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Does Crime Lower Growth? Evidence from Colombia

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About the Series

The Commission on Growth and Development led by Nobel Laureate Mike Spence was established in April 2006 as a response to two insights. First, poverty cannot be reduced in isolation from economic growth—an observation that has been overlooked in the thinking and strategies of many practitioners. Second, there is growing awareness that knowledge about economic growth is much less definitive than commonly thought. Consequently, the Commission's mandate is to "take stock of the state of theoretical and empirical knowledge on economic growth with a view to drawing implications for policy for the current and next generation of policy makers."

To help explore the state of knowledge, the Commission invited leading academics and policy makers from developing and industrialized countries to explore and discuss economic issues it thought relevant for growth and development, including controversial ideas. Thematic papers assessed knowledge and highlighted ongoing debates in areas such as monetary and fiscal policies, climate change, and equity and growth. Additionally, 25 country case studies were commissioned to explore the dynamics of growth and change in the context of specific countries.

Working papers in this series were presented and reviewed at Commission workshops, which were held in 2007–08 in Washington, D.C., New York City, and New Haven, Connecticut. Each paper benefited from comments by workshop participants, including academics, policy makers, development practitioners, representatives of bilateral and multilateral institutions, and Commission members.

The working papers, and all thematic papers and case studies written as contributions to the work of the Commission, were made possible by support from the Australian Agency for International Development (AusAID), the Dutch Ministry of Foreign Affairs, the Swedish International Development Cooperation Agency (SIDA), the U.K. Department of International Development (DFID), the William and Flora Hewlett Foundation, and the World Bank Group.

The working paper series was produced under the general guidance of Mike Spence and Danny Leipziger, Chair and Vice Chair of the Commission, and the Commission's Secretariat, which is based in the Poverty Reduction and Economic Management Network of the World Bank. Papers in this series represent the independent view of the authors.

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Abstract

Many analysts consider that lack of security is a major obstacle to growth in Colombia. This paper identifies a structural downturn in economic growth—of nearly two percentage points per year—as a result of the increase in illicit crops and crime rates after 1980. A decline in total factor productivity has been the key channel linking crime and economic growth. Political upheavals and high levels of inequality and poverty motivated the adoption of a new constitution in 1991. The constitution mandated additional fiscal expenditures to curb social tensions. Major progress has been made in terms of public safety and, to a lesser extent, in the provision of health and education. However, long-run growth will continue to be constrained by inadequate transport infrastructure and low international trade volumes.

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Introduction

There is a simple reason as to why Colombia (pop. 42.2 million and US$136 billion in nominal GDP in 2006) is an interesting case study for the purposes of the Commission on Growth and Development. After having been a relatively successful growth performer between 1950 and 1980, Colombia's economic growth decelerated considerably after 1980. Although the 1980s were the lost decade for most Latin American countries, what is interesting about Colombia is that during the 1990s, when growth was in full recovery across the region, growth decelerated even further. In this paper we emphasize the role of sharp changes in security conditions in explaining this result. In addition to the empirical analysis of the impact of a security shock, we look at the policy responses, some of which can also have lasting effects on growth.

The paper starts by exploring the "deep" or fundamental long-run growth determinants in Colombia, using variables that capture human capital, institutions, and geography. The main message is that Colombia's per capita GDP in 2000, as well its growth rate between 1960 and 2000, does not deviate considerably from the predictions of a standard model, where human capital, institutions, and geography are measured and instrumented in standard ways. What this means is that better security conditions can bring GDP growth back to its long-term rate, but to further accelerate growth Colombia needs to make improvements in some of the more fundamental determinants of growth.

The paper then moves to the analysis of the annual time series. The evidence indicates a large and significant downturn in GDP growth—of the order of two percentage points per year—which occurred around 1979. Moreover, using a standard growth decomposition exercise we are able to find that the GDP growth deceleration is explained by a reversal in total factor productivity growth, suggesting that changes in the rate of physical and human capital accumulation were not the main cause of the problem.

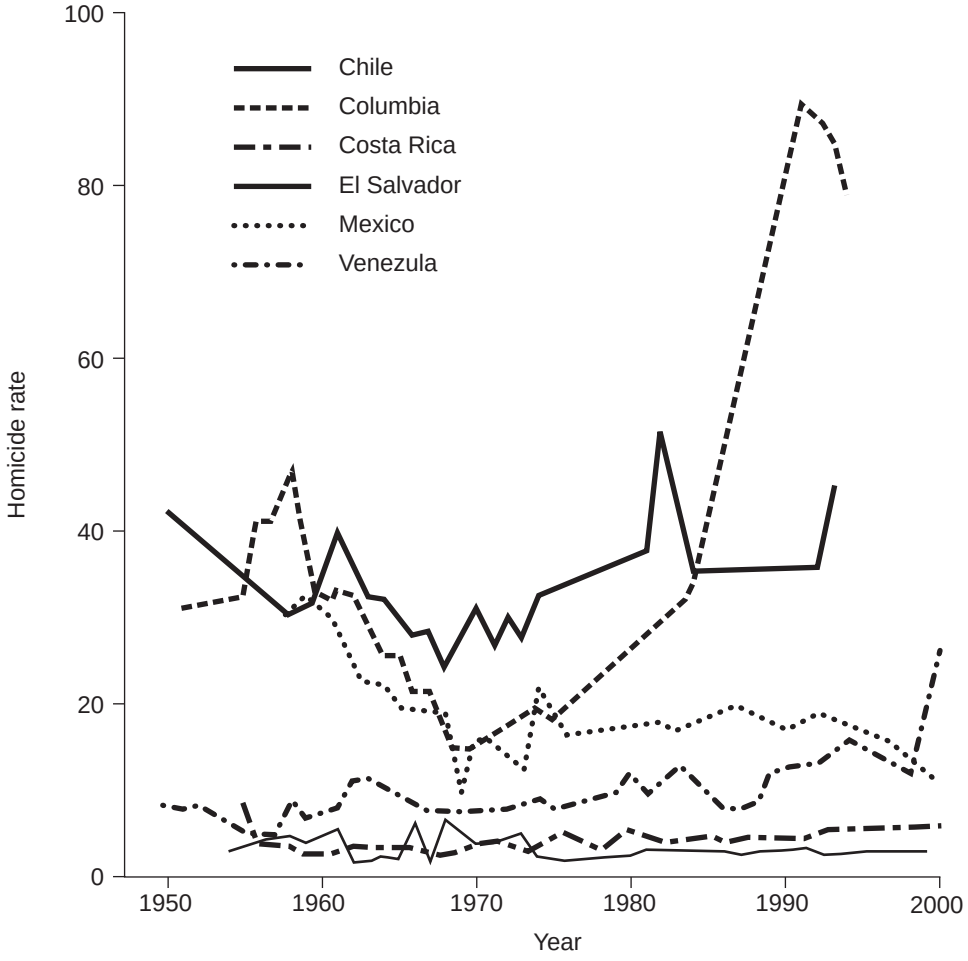
How did this growth collapse come about? We argue that the exponential increase in drug trafficking and crime was the driving force behind the reversal in total factor productivity. As we will show, illicit drug trade took off

[1] Both authors were at Fedesarrollo in Bogotá, Colombia while this paper was prepared.

unexpectedly during the late 1970s and early 1980s, causing a major deterioration in public safety and, ultimately, affecting long-run economic growth. We are not alone in this interpretation. In fact, there is a growing body of literature that gives drug trafficking a center-stage role in explaining changes in outcomes and trends in various socioeconomic variables in Colombia.[2]

Figure 1 shows the annual time-series data from the World Health Organization on homicide victimization rates per one hundred thousand residents for varying years between 1950 and 2000 (available for forty four countries). What the data shows is that homicide rates in Colombia skyrocketed during the 1980s, reversing the significant decline observed between 1960 and the mid 1970s.

Figure 1: Homicide Rates in Latin America 1950–2000



Source: World Health Organization.

[2] See Ibáñez and Jaramillo, 2007 for a recent survey. The relationship between lack of public safety and Colombia´s disappointing growth performance has been analyzed by Echeverry et al. (2001) and Cárdenas (2007). Angrist and Kugler (2008) find evidence on the link between drugs and violence, and little positive economic spillover of the drug business. Urdinola (2004) and Camacho (2007) study the effects of violence on infant mortality and low birth weight.

The sharp increase in the homicide rate makes Colombia an ideal case to study the complexities of the relationship between crime and growth. Unfortunately, lack of reliable crime data prior to the 1950s prevents a more comprehensive historical analysis, which until now has relied primarily on the narrative on the political causes and social implications of civil conflict. In this paper we focus on the period 1958–2006, which could be loosely characterized as the phase associated with the end of the bipartisan conflict and the beginning of the guerrilla activities in Colombia. This period had two clearly different phases: before and after the emergence of Colombia as a major drug producer in 1980. In the first phase the homicide rate was falling, conflict was of low intensity, and economic growth was not constrained by security considerations. In the second phase all this changed with the exponential increase in drug cultivation and trafficking.

Box 1: Conflicts in Colombia

Conflicts have been a recurrent theme in Colombia's history. Some of the more violent episodes during the nineteenth century included the War of the Supremes (1839–42), the War of the Convents (1851), the 1877 war, and the Thousand Days War (1899–1903). The mid-twentieth century was also tumultuous, especially after the late 1940s. In 1948, the assassination of Jorge Eliécer Gaitán, a leftist leader with wide popular support, marked the beginning of a new wave of partisan conflict known as *La Violencia*. As a result, homicide rates steadily rose throughout the 1950s leading in 1958 to a power-sharing agreement (called the National Front) between the two main political parties (liberal and conservative). The pact was successful in reducing violence (the homicide rate fell considerably), but excluded the left from political participation and access to power. In response to that exclusion, and inspired by the Cuban revolution, insurgent groups formed in the mid-1960s (such as ELN, EPL, and FARC). Although relatively small and concentrated in certain regions of the country, these groups were consolidated throughout the 1970s, attacking military targets, and seizing small municipalities in the rural areas. Most of their financing came from kidnappings and bank robberies. However, based on the homicide rate of the period and the number of terrorist attacks, the conflict during the 1970s was not particularly intense.

Conditions changed dramatically during the 1980s with the emergence of major drug trafficking activities in Colombia, and the subsequent creation of the paramilitary groups (to protect the drug cartels from guerilla attacks). The intensity of the conflict escalated to unprecedented levels in terms of homicides, kidnappings, and terrorist attacks, especially after the guerilla engagement in the drug business in the early 1990s. Also, conflict became more generalized across the various regions of the country. As a result, Colombia was one of the worst performers in the world in terms of public safety in the 1990s.

There are many possible channels through which conflict can affect growth. In this paper, in addition to underscoring the role of total factor productivity as a key channel, we discuss at a very preliminary level the effects of crime on fiscal policies. Political and social unrest during the 1980s, associated with the expansion of drug trafficking, increased popular support for a major political reform. The 1991 constitution materialized that sentiment by mandating an expansion of the public sector in order to deliver more security, justice, and social services. Also, security and defense expenditures responded to the worsening safety conditions. Problems of exclusion—considered an underlying determinant of the conflict—motivated the expansion in social expenditures, especially in health and education.

Although a comprehensive analysis of these policy decisions is beyond the scope of this paper, the large increase in government expenditures in security and social sectors crowded out some key investments in infrastructure, which some consider a binding constraint for growth in Colombia. Also, many of the additional expenditures were either hardwired into the 1991 constitution or made inflexible by subsequent legislation. As a result, fiscal policy lost some capacity to adapt to economic circumstances. Another relevant consideration is related to tax policy. The need to rapidly raise fiscal revenues was costly in terms of the tax structure. Inefficient taxes were created, tax rates were raised, and the use of tax exemptions and benefits to compensate certain sectors became pervasive. In sum, fiscal policies have been characterized by lack of sustainability, inefficiencies in taxation and expenditures, and excessive rigidity. This is a situation that countries facing extreme conflict and crime conditions would like to avoid.

We develop the analysis on the growth implications of these policy responses in the seven following sections of this paper. Section 2 analyses the "deep" or "fundamental" determinants of growth and concludes that Colombia is not an outlier in a cross section of countries. Using the time series evidence, Section 3 finds that a structural downturn in growth occurred in 1979. Section 4 presents the standard sources-of-growth decomposition in order to quantify the role of physical and human capital accumulation, as well as technological change in per-worker GDP growth. The key finding of this section is that the deceleration in growth was the result of an implosion in total factor productivity, rather than changes in factor accumulation. Section 5 deals with the causes of the productivity implosion and finds that, to a large extent, the exponential increase in crime and violence was a key driver. In spite of the limited number of observations, the econometric evidence supports the argument that illicit drug trade *caused* more crime, and that crime in turn had a negative impact on total factor productivity. Section 6 reinforces the link between drugs, crime, and

growth by looking at the department-level data. Section 7 looks in a broad way at policy response, mainly in the fiscal areas. Finally, section 8 concludes with some lessons and policy recommendations that could be useful for countries that face similar shocks.

A Look at the Fundamentals

The growth literature, new and old, has identified human capital and institutions as the fundamental variables that explain economic progress in any country. However, a consensus has not been reached over whether economic growth and human capital cause good-quality institutions, or vice versa. In their well known papers Acemoglu, Johnson, and Robinson (2001 and 2002) and Rodrik, Subramanian, and Trebbi (2002), suggest that institutions are the primary cause of economic growth. However, Glaeser et al. (2004) support the idea that human capital accumulation has been a necessary factor for the generation of institutions.

We do not attempt to settle the debate over the causality between institutions, human capital, and growth. More modestly, we want to measure to what extent these fundamental variables are good predictors of Colombia's per capita GDP growth and to determine if there are other additional variables, ignored by these simple models, which have affected Colombian economic growth. In particular, we follow Glaeser et al. (2004) and regress per capita GDP growth between 1960 and 2000 on the logarithm of GDP per capita in 1960, the log years of schooling in 1960, the share of population living in a temperate zone in 1995, and three measures of institutional quality: (i) constraints of the Executive (average between 1960 and 2000); (ii) risk of expropriation (average between 1982 and 1997); and (iii) autocracy (average between 1960–90). With the purpose of identifying a country-specific growth determinant, we add a dummy variable for Colombia.

Table 1 shows the estimation results for a total of 217 countries (the variables′ definitions and sources are identical to the ones in Glaeser et al., 2004). The estimations show the now standard observation of convergence (negative coefficient on initial income) and a positive effect of the share of the population living under temperate weather. Moreover, the evidence shows a strong positive correlation of economic growth with institutional variables and initial years of schooling. Our variable of interest is the Colombian dummy that comes out not statistically significant, suggesting that beyond human capital and institutions, Colombia-specific determinants are not relevant in explaining economic growth. In other words, Colombia's growth performance between 1960 and 2000 can be predicted given its initial levels of income and education, the presence of tropical conditions, and measures of institutional quality.

Table 1: Ordinary Least Squares (OLS) Estimations

Dependent variable growth of GDP per capita 1960-2000	Eq. 1	Eq. 2	Eq. 3
Log GDP per capita (1960)	–0.001***	–0.013***	–0.011***
	(0.003)	(0.003)	(0.003)
Log years of schooling (1960)	0.005**	0.007***	0.006**
	(0.002)	(0.0023)	(0.002)
Share of population living in temperate zone (1995)	0.017**	0.013***	0.017***
	(0.005)	(0.004)	(0.005)
Executive constraints (1960–2000)	0.002**		
	(0.0008)		
Expropriation risk (1982–97)		0.003***	
		(0.001)	
Autocracy (1960–90)			–0.005*
			(0.003)
Dummy Colombia	0.001	0.002	0.0007
	(0.002)	(0.002)	(0.003)
R^2	0.41	0.56	0.43
Observations	71	69	71

Source: Authors' calculations.

Notes: *** significant at 1%; ** significant at 5%; * significant at 10%.

We next control for endogeneity between growth, institutions, and human capital using instrumental variables (IV). In the first stage, we estimate the average years of schooling and the institutional quality variables (executive constraints, expropriation risk, and autocracy) on French legal origin, the logarithm of settler mortality, the logarithm of 1,500 population density, and a dummy variable for Colombia (again variables are defined in Appendix 1). In the second stage, the log of GDP per capita in 2000 is regressed on the log years of schooling, the institutional quality measure and the share of the population living in temperate zones.

The results, shown in table 2, suggest that human capital is a strong predictor of GDP growth but institutional variables are not. More relevant for the purposes of this paper, the dummy variable for Colombia is not significant in the first stage regressions, suggesting that the level of schooling and the institutional quality are in line with what can be expected according to the more exogenous determinants, such as legal origin, geographic characteristics, and type of colonial settlements. The dummy remains insignificant when it is included in the second stage, implying that Colombia's level of income is well explained by the log of the years of schooling, which was relatively low in 1960. This is important because it implies that education is a key element that could explain why Colombia has not performed better in terms of growth. Looking ahead, although some progress has been made on this front, the increase in educational attainment should be considered as a top priority.

Table 2. Instrumental Variables

a. Dependent variable is log GDP per capita in 2000. Dummy for Colombia in first stage

Panel A: Second-stage regressions

	(1)	(2)	(3)
Years of schooling (1960–2000)	0.55***	0.44***	0.37**
	(0.16)	(0.11)	(0.15)
Executive constraints (1960–2000)	−0.16		
	(0.16)		
Expropriation risk		−0.23	
		(0.25)	
Autocracy (1960–90)			−0.10
			(0.61)
Share of population living in temperate zone (1995)	−0.69	0.11	−0.09
	(0.70)	(0.47)	(0.63)
R^2	0.64	0.64	0.76
Observations	47	44	47

Panel B: First-stage regressions

	Executive	Years of school	Expropriation	Years of school	Autocracy	Years of school
Share of population living in temperate zone (1995)	−1.25	1.72**	1.21*	1.66**	0.31	1.72**
	(0.75)	(0.82)	(0.61)	(0.85)	(0.26)	(0.82)
Log settler mortality	−0.71***	−0.93***	−0.31**	−0.93***	0.21**	−0.93***
	(0.18)	(0.20)	(0.14)	(0.20)	(0.06)	(0.20)
Log population density in 1500	−0.39***	−0.55***	−0.1198	0.57***	0.09**	−0.55***
	(0.12)	(0.13)	(0.10)	(0.14)	(0.04)	(0.13)
French legal origin	−1.69***	−0.65	−0.85**	−0.66	0.24*	−0.65
	(0.38)	(0.42)	(0.314)	(0.43)	(0.13)	(0.42)
Dummy for Colombia	1.96	−0.15	0.97	−0.17	−0.75*	−0.16
	(1.19)	(1.30)	(0.96)	(1.33)	(0.41)	(12.96)
R^2	0.64	0.78	0.56	0.77	0.47	0.78
Observations	47	47	44	44	47	47

(Table continues on next page)

Table 2 (continued)

b. Dependent variable is log GDP per capita in 2000. Dummy for Colombia in second stage

Panel A: Second-stage regressions

	(1)	(2)	(3)
Years of schooling (1960–2000)	0.6***	0.46***	0.64
	(0.18)	(0.13)	(0.44)
Executive constraints (1960–2000)	−0.23		
	(0.18)		
Expropriation risk		−0.31	
		(0.29)	
Autocracy (1960–90)			1.12
			(1.98)
Share of population living in temperate zone (1995)	−0.84	0.20	−0.95
	(0.78)	(0.52)	(1.59)
Dummy for Colombia	0.73	0.58	1.19
	(0.74)	(0.67)	(1.67)
R^2	0.58	0.58	0.38
Observations	47	47	47

Panel B: First-stage regressions

	Executive	Years of school	Expropriation	Years of school	Autocracy	Years of school
Share of population living in temperate zone (1995)	−1.25	1.72**	1.21**	1.66**	0.31	1.72**
	(0.75)	(0.81)	(0.61)	(0.85)	(0.26)	(0.81)
Log settler mortality	−0.71***	−0.93***	−0.31**	−0.93***	0.21***	−0.93***
	(0.18)	(0.20)	(0.14)	(0.20)	(0.06)	(0.19)
Log population density in 1500	−0.39***	−0.55***	0.11	0.57***	−0.55***	−0.55***
	(0.12)	(0.13)	(0.10)	(0.14)	(0.13)	(0.13)
French legal origin	−1.69***	−0.65	−0.85**	−0.66	−0.65	−0.65
	(0.38)	(0.42)	(0.314)	(0.43)	(0.41)	(0.41)
Dummy for Colombia	1.96	−0.15	0.97	0.17	−0.15	−0.15
	(1.18)	(1.30)	(0.96)	(1.33)	(1.29)	(1.29)
R^2	0.64	0.78	0.56	0.77	0.78	0.78
Observations	47	47	44	44.00	47	47

Source: Authors' calculations.

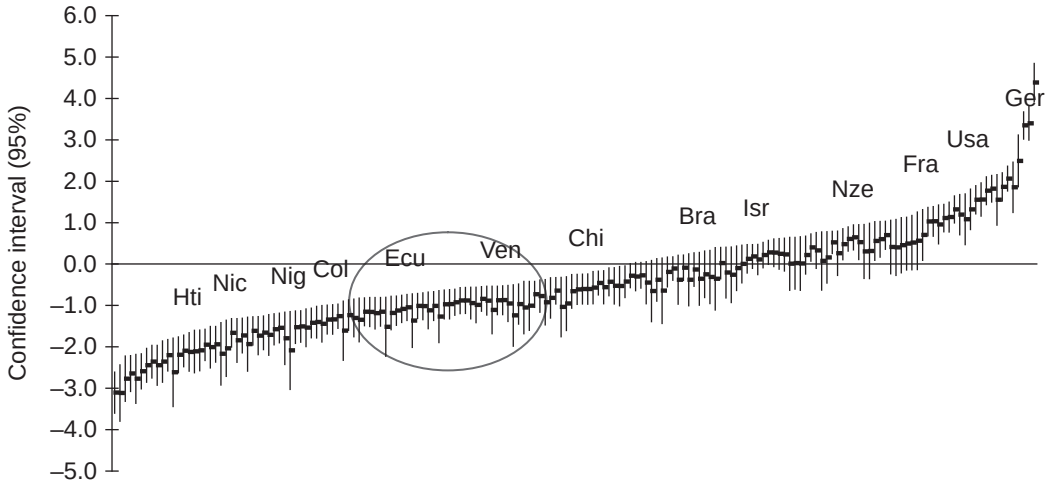
Notes: *** significant at 1%; ** significant at 5%; * significant at 10%.

At a different level, the relationship between trade and growth has also received significant attention in the growth literature. Several studies have analyzed the effects of trade on income. Frankel and Romer (1999) found that trade has a quantitatively large, positive, and robust effect on income.[3] Their empirical test is based on a measure of trade that is constructed using the gravity model, reducing the endogeneity problems between trade and growth. Their model uses geographic variables, such as distance between countries, size, and other covariates that are exogenous to growth.

Based on the database constructed by Rose (2004), including 234,597 bilateral trade observations from 178 countries during the period 1948–99, Cárdenas and García (2005) estimated trade between two countries as a function of distance between their main cities, GDP, population and area of each country, and other dummy variables that account for a common language, borders, trade agreements, and currencies.[4] The estimation also includes country fixed effects to see if the model is a good predictor of the countries' actual level of trade.

In the case of Colombia, the fixed effect is largely negative, suggesting that the geographical variables overestimate the level of trade. More precisely, the coefficient on the country dummy shows that Colombia's foreign trade is 73 percent less than what would be expected given the variables included in the model.[5] This implies that other factors not included in the model, such as high tariffs and poor infrastructure, may be relevant in explaining Colombia's low trade.

Figure 2: Fixed Effects in the Gravity Model of Trade



Source: Cárdenas and García (2005).

[3] There is a long literature on the effects of trade on growth. See, among others, Sachs and Warner (1995).

[4] Other dummies control for common colonial background and the existence of free trade between the two countries.

[5] In fact, the estimated coefficient is –1.34, implying a 73 percent difference between actual and predicted trade: (exp(−1.34) −1) = 0.73.

In summary, this very preliminary analysis suggests that Colombian GDP growth is well explained by the traditional model of human capital and institutions, and a country dummy has little explanatory power. However, the gravity model reveals that Colombia has a level of trade that is lower than what would be expected given its geographical characteristics. In other words, the country's size and location (particularly its proximity to the United States) would predict a much larger level of foreign trade than what is observed. Given that the level of institutional development is not far off from what would be expected given colonial past, legal origin, and geography, increasing trade seems as natural priority for long-term growth. This would require some infrastructure upgrading, an issue to which we will return in Section 7.

Changes in Growth Trajectories

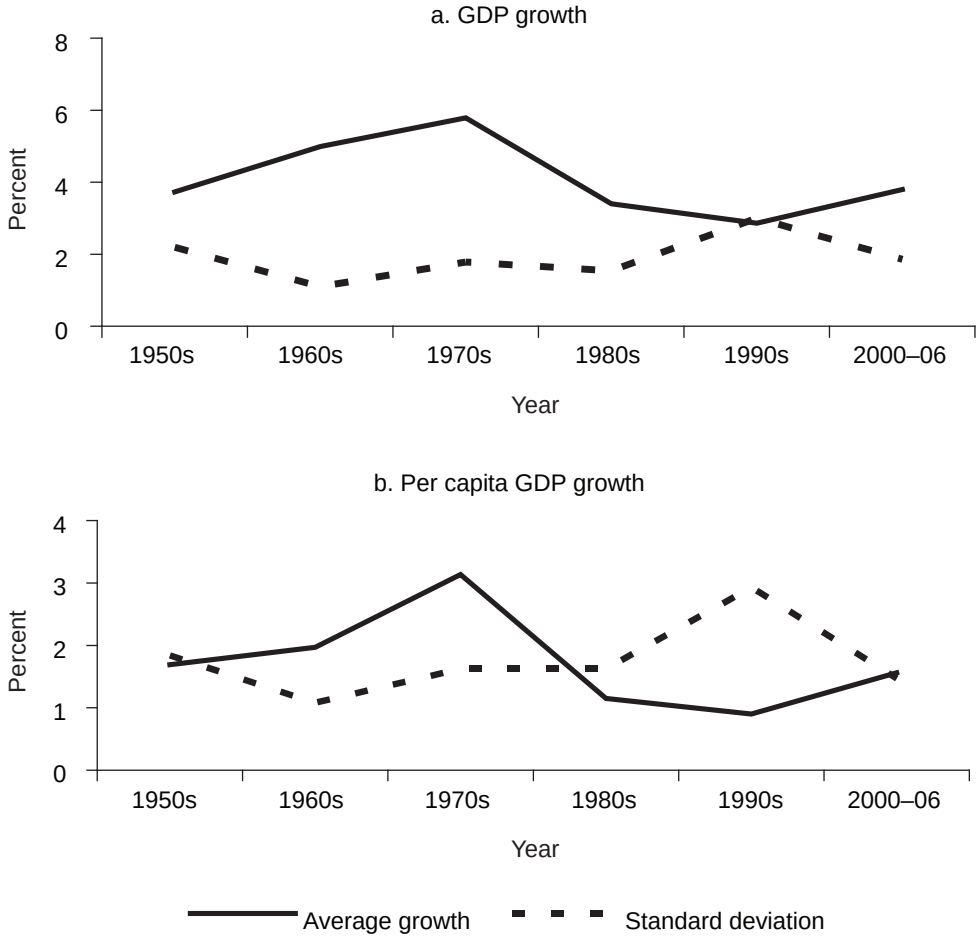
Between 1950 and 2006 Colombia's annual average GDP growth was 4.2 percent (with a standard deviation of 2.1 percent). Given an average rate of population growth of 2.4 percent, per capita GDP rose at a moderate rate of 1.8 per year, in contrast to an average of 2.7 percent per year between 1900 and 1950.

Averages per decade, shown in figure 3, are useful in order to identify three different phases. The first phase covers the period between 1950 and 1980 when macroeconomic performance was characterized by increasing GDP growth rates (which rose to 5.8 percent on average in the 1970s from 4.3 percent in the 1950s), combined with relatively low volatility (measured here by the standard deviation in growth rates). Given the declining rates of population growth, per capita GDP growth reached a peak in the 1970s (3.1 percent). Because inequality decreased during the 1960s and 1970s, many observers consider this period a success in terms of economic development.

In the second phase, which covers the 1980s and 1990s, growth declined significantly. During the 1980s average GDP growth fell to 3.4 percent per year, while annual per capita GDP growth was 1.2 percent (nearly two percentage points below the rate observed in the previous decade). This was of course explained by Latin America's debt crisis, when GDP contractions were the norm in the region. In fact, at that time Colombia was seen as an overperformer, mainly because it did not default on its debt and did not experience negative economic growth, contrary to what was observed in many other Latin American countries. However, during the 1990s Colombia's economic growth decelerated even further—to an average per capita growth rate of 0.9 percent per year—precisely when the rest of the region was recovering. Haiti was the only other country in Latin America to have such disappointing growth performance.[6]

[6] In the growth model estimated by Loayza, Fajnzylber, and Calderón (2005) Colombia and Haiti are the only two countries with lower growth relative to the model predictions in the 1990s.

Figure 3: GDP and Per Capita GDP Growth (per decade)



Source: Authors' calculations based on national accounts from DANE (Departamento Administrativo Nacional de Estadística), http://www.dane.gov.co.

Finally, the third phase covers the period starting in 2000, which has been characterized by accelerating growth rates after a major recession in 1998–99 (GDP fell by 4.2 percent in 1999). In 2006 and 2007, GDP growth was on average 7.2 percent per year.

These phases can be more precisely identified with the help of the two-step procedure proposed by Bai and Perron (1998, 2003a) aimed at testing for multiple structural breaks in single time series (see Appendix 2). Results reveal that annual GDP growth (between 1951 and 2006) experienced a significant downturn in 1979 (see figure 4).[7] According to the estimates, GDP growth fell to 3.2 percent between 1980 and 2006, from 5.2 percent between 1951 and 1979.[8] This is a

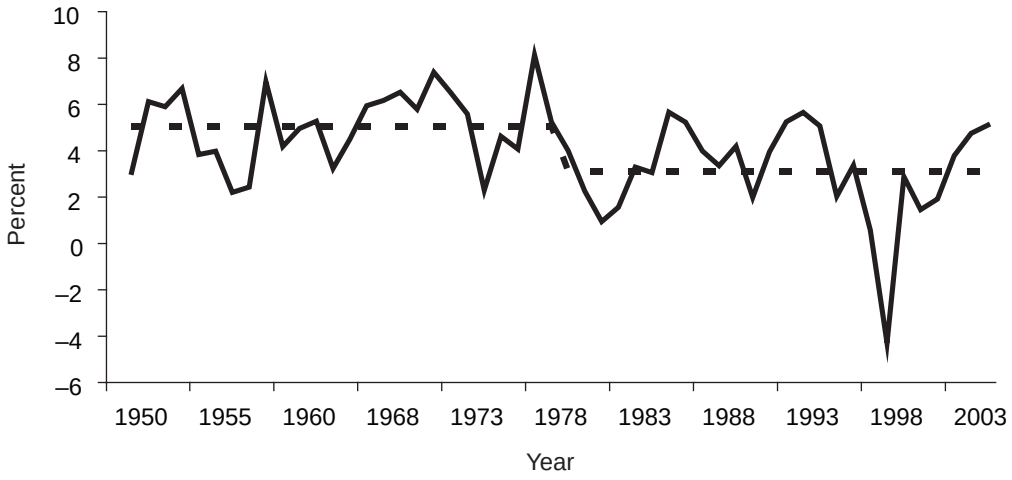
[7] The estimated downbreak is robust to the specification of the test (that is, the length of the interstitiary period). Other procedures (for example, Ben-David and Papell, 1997) reach the same result.

[8] Per capita GDP follows the same trends. Average growth between 1951and 1979 was 2.3 percent and fell to 1.2 percent between 1980 and 2006.

significant alteration in growth path: while output doubled every 13 years until 1979, it has taken 22 years since 1980.

We are aware of the fact that economic growth has recovered considerably since 2000 making the occurrence of a structural upturn highly likely somewhere around 2002 or 2003. Given the limited number of observations, Bai and Perron's procedure does not have the power to determine if economic growth has experienced an upturn since 2000. As we focus on the causes of the 1979 downturn and its policy consequences, future papers would have to deal with the explanation of the recent upturn, in case it materializes. An improvement in security conditions will seem a likely hypothesis.

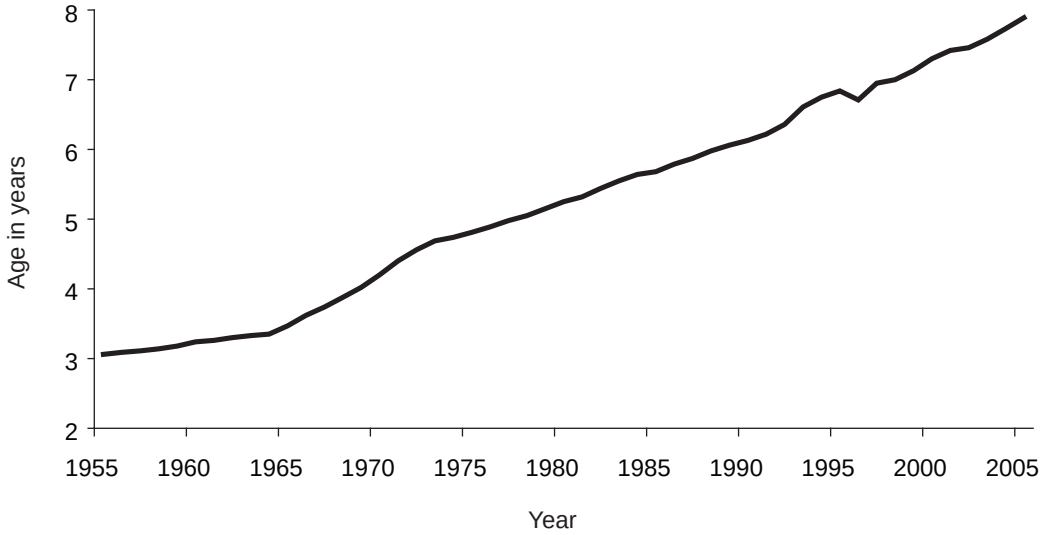
Figure 4: GDP Growth with Structural Break



Source: Authors' calculations based on national accounts from DANE.

Note: Minimum period between structural breaks was set to h=13 years.

Figure 5: Average Years of Schooling (population over 15 years of age)



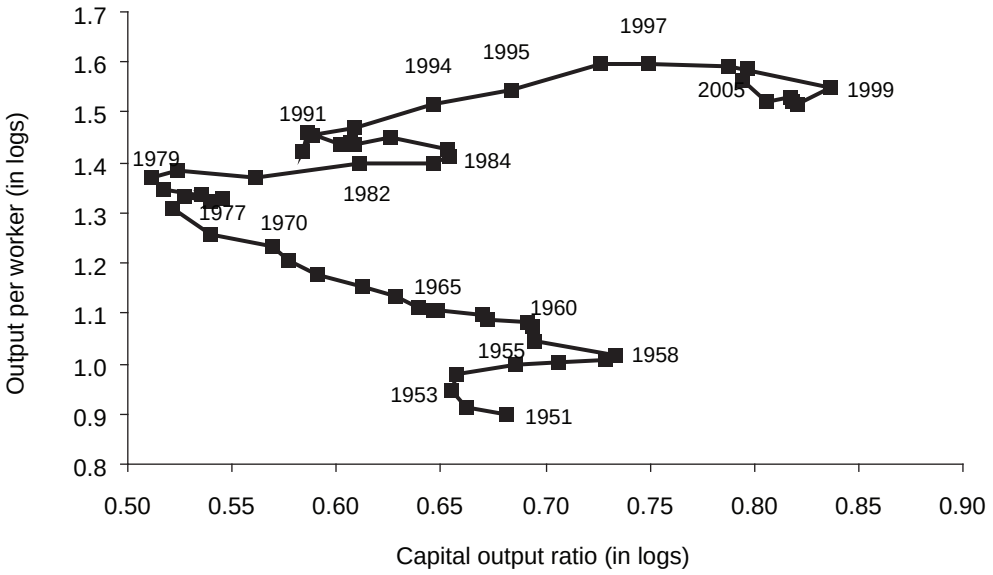
Source: Departamento Administrativo Nacional de Planeación (www.dnp.gov.co).

The Role of Productivity

This section applies a standard framework in order to decompose growth in output per worker into changes in physical capital intensity, growth in human capital per worker (educational attainment), and growth in productivity (the residual).[9] We use data on output (GDP), labor input (employment), average educational attainment, and physical capital for the 1950–2005 period. Figure 5 shows the average years of schooling of the urban and rural population based on the population censuses and the household surveys.[10] Note that the educational attainment has been increasing at a stable rate since the early 1970s. Even though faster progress on this front was made between 1965 and 1973, we will show that this was not a key factor in explaining the origin of the growth reversal.

Before showing the results of the decomposition it is useful to take a cursory look at the raw data. Figure 6 plots output per worker against the capital/output ratio for the period 1955–2005 (in logs). Interestingly, there seems to be a regime change in 1979. The pre-1979 period is characterized by an increase in output per worker and a decrease in the capital/output ratio, suggesting that productivity played a role in explaining the increase in output per worker.

Figure 6: Output per Worker against the Capital/Output Ratio



Source: Authors' calculations.

[9] Note that using GDP per worker (compared to GDP per capita) is a better measure of welfare when nonmarket production is important. Also, writing the decomposition in terms of the capital-output ratio rather than the more traditional capital-labor ratio facilitates the interpretation because the former is proportional to the investment rate.

[10] Barro and Lee (2000) report a lower level but also an increasing and stable trend.

In contrast, between 1979 and 1999, increases in the capital/output ratio were proportionally larger than increases in output per worker. This can be taken as evidence that the accumulation of physical capital is not likely to be the cause of the deceleration in growth since 1979.

This is indeed what the decomposition shows. Table 3 presents the results of the decomposition exercise using the returns to education derived from Núñez and Sánchez (2000) and an estimated capital share (α) between 0.2 and 0.4 (we report the results corresponding to 0.3).[11] The results show that annual growth in output per worker fell to 0.8 percent between 1980 and 2005, from 1.6 percent between 1955 and 1979 (See table 3).

The decomposition indicates that the reduction in output growth cannot be explained by changes in physical and human capital intensity. In fact, physical capital intensity (that is, in the capital/output ratio) was a positive source of growth between 1979 and 2005 (adding on average 0.5 percentage points to the growth rate per year). The same is true for human capital per worker, which was a steady source of growth in output per worker. Indeed, during the post-1979 period this factor alone would have accounted for annual growth in output per worker of 0.9 percent. This means that between 1979 and 2005, the educational advancement of the population and the greater physical capital intensity would have resulted in a 1.4 percent growth rate in output per worker, not too different from what was observed before 1979. If anything, physical and human capital alone would have resulted in higher output growth in the post-1979 period, relative to the pre-1979 results.

This leaves the residual (that is, total factor productivity) as the key "explanation" of the low growth outcomes. In terms of the accounting, productivity added 1 percentage point in output growth per year up until 1979. Between 1979 and 2005 it subtracted 0.6 percentage points in the growth of output per worker per year. In the words, the growth deceleration appears to be a simple reflection of a major reversal in productivity growth.

The information per decade is also shown in table 3. Output per worker grew at an annual rate of 1.3 percent in the late 1950s and the 1960s, and then accelerated to 1.9 percent during the 1970s. It then fell to 0.6 percent during the 1980s and 1.1 percent during the 1990s.

As mentioned before, the contribution of human capital accumulation to economic growth has been relatively stable, reflecting continued progress in educational attainment (or, at least, reflecting the parsimony of the years of schooling data). There is, however, an interesting difference in the role of productivity when comparing the 1980s with the 1990s. The 1980s emerge as a period of negative productivity growth and low physical capital deepening (incidentally, the two factors often mentioned in the literature as justifying the

[11] These results remain unchanged under alternative measures of the returns of education. The same occurs when $\alpha = 0.2$ and $\alpha = 0.4$ are used.

Table 3: Growth Decomposition (percent)

	(1)=(2)+(3)+(4)	(2)	(3)	(4)
Growth in:	**Per worker GDP**	**Capital-Output ratio**	**Human capital per capita**	**Productivity**
1955–1979	1.55	−0.25	0.74	1.05
1980–2005	0.80	0.47	0.92	−0.60
1955–1959	1.31	0.31	0.26	0.72
1970–1979	1.91	−0.34	1.02	1.23
1980–1989	0.63	0.38	1.08	−0.84
1990–1999	1.13	1.00	0.80	−0.68
2000–2005	0.53	−0.28	0.87	−0.06

Source: Authors' calculations.

structural reforms of the early 1990s). In contrast, during the 1990s, capital intensity increased (as a consequence of the investment boom that resulted from trade liberalization, capital inflows, and currency appreciation), while productivity growth collapsed to lower levels.

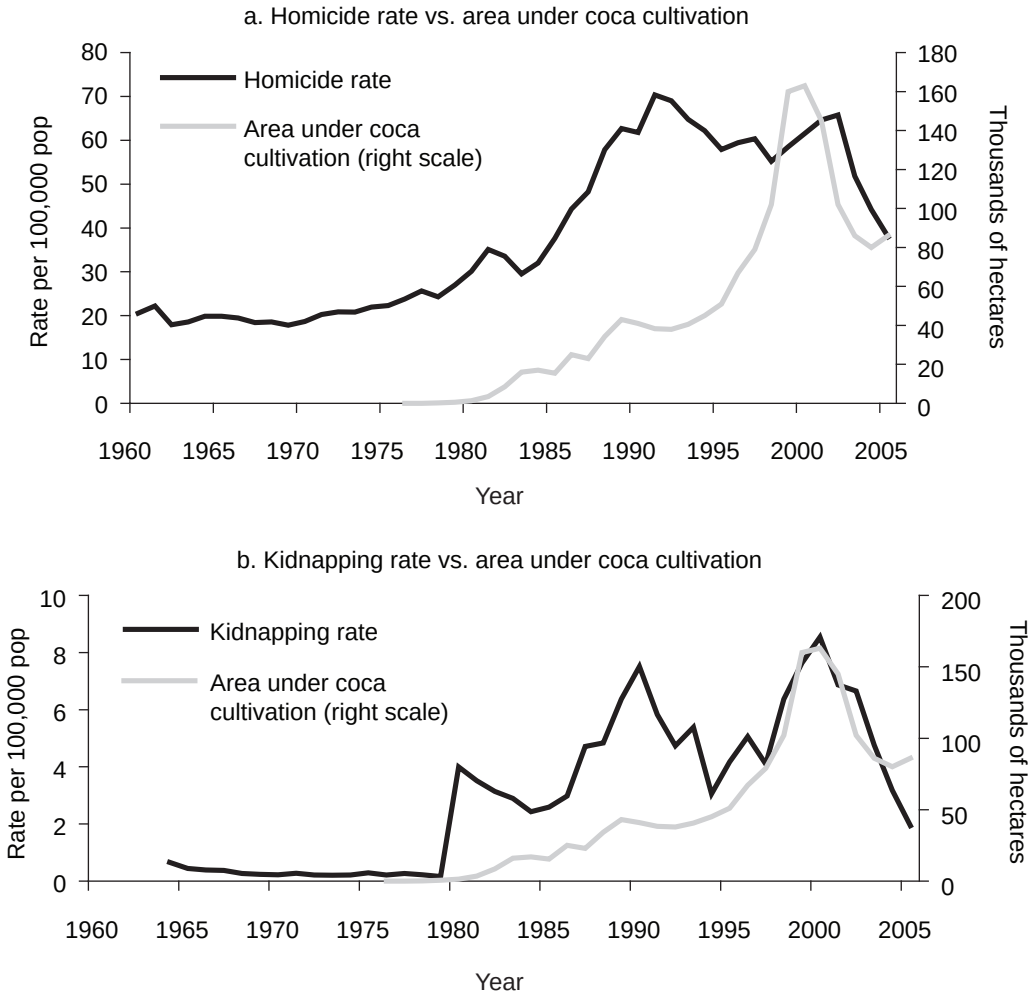
What Caused the Productivity Implosion?

The low level of educational attainment and the below-average trade/GDP ratio are good candidates in order to understand Colombia's moderate level of GDP. These features, however, are not very helpful in explaining the growth deceleration observed around 1980. The downturn in GDP growth points in the direction of institutional variables, particularly those that are related to the enforcement of law and order. The emergence of Colombia as a major illicit drug producer is perhaps the most prominent aspect of the country's recent economic and political history. According to data from the United Nations (www.unodc.org), cocaine production, which was practically inexistent in 1980, grew to 90 tons in 1990 and then rose to 700 tons in 2000. The area under cultivation of illicit crops increased to nearly 140,000 hectares in 2000, from less than 20,000 in 1980.[12]

The expansion in drug-trafficking activities can be linked to the collapse of productivity, mainly through the effect of drug trafficking on crime and violence. The homicide rate (homicides per 100,000 population) increased to 62 on average during the 1990s, from 41 during the 1980s, 23 during the 1970s, and 19 during the 1960s. A similar pattern can be observed for kidnapping rates (see figure 7). The increase in the homicide rate, in turn, is related to the increase in the activities of insurgent and paramilitary groups.

[12] Mejía and Posada (2008) provide a comprehensive survey of the information regarding cocaine production and trafficking.

Figure 7: Crime (Homicide and Kidnapping) Rates vs. Illicit Crops



Source: Policia Nacional and Ministerio de Defensa.

Social infrastructure is, arguably, the main channel linking crime and violence, on the one hand, and productivity on the other. The relationship between productivity and social infrastructure has been a recurrent theme in the growth literature (see, for example, Hall and Jones, 1999). Lack of social infrastructure encourages predatory behavior, which in turn implies that a fraction of the population is employed in unproductive activities, either by engaging in crime-related activities or by protecting human and physical assets, making no contribution to output. In addition, some of the physical capital can divert to unproductive activities. Defense equipment is perhaps the best example. This form of diversion is captured in the productivity component of the sources-of-growth accounting. Similarly, the productivity term captures the contribution of other factors of production (for example, land) that may become unusable when it is too costly to protect them.

The Colombian evidence is supportive of the fact that the expansion of drug-trafficking activities was the main factor behind the exponential increase in crime rates. It also supports the hypothesis that worsened security conditions had a negative effect on productivity growth. Using a VAR model (see Appendix 4 for the details), we test this double hypothesis and find that a positive shock in the growth of the area with illicit crops is associated with a permanent reduction in the growth of TFP. Also, the null hypothesis that changes in the log of (illicit crop) area do not Granger cause changes in the log of TFP can be rejected (see Appendix 4). Conversely, changes in TFP are not associated with significant changes in area, and the corresponding hypothesis that TFP growth does not cause area growth cannot be rejected. The estimated impulse-response functions are shown in figure 8.

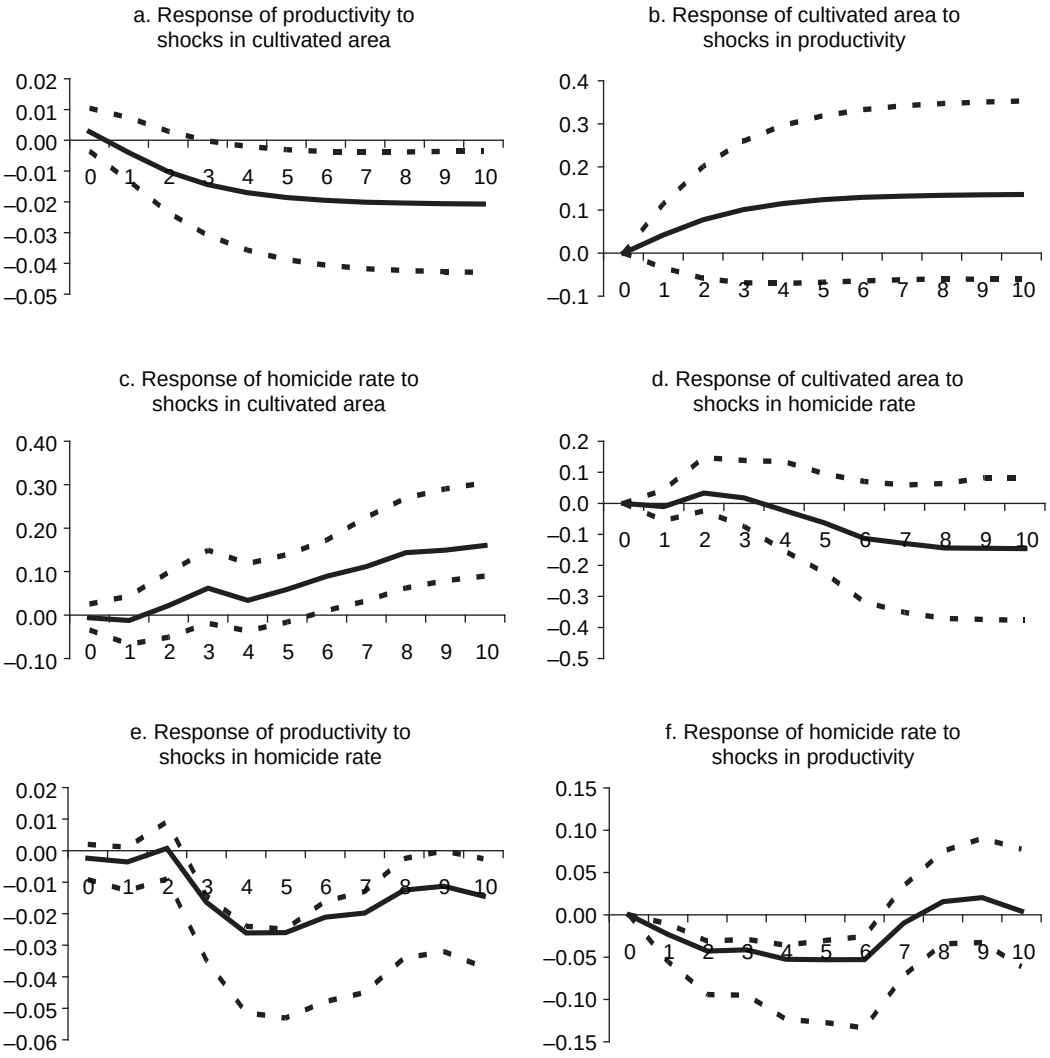
The relationship between illicit crops and homicides is also of great interest. The evidence supports the view that the expansion of drug-related activities (measured by the area under illicit crops) was a cause of the increase in homicides, rather than the other way around. In fact, positive shocks to changes in the log of area cause permanent increases in changes in the log of the homicide rate. The corresponding Granger causality supports this interpretation, while shocks to the homicide rate do not seem to have an effect on area. Finally, positive shocks to the change in the log of the homicide rate generate reductions in TFP growth, while increases in TFP growth are associated with reductions in the growth of the homicide rate. However, Granger causality tests indicate that causality runs from homicides to TFP, rather than the opposite.

In sum, the evidence presented in this section supports the view that increases in the area under illicit crops was, to a large extent, an event not caused by worsening economic conditions or by higher crime incidence. Challenging the conventional wisdom, which often sees drug-trafficking activities as a consequence of insecurity and low growth, we argue just the opposite.

According to our evidence, the increase in crime and the subsequent reduction in productivity were the result of an increase in the production of illicit crops. This result has important policy implications because it suggests that a reduction in drug production and an improvement in security conditions can have a large economic dividend, just as the recent events seem to confirm.[13]

[13] The impact of increases in security and defense expenditures on income has been widely studied in recent years. For instance, Aizenman and Glick (2003) show that increasing security and defense expenditures by 1 percent in countries with high levels of criminal distress (like Colombia) can accelerate economic growth by 0.9 percent. Arias and Ardila (2003) estimate that a 1 percent increase in security and defense expenditures may lead to additional per capita growth of 11.7 percent in the subsequent decade.

Figure 8: Impulse-Response Functions



Source: Authors' calculations.

Notes: Confidence interval at 90% using 10,000 bootstrap replications. Orthogonal impulse response function using Cholesky decomposition.

Regional Evidence

The time series evidence presented so far has the restrictions related to the very few observations available, especially regarding the area cultivated with illicit crops. To complement that evidence we now turn to the department-level data, which is generally of very good quality in Colombia. Evidence from the 32 Colombian departments can be useful in testing the joint hypothesis that the loss in terms of growth is explained by higher violence, in turn caused by higher drug trafficking.

Our starting point is the methodology developed by Querubín (2003), who estimates a difference-in-differences regression in order to explain the differential in department-level GDP growth performance before and after the changes in violence. Specifically, he estimates the following equation:

$$\Delta y_{tk} - \Delta y_{t-1,k} = \alpha + \beta\left[\Delta Hom_{tk} - \Delta Hom_{t-1,k}\right] + \varepsilon_{tk} \quad (1)$$

where Δy_{tk} is GDP growth in department *k* between years *t* and *t*-1, ΔHom_{tk} is the growth in the homicide rate (homicides per 100,000 population) and ε_{tk} represents the stochastic error. The parameter of interest, β, captures the effect of a change in the rate of growth of the homicide rate on the change in economic growth. This is interesting because not only do we have more information for the estimation compared to the aggregate national data, but also we exploit differential change in violence across departments as well as variation in terms of the moment in time at which crime and growth conditions worsened in different parts of the country.

Analogously, we could use a similar specification to isolate the effect of the acceleration in drug cultivation on changes in the rate of growth of crime. This can be obtained by estimating:

$$\Delta Hom_{tk} - \Delta Hom_{t-1,k} = \alpha + \gamma\left[\Delta Ha_{tk} - \Delta Ha_{t-1,k}\right] + \varepsilon_{tk} \quad (2)$$

where ΔHa_{tk} represents the growth in the area with illicit crops (coca) in department *k* between period *t* and *t*-1. In this case γ is the parameter of interest, capturing the effect of the change in homicide growth rate on an acceleration in the rate of growth of illicit crops.

We estimate equations (1) and (2) using a robust errors OLS procedure. The department data is annual for the period 1990–2005. Departmental GDP and population data come from DANE, homicide rates are obtained from Policía Nacional, and the department-level information on coca crops (in hectares) comes from the United Nations. Unfortunately, census information on the area with illicit crops is available only since 1999. Given this restriction, the estimation of equation (2) uses information for the 1999-2005 period.

Table 4 shows the results of the estimation of equation 1, using alternatively GDP and per capita GDP growth. The estimated coefficient suggests that crime accelerations are associated with growth decelerations. Specifically, a 100 percentage point acceleration in the rate of growth of the homicide rate is associated with a 1.1 percentage point deceleration in the rate of economic growth (both in total and per capita GDP).

Table 4: Effect of Changes in Homicide Rates over Change in Regional GDP Growth

Period: 1990–2005 (404 observations) **Estimation method: OLS, robust errors** **Dependent variable: Difference of percentage change in GDP**		
	Total	**Per capita**
Constant	0.0006***	0.0014***
	(0.000049)	(0.00004)
Difference in percentage change in homicide rates	−0.0107***	−0.0105***
	(0.0008)	(0.00083)
R^2	0.114	0.133
Prob (F)	0.0000	0.0000

Source: Calculations made by authors'. Homicide rates per 100,000 habitants were obtained from CIC-DIJIN and Policia Nacional and number of hectares with illicit crops were obtained from the SIMCI II of United Nations.
Note: *** 1% significance level; ** 5% significance level.

Turning to equation 2, the results of the estimation (shown in Table 5) indicate that γ is larger than β. In fact, a 10 percentage point acceleration in the rate of growth of the area with illicit crops is associated with a 3.9 percentage point increase in the rate of growth of the homicide rate. This evidence reaffirms the view that the acceleration in drug trafficking was a major driving force behind the increase in homicides, which in turn had negative effects on growth. Given the magnitude of the growth repercussions, policies have been adopted throughout the years to deal with these issues. We will address in the next section the most relevant policy reactions and discuss their growth effects.

Table 5: Effect of Changes on Growth of Illicit Crops over Changes in Homicide Rates

Period: 1999–2005 (98 observations) **Estimation method: OLS, robust errors** **Dependent variable: Difference of percentage change in homicide rates**	
	Total
Constant	6.2
	(4.29)
Difference in percentage change in illicit crops of coca.	0.39 **
	(0.16)
R^2	0.15
Prob (F)	0.0000

Source: Calculations made by authors'. Homicide rates per 100,000 habitants were obtained from CIC-DIJIN and Policia Nacional and number of hectares with illicit crops were obtained from the SIMCI II of United Nations.
Note: *** 1% significance level; ** 5% significance level.

Policy Responses

As mentioned in the introduction, the exponential increase in drug trafficking and crime led to some policy responses. This section discusses these policy responses in terms of their magnitude and effectiveness. We start with the enactment of a new constitution in 1991, which in many ways was a reaction to growing unrest and violence.

Political Reform

At the end of the 1980s Colombian political institutions were under severe strain. Large segments of the population demanded more political participation and inclusion after decades of bipartisan control. The call for increased security and political stability was particularly loud after the assassination of three presidential candidates in 1989. The 1991 constitution emerged as an escape valve to provide more legitimacy to the political system after various failed attempts at reforming the 1886 constitution.

The new constitution strengthened the checks and balances of the political system in an effort to endow political institutions with greater legitimacy after decades of limited participation and low representation. Although remaining extremely powerful even by Latin American standards—surpassed only by the Brazilian executive—the president lost some capacity as an agenda-setter relative to the previous period, whereas congress and the constitutional court (CC) gained relative power. Also, with greater fiscal and political decentralization, mayors, governors, and local politicians became more autonomous. As a consequence of the larger number of relevant players and the diminished presidential powers, political transaction costs increased in several policy areas, so the gains in representation came at a cost in terms of cooperation.

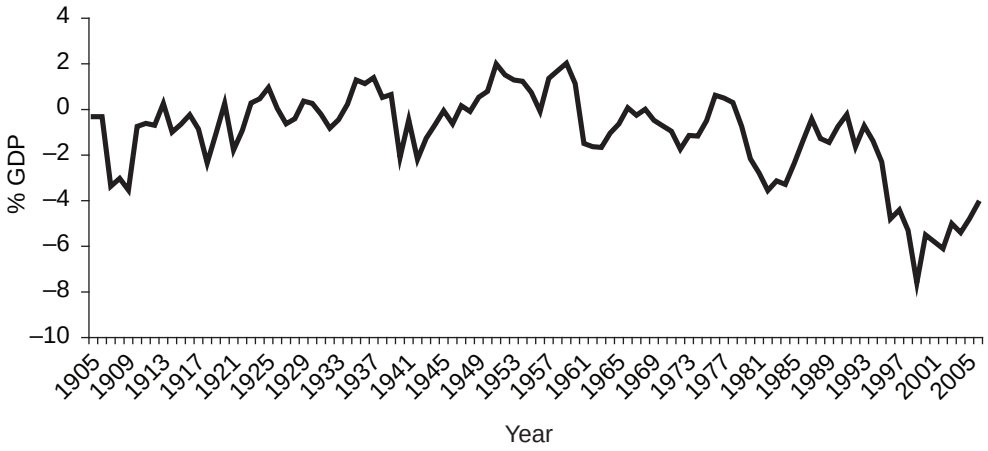
In addition to the changes in the number of key players, as well as in the rules of the political game, the new constitution covered many specific, previously nonconstitutional, aspects of policy. This is particularly the case of fiscal policy, where key components of public expenditures—such as pensions, fiscal transfers for education and health, and public sector wages—were either "hard-wired" into the constitution or were determined through the constitutional review process. Even in those policy areas where there is some constitutional flexibility, the executive has faced a more divided and fragmented congress, which has increased political transaction costs and has lowered the probability of approval of bills. Apart from the quantitative aspect, bills that are approved are typically watered down relative to executive proposals (see Cárdenas et al., 2006).

From the fiscal policy point of view, the rigidity in some policy areas and the presence of new and powerful players has had important implications. As shown in figure 9, fiscal deficits increased considerably after 1991. Many observers have suggested that these embedded rigidities have been a major source of growing

fiscal deficits and public debt, tax uncertainty, and inefficient government expenditures, which are frequently mentioned as the causes of macroeconomic instability and low growth during the late 1990s. In an extreme form of rigidity, changes in fiscal policy often require constitutional reform, which by definition involve political transactions that are slow and costly. As a result, fiscal policies are not adaptable to economic shocks, in contrast to Colombia's previous track record in terms of macroeconomic and fiscal stability.

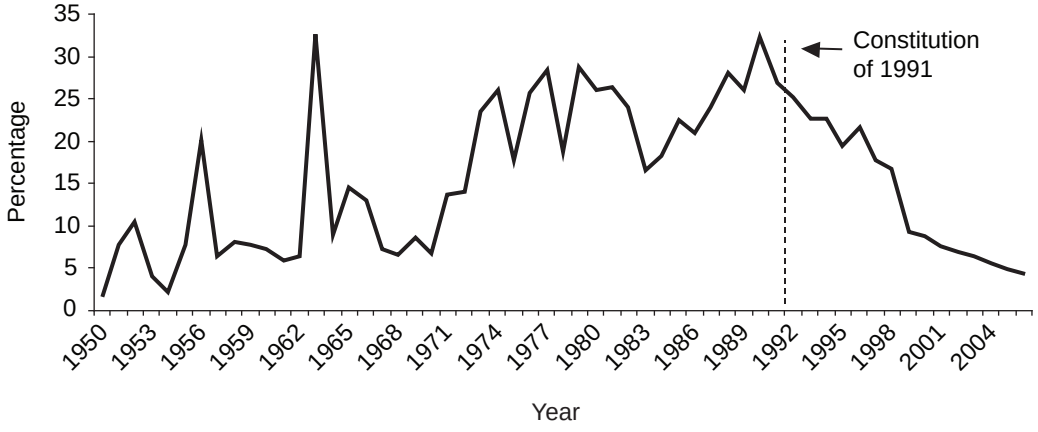
In the case of monetary and exchange rate policies, the 1991 constitution granted independence to the central bank's board and banned direct monetary financing to the private sector (lending to the government is allowed but requires unanimity of all board members.) These constitutional provisions have been reinforced by the appointment of technocrats to the board by successive presidents. As a result, inflation rates are considerably lower than before 1991 (see figure 10).

Figure 9: Fiscal Balance of the Central Government



Source: Junguito and Rincón (2004) and Ministerio de Hacienda y Crédito Público.

Figure 10: Inflation Rate



Source: Banco de la República and Departamento Administrativo Nacional de Estadística.

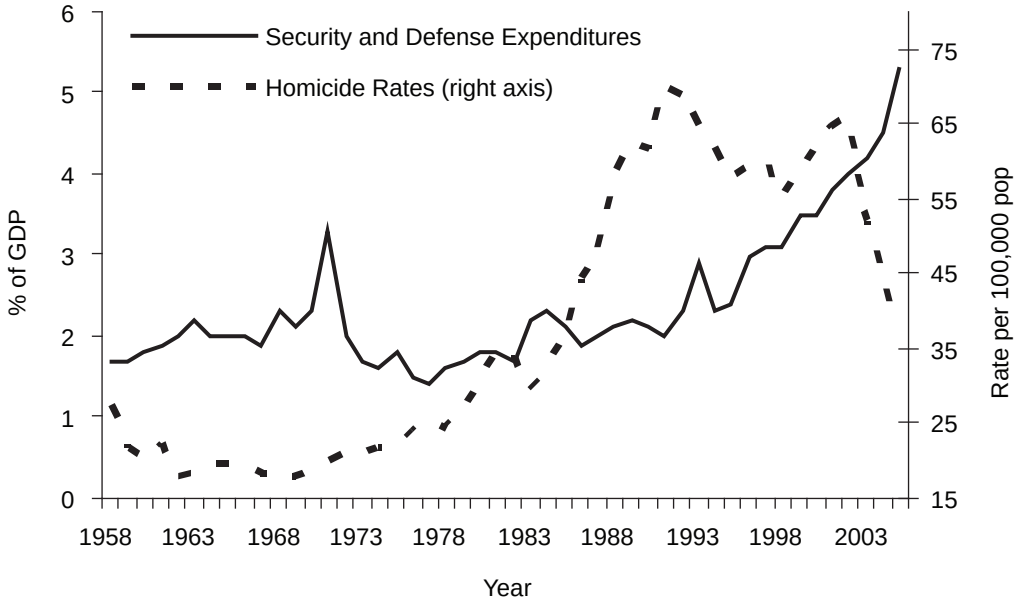
Although the growth implications of political reform are hard to determine, the reform brought political stability and prevented regime ruptures, as the ones experienced in recent times by other Latin American countries.

Security and Defense

The most noticeable government reaction in response to the growing security problems of the country has been an increase in security and defense expenditures. In particular, these expenditures increased dramatically during the 1990s. As shown in figure 11, public expenditures in defense and security rose to 4.5 percent of GDP in 2000 from 2.1 percent of GDP in 1990. In addition, according to data of the Security Superintendence of Colombia, private expenditures in security were close to 2.7 percent of GDP in 2006. This means that public and private expenditures in security are over 7 percent of GDP.

The effects of higher expenditures on actual crime are difficult to measure. What is self-evident is that improvements in security conditions occurred almost a decade after the rise in expenditures so it is possible to argue that expenditures had to be sustained for a long period before beginning to deliver results (something that many policy makers would be discouraged to do). Resources from the United States in support of Plan Colombia (on the order of 0.5 percent of GDP per year) have supplemented the Colombian security budget since 2000. Despite the improvements, security conditions are still alarmingly high relative to the rest of Latin America. For instance, in 2006 the homicide rate (per 100,000 population) in Chile was 1.7 while in Colombia it was 37.

Figure 11: Defense and Security Expenditures vs. Homicide Rates



Source: Ministerio de Defensa and Departamento Nacional de Planeación.

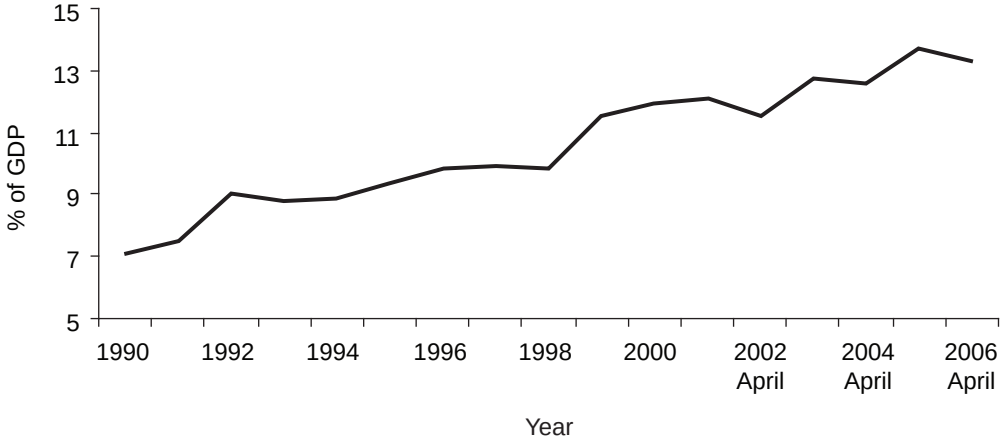
Social Expenditures

The origins of the increase in social expenditures are intertwined with the 1991 constitution. Several provisions of the constitution were explicit in mandating additional expenditures in education and health, as well as in other social areas. For example, the constitution stated that social expenditures would have priority over every other allocation (except defense) and declared unconstitutional any reduction in the share of social investment in total expenditures. Another set of articles mandated an increase in fiscal transfers to the departments and municipalities earmarked for social programs. In practice, fiscal transfers to municipalities and departments rose to 43.5 percent of the central government's current revenues in 2001 from 29 percent in 1990.

In line with the constitutional provision, social expenditures grew to 15.3 percent of GDP in 1999, from 9.2 percent in 1990 (see figure 12). For example, in the case of health, public expenditures rose to 3.1 percent of GDP in 2003 from 1.4 percent in 1993. However, concerns have been raised throughout the years on the efficiency of social expenditures.

In the case of education, total expenditure per student nearly doubled between 1993 and 2004, but educational quality remains as a major concern according to national and international standardized tests (figure 13). Net enrollment rates in basic and medium education have increased to 80.1 percent in 2005 from 71 percent in 1996, but the gap in years of schooling between urban and rural populations increased to 3.8 years of schooling in 2004, from 2.4 years in 1950. As Barrera (2007) mentions, primary and secondary enrollment rates vary considerably by income quintile of the population. In the case of secondary, for example, enrollment rates are 90 percent for the top quintile and below 75 percent for the bottom quintile.

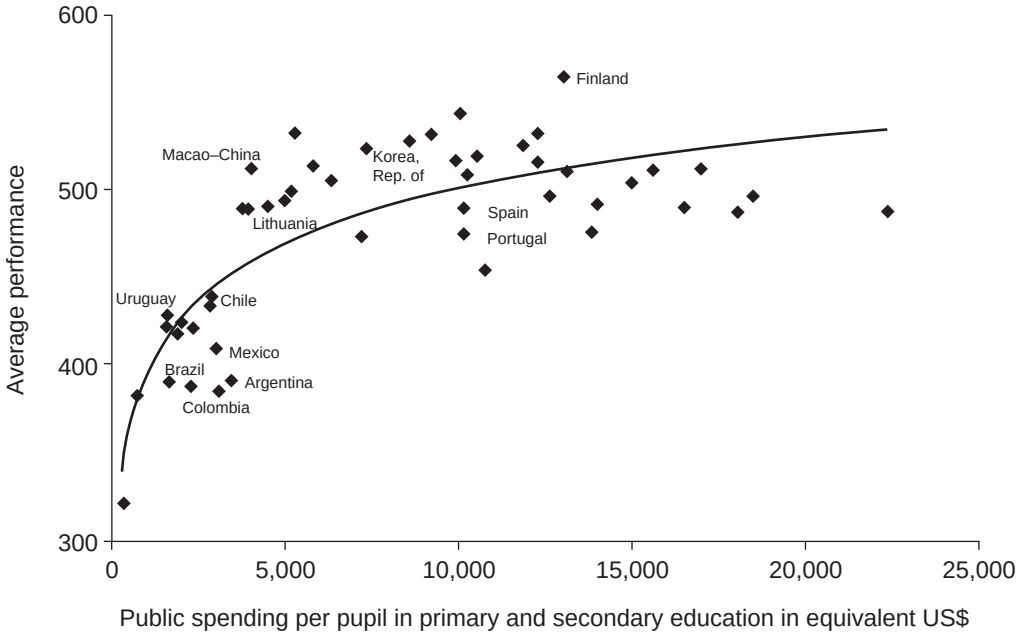
Figure 12: Social Expenditures



Source: Departamento Nacional de Planeación.

Note: Total social expenditures correspond to the sum of education, water, culture, health, ICBF, social security and rural social expenditures.

Figure 13: Public Expenditures in Education in 2000 and Performance in PISA (science average scores)



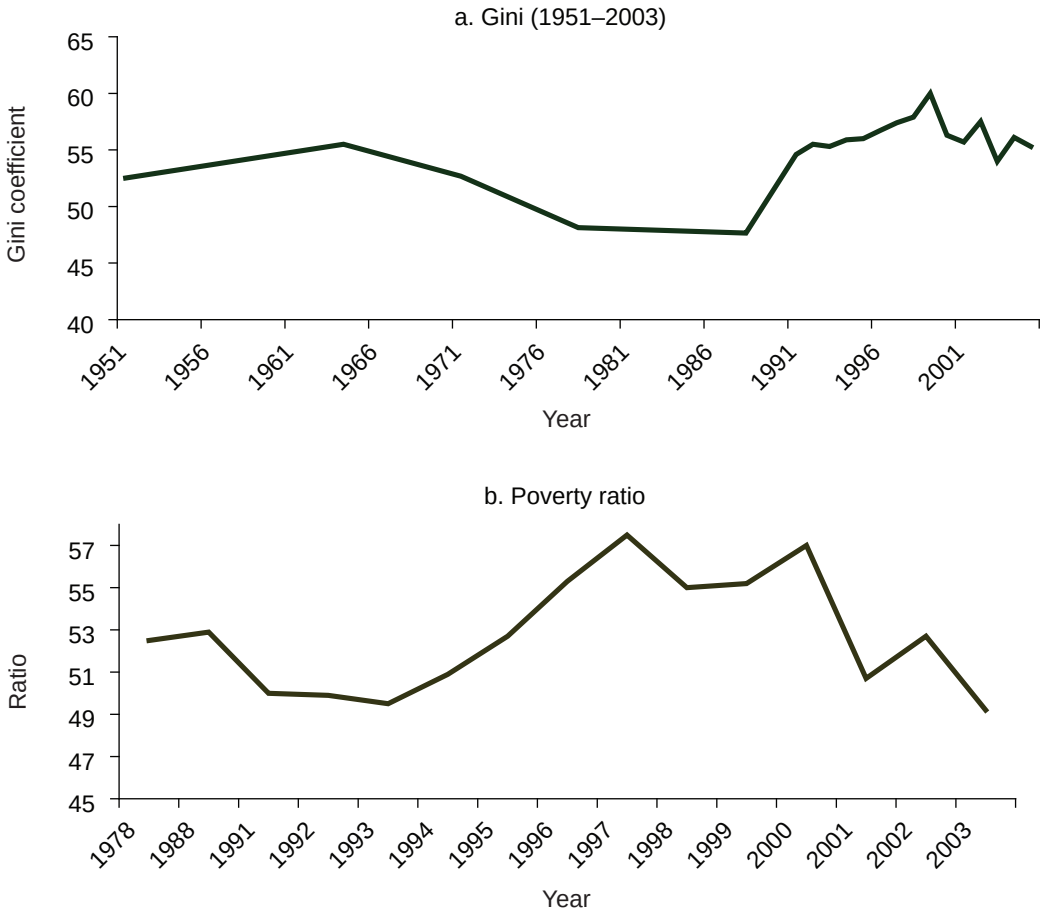
Source; OECD Development Centre calculations based on the UNESCO World Educational Indicators, UNESCO's Institute of Statistics database.

It is interesting to note that in spite of the rapid growth in social expenditures during the 1990s, poverty and inequality increased significantly, in contrast with the experience during the 1970s and 1980s. Poverty rates fell to 65 percent in 1988 from 80 percent in 1978 (extreme poverty decreased to 29 percent from 45 percent during the same period) while inequality measured by the Gini coefficient fell to 0.48 in 1988 from 0.53 in 1971. As shown in figure 14, these trends were drastically reversed during the 1990s due to the lower economic growth. This means that in spite of much greater social expenditures, social conditions worsened during the 1990s. Problems of design and targeting of social programs became all too evident. In fact, Lasso (2006) finds that a mere 17.5 percent of total social expenditures go to the first quintile of the population, while the top quintile gets 29.1 percent.

In addition to their limited effectiveness in alleviating poverty, social expenditures have also posed challenges from the viewpoint of the sustainability of the public finances. As mentioned before, large deficits and growing debt were the norm throughout the late 1990s. In this context, external shocks related to turmoil in world financial markets in 1998 and 1999 had devastating effects for the economy. Low growth and high unemployment reversed much of the social progress of the previous decades.[14]

[14] See Cárdenas and Urrutia (2004).

Figure 14: Inequality and Poverty



Source: 1938-1988: Londoño (1995); 1991-2005: Departamento Nacional de Planeación.

Importantly, inequality has reduced the impact of growth on the reduction of poverty. Perry et al. (2006) estimate that the poverty elasticity with respect to growth in Colombia is between –0.5 and –1, which represents one of the lowest levels in the world. This implies that the reduction of poverty in the country requires higher efforts in terms on economic growth relative to other countries with lower levels of inequality. In sum, Colombia would need both sustained growth and significant redistribution in order to make fast improvements in poverty reduction.

Taxation

Given the increase in government expenditures, there has been a deliberate, although insufficient, effort to raise revenues. A total of 12 significant tax reforms were adopted between 1990 and 2007, resulting in an increase in tax revenues of the central government from 9.7 to 16 percent of GDP between 1990 and 2006, a figure around the median of similar middle-income countries.

The analysis of the contents of recent tax reforms, as well as the formal objectives established in the draft projects, confirms that the major objective of the executive in the tax reform process has been to increase tax revenues as a means of reestablishing fiscal balances. Even though the priority has been the increase in fiscal revenues, the draft tax reform projects submitted to congress have given importance to the structure of the tax system, an area in which governments have been only partially successful. For example, most of the draft projects submitted to congress have sought to widen the VAT base, with limited success.

As a consequence of congress' reluctance to widen the income and VAT tax base, the executive has introduced new—and highly distortionary—tax sources. In 1998, a temporary 0.2 percent financial transactions tax was introduced in the context of a financial crisis that required some government intervention. However, the rate was raised to 0.3 percent in 2000 and raised again to 0.4 percent in 2003. In 2006 this tax was made permanent, ignoring the evidence on its negative effect on financial intermediation and, ultimately, on economic growth. In the same vein, in 2002 the Uribe government, using an extraordinary internal commotion decree, adopted a transitory net wealth tax earmarked to the strengthening of democratic security in Colombia. This tax was extended for three additional years in 2003 and again for four years in December 2006. The conclusion is that revenue pressures have led to decisions that disregard the basic principles of an equitable and efficient tax structure. The overriding goal is to raise revenues in ways that have the lowest political cost for the government and congress. The end result, however, is complex system, with a large number of loopholes. Also, temporary taxes are extremely likely to become permanent.

The role of congress as a political actor in tax reform has been significant. Although congress has approved all tax reform initiatives, it could be partly blamed for the insufficiency of revenues that come from the reforms, for the increase in expenditures, and for the deficiencies in the structure of the taxing system. An analysis of tax legislation submitted by the executive reveals that congress tends to water down proposals during debate, both in terms of revenues and, more importantly, in terms of the quality of the reforms. The constitutional court (CC) has also been a significant actor in tax policy outcomes. For example, in 1999, a ruling on the financial transactions tax limited the scope in the use of revenues, while in 2003 the CC denied the approval of the generalization of the VAT and the taxation of specific activities. The difficulty in reforming the VAT—as well as personal income taxation—is related to inequality. Political opposition to these taxes is stiff. Legislators prefer taxes that are perceived as less regressive, even if they create economic inefficiencies. This is the case of corporate income tax rates, as well as wealth taxes.

One example of these inefficiencies is related to incentives for informality associated with the tax system. As suggested by Perry et al. (2007), informal firms either do not have opportunities in the formal sector or believe that

informality offers more benefits than the formal sector. In Colombia, various surveys confirm that the dominant reason for informality is the existence of high taxes and contributions. Just as an example, the Global Competitiveness Report for 2007 reveals that in Colombia the most problematic factors for doing business are policy instability and high tax burden.

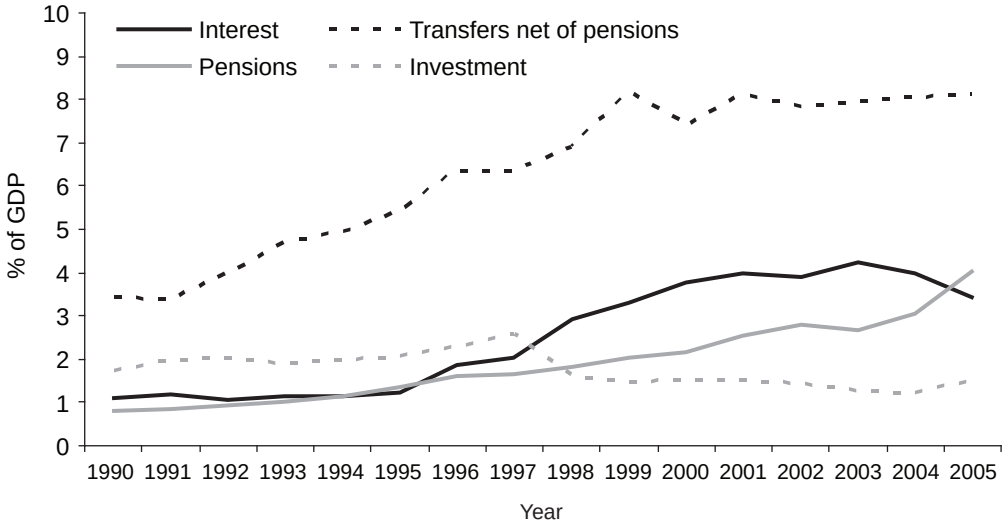
In the corporate sector, lobbying for special treatments is an effective way of avoiding high income tax rates. The large number of exemptions, discounts, and deductions has brought extreme complexity to the system, making administration complex and producing horizontal inequalities. More importantly, these exemptions are not designed in a way that stimulates economic growth. In fact, the sectors with the largest tax breaks are not the ones with the highest output growth.[15]

Infrastructure

The rapid growth in social expenditures contrasts with the performance of investment in infrastructure. Capital formation by the national government fell to an amount equivalent to 1.5 percent of GDP in 2005 from nearly twice that figure during the early 1990s (see figure 15). A natural consequence has been the reduction in infrastructure investment, which is a critical determinant of growth.

To some extent this was also a deliberate policy decision as it was expected that the private sector would take a leading role in infrastructure investment after the reforms of the 1990s, in the spirit of the Washington Consensus.

Figure 15: Expenditures of the Central Government



Source: Ministerio de Hacienda y Crédito Público.

[15] See Cárdenas and Mercer-Blackman (2006).

However, the evidence suggests that the private sector did not respond as initially expected and investment in infrastructure remains low, especially in the transport sector where the World Bank (2004) estimates investment needs of approximately 1.6 to 2.3 of GDP, while historical levels are near 1 percent. A natural consequence is transport infrastructure in Colombia does not compare well relative to other Latin American countries.

What the performance of infrastructure in Colombia suggests is that one of the consequences of the increase in crime was the inability to adequately invest in transport infrastructure. This not was evident at the time when security was the binding constrained to growth. As that constraint has been partly relaxed, the limitations imposed by insufficient infrastructure are all too evident. In fact, this is now emerging as one of the key constrains to growth. In other words, low past levels of investment in infrastructure will hold back economic growth even if security conditions continue to improve.

Conclusions

The main findings of this paper suggest that Colombia's per capita GDP, as well as its average growth between 1960 and 2000, are consistent with the predictions of a standard model where human capital and the quality of institutions are the key explanatory variables. Moreover, the level of these variables in Colombia conforms well to the more exogenous determinants such as the colonial past, legal origin, and geographical conditions. On a different vein, Colombia's international trade in is one area where there are significant differences between the predictions of the gravity model and actual performance, suggesting that natural and manmade barriers to trade have been a key constraint to economic growth in the long run.

Many analysts consider that lack of security is a major obstacle to growth in Colombia. This paper shows that this has been the case, but only since 1980. The econometric analysis identifies a structural downturn in economic growth in 1979, at the time when illicit crops and crime rates began to increase exponentially. In terms of specific channels, the paper finds that the emergence of Colombia as a major drug producer had a negative impact on overall crime, which rose dramatically during the 1980s and 1990s. Higher crime has been very costly in terms of economic efficiency. In fact, total factor productivity declined until 2000 and, as a result, annual economic growth fell by nearly two percentage points.

Policy responses to the growth collapse are also discussed in the paper. The worsening public safety conditions resulted in a strong increase in security and defense expenditures. Also, political upheavals and high levels of inequality and poverty motivated the adoption of a new constitution in 1991. The constitution mandated additional fiscal expenditures to curb social tensions. Some

improvements have been achieved in social areas (higher provision of health and education), although at a large fiscal cost due to inefficiencies and targeting problems.

One particularly negative side effect has been the compression of public investments in transport infrastructure. Also, inequality and poverty remain a major problem in spite of the drastic increase in social expenditures. Recent progress in public safety has allowed the country to recover two percentage points in annual GDP growth. However, growth will continue to be seriously constrained unless greater progress is made in infrastructure, as well as in the reduction of inequality and poverty.

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Appendix 1: Variable Definitions for the Cross-Country Exercise

We use the same variables and definitions as in Glaeser et al. (2004). This appendix is taken directly from their paper.

1. Executive constraints:

A measure of the extent of institutionalized constraints on the decision making powers of chief executives. The variable takes seven different values: (1) Unlimited authority (there are no regular limitations on the executive's actions, as distinct from irregular limitations such as the threat or actuality of coups and assassinations); (2) Intermediate category; (3) Slight to moderate limitation on executive authority (there are some real but limited restraints on the executive); (4) Intermediate category; (5) Substantial limitations on executive authority (the executive has more effective authority than any accountability group but is subject to substantial constraints by them); (6) Intermediate category; (7) Executive parity or subordination (accountability groups have effective authority equal to or greater than the executive in most areas of activity). This variable ranges from one to seven where higher values equal a greater extent of institutionalized constraints on the power of chief executives. This variable is calculated as the average from 1960 through 2000, or for specific years as needed in the tables. Source: Jaggers and Marshall (2000).

2. Expropriation Risk:

Risk of "outright confiscation and forced nationalization" of property. This variable ranges from zero to ten where higher values are equals a lower probability of expropriation. This variable is calculated as the average from 1982 through 1997, or for specific years as needed in the tables. Source: International Country Risk Guide at http://www.countrydata.com/datasets/.

3. Autocracy:

This variable classifies regimes based on their degree of autocracy. Democracies are coded as 0, bureaucracies (dictatorships with a legislature) are coded as 1 and autocracies (dictatorship without a legislature) are coded as 2. Transition years are coded as the regime that emerges afterwards. This variable ranges from zero to two where higher values equal a higher degree of autocracy. This variable is measured as the average from 1960 through 1990; or for specific years as needed in the tables. Source: Alvarez et al. (2000).

4. Share of population living in temperate zone:

Percentage of a country's population in Koeppen-Geiger temperate zone in 1995. Source: Center for International Development, Geography Data Sets. Found

online at: http://www2.cid.harvard.edu/ciddata/geographydata.htm#General percent20measures percent20of percent20geography.

5. Log settler mortality:

Log of the mortality rate faced by European settlers at the time of colonization. Source: Acemoglu et al. (2001).

6. Population density in 1500:

Total population divided by total arable land in 1500 A.D. Source: McEvedy and Jones (1978) as cited in Acemoglu et al. (2002).

7. Years of schooling:

Years of schooling of the total population aged over 25. This variable is constructed as the average from 1960 through 2000; or for specific years as needed in the tables. Source: Barro, Robert J. and Jong-Wha Lee, International Data on Educational Attainment: Updates and Implications. Source: Barro and Lee (2000). Data posted on http://www.cid.harvard.edu/ciddata/ciddata.html

8. GDP per capita:

Gross domestic product over population. Source: Aten et al. (2002). Data available on-line at: http://pwt.econ.upenn.edu/ (this paper uses data from the 04-06-2003 version). GDP per capita for the 1870-1950 periods comes from Maddison (2003).

9. French Legal Origin:

Identifies the legal origin of the company law or commercial code of each country (English, French, Socialist, German, and Scandinavian). Source: La Porta et al. (1999)

Appendix 2: Testing for Structural Breaks

We follow closely the empirical strategy of Berg et al. (2006) and apply the two-step procedure proposed by Bai and Perron (1998, 2003a) aimed at testing for multiple structural breaks in a single time series, when both the total number and the potential location of those breaks are unknown. In the first step, the procedure identifies all possible breaks and estimates their statistical significance using *F* tests. If there is evidence of at least one structural break, the procedure then selects the optimal number of breaks using information criteria, such as the Bayesian Information Criteria (BIC) or the modified Schwartz criterion (LWZ). As an alternative to information criteria, Bai and Perron (2003a) suggest using a sequential *F* statistic, which tests the null hypothesis of 0 breaks against 1 break; if the null is rejected, then a new break is added and the test is performed again, testing the null of 1 break versus 2 breaks, and so on.

In empirical work, an important issue is concerned with the selection of the minimum number of years between breaks h (known as the "interstitiary period"). This decision involves a tradeoff because choosing a long interstitiary period (say $h=10$ years) means that the procedure can miss some true breaks that are less than 10 years apart. But, on the other hand, a short interstitiary period implies the use of very small subsamples with as few as $2h+1$ observations. A shorter sample lowers the power of the test (i.e. the null hypothesis of no structural break is not rejected when it should be rejected).

We use annual GDP growth data between 1951 and 2005, so the total sample size (T) equal to 55 observations. Additionally, we impose a relatively long interstitiary period, $h=13$, to minimize the problem of small subsamples. Thus, the maximum number of breaks allowed by the procedure, m, where $m=\text{int}\left[T/h\right]-1$, is equal to 3.

Table A2.1 summarizes the results, which robustly support the presence of a downturn in 1979.[16]

[16] The dates and number of breaks remained constant for shorter interstitiary periods. In addition, we applied the methodology presented in Ben-David and Papell (1997), who estimating an equation of the form:

$$\Delta y_t = \mu + \theta D_t + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t$$

Where y is the log of GDP, μ is a constant, D_t is a dummy variable that takes a unitary value if $t > T_B$, where T_B is an arbitrary break in the sample. The coefficient θ captures the effect of structural changes in economic growth. Using all the possible values for T_B we test the null hypothesis of no structural change in growth (θ = 0) and compare the t-statistic of all the estimated values of θ (using $k = 4$ based on the Akaike information criterion). The structural change corresponding to T_B = 1979 has the maximum t-statistic.

Table A2.1: Structural Break Test

Specifications			
z_t={1}	h=13	m=2	T=55
Tests 1/			
supF(1)	**supF(2)**	**UDmax**	**WDmax**
6.6666*	4,5130	6.6666*	6.6666*
SupF(1|0)	**SupF(2|1)**		
6.6666*	2,5893		
Number of breaks selected			
Sequential	**BIC**	**LWZ**	
1	1	1	
Parameter estimates with one break (std. errors in brackets)			
δ_1	δ_2	T_1	
5,1747	3,1879	1979	
(0.3532)	(0.3730)		

Source: Author's calculations.

Series: Colombia GDP growth, 1951 to 2005. For all tests and calculations of standard errors, a heteroskedasticity and autocorrelation consistent covariance matrix using a quadratic kernel with automatic bandwidth selection based on an AR(1) approximation is used. Residuals are pre-whitened using a VAR(1). See Bai and Perron (2003a). * Significant at 10 percent level.

Appendix 3: Growth Decomposition

We follow Hall and Jones (1999) in order to estimate the contribution to growth of changes in the capital-output ratio, changes in the educational attainment of the population, and changes in productivity.

Using the simplest Cobb-Douglas approach, assume that output Y_t in period t is produced according to:

$$Y_t = K_t^{\alpha}\left(A_t H_t\right)^{1-\alpha},$$

where K_t denotes the stock of physical capital, H_t is the amount of human capital-augmented labor used in production, and A_t is the labor-augmenting measure of productivity. Assume that each unit of labor (L_t) has been trained with E_t years of schooling. Human capital-augmented labor is given by:

$$H_t = e^{\phi(E_t)} L_t.$$

According to this specification, the function $\phi(E)$ reflects the efficiency of a unit of labor with E years of schooling relative to one with no schooling ($\phi(0) = 0$). The derivative $\phi'(E)$ measures the effect on efficiency of an additional year of schooling, which corresponds to the return to schooling estimated in a Mincerian wage regression.

Rewriting the production function in terms of output per-worker, $y \equiv Y/L$, we obtain:

$$y_t = \left(\frac{K_t}{Y_t}\right)^{\alpha/(1-\alpha)} h_t A_t,$$

where h_t is human capital per worker. Taking logs and first-differences:

$$\Delta \ln y_t = \frac{\alpha}{1-\alpha} \Delta \ln\left(\frac{K_t}{Y_t}\right) + \Delta\phi(E_t) + \Delta \ln A_t.$$

Returns to schooling are a key input in order to construct the function $\phi(E)$. Núñez and Sánchez (2000) estimate a Mincer equation and provide this information. According to their results, which are based on the quarterly household surveys for the period 1976–1998, the rates of return to education in Colombia do not have the standard concavity that has been obtained for other countries (see below). In fact, the returns to education per year of education (for individuals with 11 years of schooling) are 10 percent for men and 16 percent for women. These levels are about the same as the ones observed for individuals

with five years of schooling, corresponding to primary education. Workers with completed higher education have the highest returns to education (21.5 percent).

Returns to Schooling

Years of schooling	Total	Men	Women
0-4	0,0853	0,0763	0,0830
5	0,1214	0,1029	0,1576
6-10	0,0761	0,0618	0,1021
11	0,1369	0,1018	0,1595
12-15	0,1201	0,1238	0,1127
16+	0,2158	0,2320	0,2026
Average	**0,1020**	**0,0923**	**0,1152**

Source: Nuñez and Sánchez (2000).

The stock of capital was constructed using the perpetual inventory model on disaggregated investment data since 1925. For the year 2005, the stock of capital corresponds to the sum of all investment since 1925, net of depreciation (8 percent for machinery and furniture, 20 percent for transportation equipment, and 2 percent for housing and construction). Although the methodology underestimates the stock of capital for earlier dates, the capital stock is only used for the 1955–2005 period (due to the limitations with data on years of schooling prior to 1955). Thus, in practice at least 30 years of investment data are considered for each observation of the stock of capital.

Appendix 4: VAR Model

VEC and VAR models provide a more precise estimation of the causal relationship between the three variables of interest: Area under illicit crops, homicide rates, and TFP. Although the three variables should ideally be included in the same model, in practice this is not possible given the limited number of observations. In fact, the variable measuring the area under illicit crops is available only since 1975, severely reducing the degrees of freedom in a model with three equations. Therefore, we estimated a VAR model for each one of the three pairs of variables, rather than including the three variables jointly.

All models shown in this section use first differences in logs of the variables of interest, given that they are all integrated of order one, I(1), in levels:

Unit Root Tests

Series	Deterministic	ADF	Critical value (5%)	Result	KPSS	Critical value (5%)	Result	Sample
log(Area)	Constant	-2.92	-2.97	I(1)	0.574	0.463	I(1)	1976-2005
log(TFP)	Constant	-2.75	-2.92	I(1)	0.351	0.463	I(0)*	1955-2005
log(Homicide Rate)	Constant	-1.23	-2.92	I(1)	0.757	0.463	I(1)	1958-2005

*I(1) at 10%.

Source: Author's calculations

Also, the null hypothesis of cointegration between these variables can be rejected. Once stationary variables were obtained, we used the minimum number of lags—in each VAR model—that allows the errors to be normal while not exhibiting multivariate autocorrelations.

The first VAR(1) model uses first differences of the logs of area under illicit crops and TFP:

$$\begin{bmatrix} \Delta Ln(Area)_t \\ \Delta Ln(TFP)_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} + \begin{bmatrix} \phi_{111} & \phi_{112} \\ \phi_{211} & \phi_{212} \end{bmatrix} \begin{bmatrix} \Delta Ln(Area)_{t-1} \\ \Delta Ln(TFP)_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

Figure 8a shows that a positive shock in the growth of the area with illicit crops is associated with a permanent reduction in the growth of TFP. Also, the null hypothesis that changes in the log of Area do not Granger cause changes in the log of TFP can be rejected (see Appendix 2):

Granger Causality Test

Variable	Lags in VAR	Null hypothesis	Result at 5%	P value F test
Growth in Homicide Rate	5	Cultivated Area does not granger causes Homicide Rate	Reject null	0.0078
Growth in Cultivated Area		Homicide Rate does not granger causes Cultivated Area	Don't reject null	0.8820
Growth in Homicide Rate	12	Productivity does not granger causes Homicide Rate	Don't reject null	0.5207
Growth in Productivity		Homicide Rate does not granger causes Productivity	Reject null	0.0011
Growth in Cultivated Area	1	Cultivated Area does not granger causes Productivity	Reject null	0.0466
Growht in Productivity		Productivity does not granger causes Cultivated Area	Don't reject null	0.4182

Source: Author's calculations.

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Conversely, changes in TFP are not associated with significant changes in Area, and the corresponding hypothesis that TFP growth does not cause Area growth cannot be rejected.

Turning to the relation between Area and Homicides we estimate a VAR (5) of the following form:

$$\begin{bmatrix} \Delta Ln(Area)_t \\ \Delta Ln(Homicide\ Rate)_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} + \begin{bmatrix} \phi_{111} & \phi_{112} \\ \phi_{211} & \phi_{212} \end{bmatrix} \begin{bmatrix} \Delta Ln(Area)_{t-1} \\ \Delta Ln(Homicide\ Rate)_{t-1} \end{bmatrix} + \ldots$$
$$\ldots + \begin{bmatrix} \phi_{151} & \phi_{152} \\ \phi_{251} & \phi_{252} \end{bmatrix} \begin{bmatrix} \Delta Ln(Area)_{t-5} \\ \Delta Ln(Homicide\ Rate)_{t-5} \end{bmatrix} + \begin{bmatrix} \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix}$$

Figure 8c shows that positive shocks to changes in the log of Area cause permanent increases in changes in the log of the Homicide Rate. The corresponding Granger causality supports this interpretation (Appendix 2). Shocks to homicide rate do not seem to have an effect on Area (figure 8d).

Finally, the relationship between Homicides and TFP is estimated with a VAR(12) of the following form:

$$\begin{bmatrix} \Delta Ln(Homicide\ Rate)_t \\ \Delta Ln(TFP)_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \end{bmatrix} + \begin{bmatrix} \phi_{1,1,1} & \phi_{1,1,2} \\ \phi_{2,1,1} & \phi_{2,1,2} \end{bmatrix} \begin{bmatrix} \Delta Ln(Homicide\ Rate)_{t-1} \\ \Delta Ln(TFP)_{t-1} \end{bmatrix} + \ldots$$
$$\ldots + \begin{bmatrix} \phi_{1,12,1} & \phi_{1,12,2} \\ \phi_{2,12,1} & \phi_{2,12,2} \end{bmatrix} \begin{bmatrix} \Delta Ln(Homicide\ Rate)_{t-12} \\ \Delta Ln(TFP)_{t-12} \end{bmatrix} + \begin{bmatrix} \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix}$$

The results suggest that positive shocks to the change in the log of the homicide rate generate reductions in TFP growth, while increases in TFP growth are associated with reductions in the growth of the Homicide Rate. However, Granger causality tests indicate that causality runs from homicides to TFP, rather than the opposite.

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There is a simple reason as to why Colombia (pop. 42.2 million and US$136 billion in nominal GDP in 2006) is an interesting case study for the purposes of the Commission on Growth and Development. After having been a relatively successful growth performer between 1950 and 1980, Colombia's economic growth decelerated considerably after 1980. The deceleration was particularly strong during the 1990s, when growth was in full recovery in most Latin American countries after the lost decade of the 1980s. In this paper we emphasize the role of security in explaining this result. Understanding the driving forces behind the growth deceleration in Colombia is illustrative of the type of negative shocks than can have adverse effects on growth trajectories. Also, the Colombian experience can be valuable for the design of appropriate policy responses in other countries facing similar shocks.

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