore he proposes the following model:¹⁶

$$\Delta y_{kt} - \Delta y_{kt-1} = \mathbf{g} + \mathbf{b}(\Delta Viol_{tk} - \Delta Viol_{t-1k}) + \mathbf{x}_{tk}$$

The author further controls for some variables that: are important at a regional level, have clearly changed over time and for which there is available data. These are central government transfers to the regions and

¹⁴ Querubin, P. (2003). "Crecimiento Departamental y Violencia Criminal en Colombia" *Documento CEDE* 2003-12, April.

¹⁵ Homicide rates, kidnappings, actions by armed illegal armed groups and illicit drugs income.

¹⁶ One of his main critiques to the existing literature in Colombia is the fact that they have completely ignored these two issues. That might help explain why the literature hasn't been conclusive on the effects of violence and conflict on growth.

illegal drugs regional income. He also considers the variable $Viol_{ik}$ as a vector with (the log of) different measures of conflict, complementing then these explanatory variables with per capita transfers and per capita illegal drugs income. The estimation method was GLS. The main results are the following¹⁷:

1. If in the three measures of conflict one includes (homicides, kidnappings and armed groups violent actions) all of them are significant at 1% and have the expected sign.
2. Adding illegal drugs income doesn't change the previous result. Interestingly, illegal drugs income enters with a positive sign and it is significant at 5%.
3. Adding central government transfers doesn't change the previous results and it doesn't help explaining the dependent variable.

In quantitative terms: an increase of 10 percentage points in the rate of growth of the rate of homicides implies a reduction of 0.37 percentage points in the RGDP growth rate. Similarly, the effect is 0.13 if the increase is on the rate of growth of the rate of kidnappings. Finally the effect is 0.07 if the change is on the third measure of conflict. As the author argues, this doesn't mean that this last factor has a minor effect on the acceleration of per capita RGDP. In fact, in some regions and at some periods of time, the change in the rate of growth of armed group actions has been up to 500 percentage points.

Contemporaneous to the study of Querubín, Juan F. Vargas's paper '**Conflicto Interno y Crecimiento Económico en Colombia**'¹⁸ ('Internal Conflict and Economic Growth in Colombia') leaves aside criminality measures and focuses primary on the economic impact of the civil conflict. The author observes that Colombian economic growth has slowed down importantly in the last years and argues that, among other traditional explanations, the increase in the intensity of the internal conflict can be associated to some extent with this phenomenon. The author develops a neoclassical growth model in which both total factor productivity and the accumulation of physical and human capital are endogenous to the intensity of the conflict, and estimates it using quarterly data from 1988 to 2001. He finds that the growing intensity of the conflict accounts for a slowdown in the rate of economic growth of more than 2 percentage points.

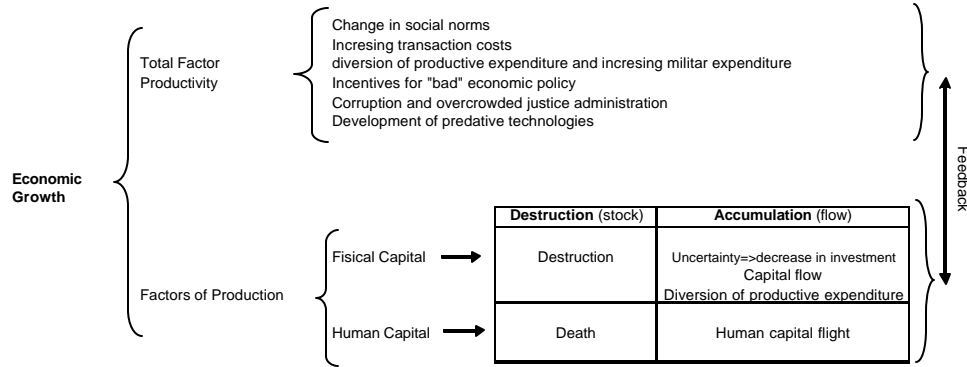
In the first part of the paper Vargas revises the international literature on civil wars and the Colombian growing literature on the country's internal conflict. The author underlies some shortcomings of previous studies like the use of cross section regressions (and thus the lack of dynamics) in the international case or the emphasis in the use of criminal figures instead of conflict-related data in the case

¹⁷ Notice, the author doesn't keep track of the statistical properties of e_{ik} in the first regression; he rather assumes a new error term in the second equation.

¹⁸ Vargas, J. F. (2003). "Conflicto Interno y Crecimiento Económico en Colombia". Tesis PEG, Universidad de los Andes, May.

of Colombia. Exceptions to both cases are also recognized. Vargas discusses some possible transmission mechanisms from conflict to the economic (Fig. 1).

Figure 1 (Source: Vargas 2003)



In order to assess the impact of the conflict, the author proposes a simple Solow-type Neoclassical growth model with human capital –like the one used by Mankiw, Romer and Weil (1992)— in which TFP, and the accumulation rate of both forms of capital depend, among other traditional determinants, on the intensity of the conflict ‘ α ’.

$$Y_t = K_t^a H_t^b [A_t(\cdot, c_t) L_t]^{1-a-b}$$

$$\dot{K}_t = s_t^k(\cdot, c_t) K_t^a H_t^b [A_t(\cdot, c_t) L_t]^{1-a-b} - \delta K_t;$$

$$\dot{H}_t = s_t^h(\cdot, c_t) K_t^a H_t^b [A_t(\cdot, c_t) L_t]^{1-a-b} - \delta H_t,$$

where Y_t is the level of income; K_t and H_t are physical and human capital respectively; L_t is the labor force; A_t is the labor-augmenting productivity; s^k and s^h are the rates of accumulation of physical and human capital respectively and δ is the rate of depreciation that is assumed the same for both forms of capital.

In terms of effective units of labor the model can be written as:

$$\hat{y}_t = \hat{k}_t^a \hat{h}_t^b$$

$$\hat{k}_t = s_t^k(\cdot, c_t) \hat{k}_t^a \hat{h}_t^b - \hat{k}_t [d + n + g]; \hat{h}_t = s_t^h(\cdot, c_t) \hat{k}_t^a \hat{h}_t^b - \hat{h}_t [d + n + g],$$

where n and g are the growth rates of labor force and technology respectively.

Vargas then finds the steady state income, multiplies by the productivity, applies logs and writes the first difference of the resulting equation:

$$\Delta y_t = \Delta A_t(\cdot, \Delta c_t) + a_2 \Delta s_t^k(\cdot, \Delta c_t) + a_3 \Delta s_t^h(\cdot, \Delta c_t)$$

The author also assumes simple functional forms for the right hand side variables. He replaces the change in A_t , the TFP, by Δc_t and a residual, obtaining a regression model where Δc_t will capture the direct impact of the conflict in the output growth. As for the other right hand side variables, Vargas assumes a simple autoregressive behavior attempting to capture, with the lag of s^k and s^h , the effect of other determinants on the investment rates of physical and human capital, different than the intensity of the conflict. Therefore Vargas estimates the following recursive system of equations:

$$\Delta y_t = a_1 \Delta c_t + a_2 \Delta s_t^k(\cdot, \Delta c_t) + a_3 \Delta s_t^h(\cdot, \Delta c_t) + \mathbf{e}_{1t}$$

$$\Delta s_t^k = b_1 \Delta s_{t-1}^k + b_2 \Delta c_t + \mathbf{e}_{2t}$$

$$\Delta s_t^h = d_1 \Delta s_{t-1}^h + d_2 \Delta c_t + \mathbf{e}_{3t},$$

where a_1 captures the direct impact of conflict on the growth rate of output per capita, a_2 the indirect effect through physical capital accumulation and $a_3 d_2$ the indirect effect through human capital accumulation. 3SLS estimates indicate that the increase in the intensity of the Colombian conflict since the late 1980s accounts, on average, for 0.3 percentage points of the slowdown of the growth rate of per capita income during the 90s. Moreover, the further intensification of the bellicose actions since 1997-1998 could have caused a slowdown of more than 1 percentage point in the per capita growth rate. This is almost 3 percentage points of economic growth after adding up population growth. Most of this impact (90%) on average is a direct impact (via TFP growth) and the rest is an indirect impact via physical capital accumulation.

More recently, the literature has turned to other quantitative approaches. In particular researchers are now exploiting the Real Business Cycles (RBC) approach to look at the violence-economy relationship. Surprisingly, this methodological paradigm of modern economics is quite absent in the Colombian literature on violence and growth. Now, even though it doesn't address explicitly the relation between violence and growth, Andres Arias and Laura Ardila's paper on '**Military Expenditures and Economic Activity**'¹⁹ does introduce in the Colombian literature a well known methodological tool to address the problem. Their model is a standard RBC enhanced with military expenditures that reduces the rate of capital destruction due to the armed conflict. That is, the model captures a trade off in military

¹⁹ Arias, A., Ardila, L. (2003). "Military Expenses and Economic Activity" *Documento CEDE* 2003-20, August.

expenditures: the crowding out of private consumption and investment vs. less capital destruction and therefore higher marginal productivity of capital and labor. Therefore, they analyze how the military expenditures affect the economic activity by a way of reducing, before overcrowding effects show up, the negative effects of capital depletion due to conflict.

The paper by Arias and Ardila is contemporaneous to that of Mejía and Posada (2003) reviewed below. The later takes a similar approach: a dynamic general equilibrium model but with two important differences. First, the armed conflict increases capital destruction as in Arias and Ardila but here there is a fraction of the labor force that is diverted to the defense sector in order to counterbalance the destructive nature of the armed conflict. Therefore the trade off is between more employment dedicated defense sector (and hence less capital destruction), and less employment in the final goods productive sector. Second, they do not calibrate the model to Colombian data. It is a purely theoretical exercise motivated by some interesting data on Colombia (see below).

Back to Arias and Ardila, their model assumes that capital accumulates according to:

$$k_{t+1} = (1 - \mathbf{d})(1 - \mathbf{g}_t)k_t + I_t$$

Where k_t is the real stock of capital, I_t is gross real investment, \mathbf{d} is the rate of depreciation of capital and \mathbf{g}_t is the rate of capital destruction due to the armed conflict. The amount of capital observed and used for production in period t is $(1 - \mathbf{g}_t)k_t$.

Capital destruction is related to real government expenditures in the military, m_t by:

$$\mathbf{g}_t = bm_t, b < 0.$$

Except for these two features, the model is a standard RBC model: preferences are logarithmic in consumption and linear in employment (i.e. labor is indivisible as in Hansen, 1985), aggregate technology is summarized by a constant returns to scale production function with two inputs: capital and labor.

The model is calibrated to match long run properties of the Colombian economy. Of particular interest is the steady state value of \mathbf{g}_t and b . The former is set to 0.027.²⁰ That is, besides the regular depreciation of capital in the production process, an additional 3% of the capital stock is lost every year due to the internal conflict. The parameter was calibrated based on the cost in terms of output of shifting between an economy with the same technology and employment rate, but different steady state value of \mathbf{g}_t . Using other studies (Trujillo and Badel, 1997 –here referred- and Contraloría General de la

²⁰ This is the value reported in the Calibration Appendix, section 7, page 13.

Republica, 2002) with different techniques they have estimated this cost to be around 1.22% of GDP, g , was calibrated around 0.027. Now, given military expenditures in the steady state, the parameter b is calibrated in order to be consistent with the resource constraint.

As for the results, the authors calculate the impact on output, consumption and investment of a 1% increase in government expenditures. Even though it is a temporary shock it is persistent lasting for a few years. Their results show a cost in terms of consumption in the first years due to the crowding out effect while capital destruction is slowed. After ten years, output is 11.68% percent above steady state (having been always above steady state), consumption is 0.72% above steady state (having been below steady state for a few years) and investment 9.9% above steady state (having been always above steady state). Therefore the paper finds an unambiguous positive effect on investment and output. In terms of consumption, there is a negative effect during transition but a positive one after a couple of years. The authors don't provide welfare estimates of the policy experiment.

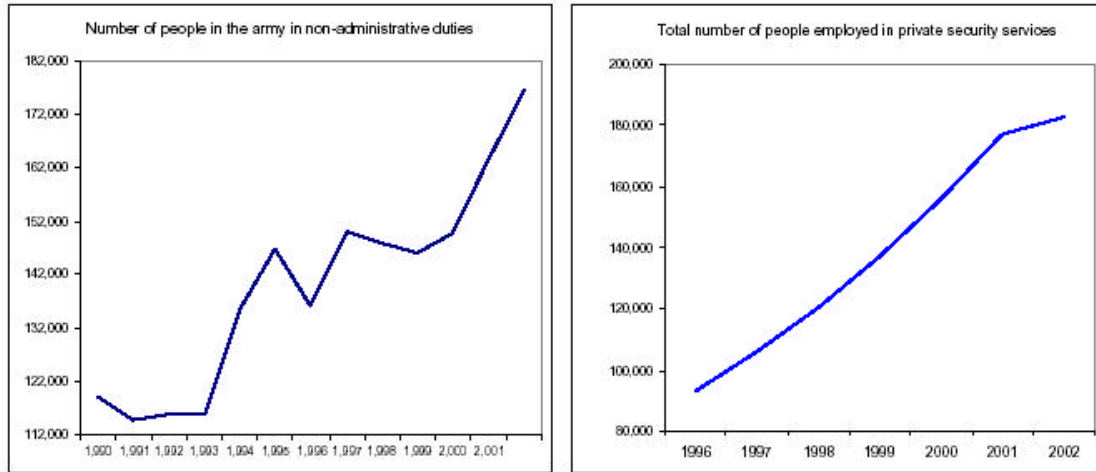
Daniel Mejía and Carlos Esteban Posada's '**Capital Destruction, Optimal Defense and Economic Growth**'²¹ takes a similar perspective to the one by Arias and Ardila. Rather than calibrating the model to Colombian data, they make a general analysis of the properties of the model. The paper is motivated by focusing on two aspects of Colombian data: The huge increase in the last decade of internal conflict in Colombia and, a considerable reallocation of labor to the defense sector. This data suggests a model in which labor reallocation as opposed to military expenditures is the activity counterbalancing the effects of the internal conflict measured as exogenous capital destruction. Therefore both papers (this one and Arias and Ardila) model the effects of the internal conflict in the same way (i.e. the internal conflict exogenously destroys the capital stock) but differ in the economic forces that lean against destruction. In the former, it is military expenditures that reduce capital destruction and in the latter it is a fraction of the labor force that, rather than working in the final goods sector, optimally choose to work in the defense sector. The greater the amount of workers allocated to the defense sector, the lower the rate of capital destruction. The most interesting and original data with respect to the other studies reviewed in this survey is related to the amount of people reallocated to the defense sector. The two figures below illustrate the point.

The model they use is similar to the neoclassical growth model (Ramsey-Cass-Koopmans) with one basic modification that drives all their results. It assumes that the labor force doesn't grow, and normalizes it to one.

Let r_t be the fraction of the labor force allocated to the defense sector. Then the aggregate production function of the economy is given by:

²¹ Mejía, D., Posada, C. E. (2003). "Capital Destruction, Optimal Defense and Economic Growth" *Borradores de Economía* No. 257, Banco de la Republica, May.

$$Y_t = AK_t^a (1 - r_t)^{1-a}$$



Where all symbols have their usual meaning. Capital accumulation is given by:

$$K_{t+1} = (1 - d_t)K_t + I_t,$$

where K_t is the stock of physical capital, I_t is gross investment and d_t is the net rate of violent or criminal destruction per unit of physical capital (this also includes the natural rate of capital depreciation, \bar{d}). This in turn depends on the allocation of the labor force to the defense sector:

$$d_t = \bar{d} - (\bar{g} + g_1 \bar{d}) \frac{r_t}{K_t},$$

where \bar{g} and g_1 are parameters to be calibrated. The model has two interesting implications: 1. Countries with a high level of capital per worker (i.e. rich countries) would have a smaller proportion of their labor in the defense sector. 2. A temporary increase in \bar{d} (i.e. like in a civil war) has a strong and negative effect on short term growth rates of output and consumption.

Conclusions

After a highly violent period known as “La Violencia” (1946-1962), Colombia’s record of crime stabilized to Latin American standards²² despite the formation of different rebel groups in its aftermath

²² In terms of the homicide rate.

and the growing drug business. Yet, all violence manifestations seem to start rapidly growing again in the early eighties turning the attention of social scientists to the analysis of their causes and consequences. Nevertheless, quantitative approaches did not appear before mid-nineties. Gaitán (1995), Rubio (1995) and Posada and Montenegro (1995) are among the most recognized precursors of this trend. The literature on conflict and crime has expanded even after being now one of the main research agendas of social scientists who now have available a number of datasets and techniques to help them make their contribution.

Indeed we believe there is a huge agenda ahead. Both the causes and the consequences of violence need to be further studied empirically. Techniques such as RBC models are novel to this particular subject and still have to make their break through. New datasets are becoming available (eg. Restrepo, Spagat and Vargas, 2003) and need to be urgently exploited. Also we think some theoretical modeling has to be done in order to explain the Colombian particular characteristics that do not seem to be addressed by the existing theoretical literature which focuses on social-class conflict and predatory behaviors. We do hope this short review will create more questions than answers motivating the research in the subject.

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²³ See footnote 3.

²⁴ Rubio does not provide the complete reference.

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