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FALLING KIDNAPPING RATES AND THE EXPANSION OF MOBILE PHONES IN COLOMBIA

Santiago Montenegro¹
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Abstract

This paper tries to explain why kidnapping has fallen so dramatically in Colombia during the period 2000-2008. The widely held belief is that the falling kidnapping rates can basically be explained as a consequence of the success of President Alvaro Uribe's democratic security policy. Without providing conclusive alternative explanations, some academic papers have expressed doubts about Uribe's security policy being the main cause of this phenomenon. While we consider the democratic security policy as constituting a necessary condition behind Colombia's falling kidnapping rates, we argue in this paper that a complementary condition underlying this phenomenon has been the significant increase during this period in the speed and quality of communications between potential victims and public security forces. In this sense, the expansion of the mobile phone industry in Colombia implies that there has been a substantial reduction in information asymmetries between kidnapers and targeted citizens. This has led to a higher level of deterrence as well as to higher costs for perpetrating this type of crime. This has resulted in a virtuous circle: improved security allows higher investments in telecommunications around the country, which in turn lead to faster communications between citizens and security forces, which consequently leads to greater security. We introduce a Becker-Ehrlich type supply and demand model for kidnappings. Using regional and departmental data on kidnapping, the police and mobile phones, we show that mobile phone network expansion has expanded the effective coverage of public protection; this, in turn, has led to a spectacular reduction in kidnapping rates.

JEL Classification: N46, O39.

Key words: Kidnapping, mobile phones, Colombia.

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DISMINUCIÓN DEL SECUESTRO Y EXPANSIÓN DE LA TELEFONÍA MÓVIL EN COLOMBIA

Santiago Montenegro

Álvaro Pedraza

Resumen

En este artículo presentamos una explicación de las causas de la dramática reducción del secuestro en Colombia entre 2000 y 2008. La creencia generalizada es que la disminución en las tasas de secuestro se explica fundamentalmente como consecuencia del éxito de la Política de Seguridad Democrática del Presidente Álvaro Uribe. Sin dar explicaciones alternativas concluyentes, algunos trabajos académicos han expresado dudas sobre esta hipótesis. En tanto nosotros consideramos que la Seguridad Democrática fue una razón necesaria para la disminución del secuestro, en este trabajo planteamos que la expansión y la mejor calidad de las comunicaciones entre las víctimas potenciales y la fuerza pública fue una condición complementaria a la política de seguridad para la disminución del secuestro. En este sentido, la expansión de la telefonía móvil en Colombia ha implicado una reducción en las asimetrías de información entre los secuestradores y las víctimas potenciales. Esto generó un efecto disuasivo y aumentó los costos de perpetrar este tipo de crimen. Así se dio un círculo virtuoso: las mejoras en la seguridad permitieron mayores inversiones en telecomunicaciones en todo el país, lo que a su vez implicó una mayor comunicación con la fuerza pública, y en consecuencia una mejora en seguridad. Para sustentar nuestra hipótesis introducimos un modelo teórico de oferta y demanda de secuestros del tipo Becker-Ehrlich. Usando información departamental y regional de secuestros, policía y celulares, mostramos que la expansión de la red de telefonía móvil incrementó la cobertura efectiva de la fuerza pública, lo que a su vez, condujo a una espectacular reducción de las tasas de secuestros.

Clasificación JEL: N46, O39.

Palabras clave: secuestro, teléfonos celular, Colombia.

1. Introduction

This paper tries to explain the causes of the dramatic fall in kidnapping rates in Colombia in recent years. It is widely assumed that this marked downtrend in kidnappings is a consequence of the Colombian government's successful security policy, initiated by the administration of President Alvaro Uribe. There is no doubt that without the measures introduced against terrorist organizations, Colombia's violence rate in general, and with respect to kidnapping in particular, would be significantly higher than today's level. However, in some academic circles (Rubio 2004), there has been a preoccupation with whether the government's overall security policies have been a sufficient condition underlying the steep decline observed in kidnapping rates. We argue that, while the democratic security policy has been a necessary condition, a complementary condition is required to explain the success of Colombia in reducing violence, both in general, and with respect to kidnapping in particular.

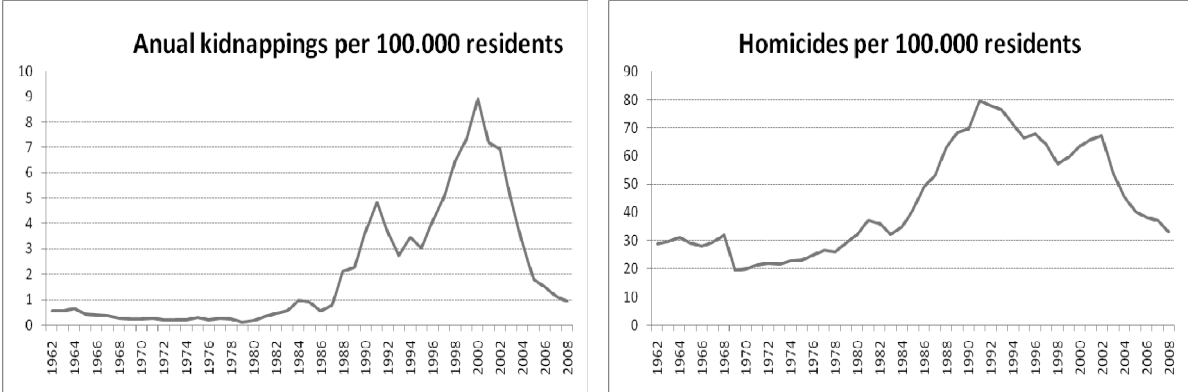
The paper is organized as follows. In section 2, we present a brief overview of the Colombian cycle of violence that began in the 80's, peaked during the 90's, and more recently, has lessened. In section 3, we focus on the manner in which kidnapping rates have evolved, review the relevant existent literature, and present an alternative explanatory hypothesis for the fall in kidnapping rates. In section 4, we introduce a Becker-Ehrlich supply and demand model for kidnappings. In section 5, we present our data and carry out an econometric estimation of the model. Section 6 concludes.

2. Colombia's last cycle of violence

Since the 1980's, the homicide and kidnapping rates have followed similar trends. Both exploded during the second half of the eighties, peaked during the nineties, and more recently have fallen (though historically speaking, the current rates are still significantly high). As indicated in Figure 1, during the early eighties, the homicide rate stood at around 30 per one hundred thousand inhabitants,

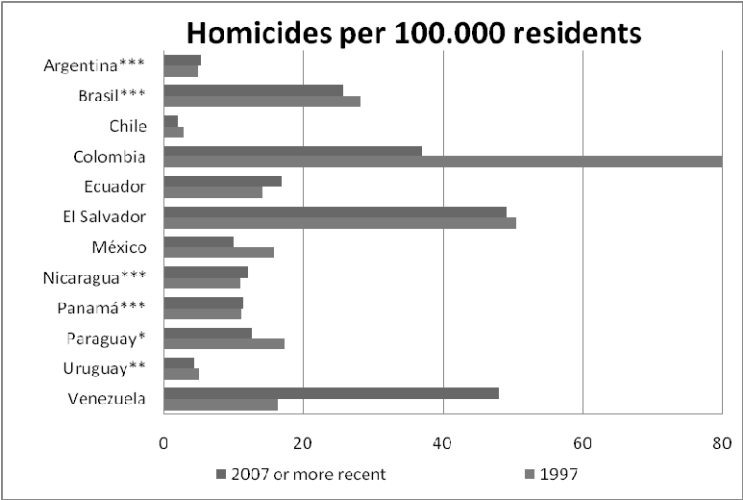
continuously increased over the course of the eighties, and peaked at 80 per one hundred thousand inhabitants in 1990. From 1990 onward, the homicide rate fell, until 1998, at which point it again began to increase, through 2002, the year the Uribe administration took over the government. Since that year, it has continuously fallen, reaching a level of 33 per one hundred inhabitants in 2008. Should these trends continue in the future, Colombia could return to pre-crisis levels of violence, which, although low relative to the peak years, were still very high when compared to international standards, as Figure 2 indicates.

Figure 1. The evolution of the kidnapping and homicide rates in Colombia, from 1962 to 2008.



Source: National Police, Dane, authors calculations.

Figure 2. Homicides per 100.000 residents in Latin America for the years 1997 and 2007



Source: Pan American Health Organization, *2000, **2005, ***2006

What caused this explosion in violence and the following cycle is subject to debate in Colombia as well as in international academic circles. A necessary but perhaps insufficient condition underlying the crisis' emergence during the eighties was the consolidation in Colombia of the illegal drug industry. First, there was the marijuana boom that began in the 1970s, and which lasted for about a decade, until domestic production in the United States began to substitute for Colombian exports. A more lethal and destructive boom began soon after that, namely that related to cocaine production and drug trafficking to U.S. and European markets. This boom was led by the powerful drug cartels of the cities of Medellin and Cali; these either killed, menaced or intimidated government officials, judges, and members of the police and armed forces. During the 1989-90 presidential campaign, three presidential candidates were assassinated, among them Luis Carlos Galán, who was then well ahead in the opinion polls.

Following some lag time, the Colombian state reacted to this criminal offensive; within a few years, and with the support of the United States and other governments, the Medellin and Cali drug cartels had been destroyed and their leaders killed, imprisoned or extradited to the United States. Unfortunately, the cartels were soon replaced by even more dangerous actors—namely, the Marxist guerrilla groups that have existed since the 1960s, along with certain right-wing paramilitary organizations.

From a certain theoretical perspective, initially the guerrilla groups were able to justify their existence and their struggle to achieve certain political goals; as soon as they began to finance their activities using drug money, however, they became less political and more criminally oriented. A failed peace process towards the end of the 1990's—whereby the government handed a Swiss-size demilitarized area to the FARC guerrilla group —ended up confirming the worst expectations. Peace was not achieved, and the rates of violence again increased to the extent that some analysts, among them, those representative of the Council on Foreign Relations, have designated Colombia a “failed state.” Within this environment,

paramilitary groups soon spread around the country, generating even more violence, anarchy and human rights violations.

Tired with and scared by the government's generous approach towards guerrilla groups, the next presidential campaign saw Colombians overwhelmingly support Alvaro Uribe, who ran on a platform promising a tougher approach in dealing with terrorism and anarchy. As soon as Uribe took office, his government began to implement his "democratic security policy," which quickly showed impressive results. Upon taking over the reins of government, the new administration found that close to 160 municipalities had no police; that illegal armed groups controlled nearly 40% of Colombia's territory; that between 1998 and 2002, Colombia's per capita GDP had not grown; that unemployment had jumped to 20% of the labor force; and that investment had collapsed to 12% of GDP. The homicide rate stood above 60 per one hundred thousand inhabitants, a figure which, while below its early-90's peak, was still nonetheless very high. Indeed, most Colombians found it impossible to travel in the countryside. Perhaps worst of all was that a significant share of Colombia's educated elite was beginning to give up on the future of the country. Young professionals were migrating abroad by the thousands, and many began to believe that Colombia would never be viable as a normal, liberal, democratic state. More than simply being pessimistic, they were fatalistic about the future.

As a result of the policies introduced by the new administration, however, together with the restructuring of the armed forces carried out by the administration of the previous president, Andres Pastrana, and the measures and activities introduced under the umbrella of the U.S.-sponsored Plan Colombia, this bleak picture began to change. Between 2002 and 2007, the number of individuals in the armed forces increased by 32%, jumping from 307.000 to 405.000 members. Moreover, before too long, all of the municipalities had a police presence. Most paramilitary groups demobilized under the umbrella of a new law approved by Congress, while others were forced to retreat to the jungles, inaccessible areas, or

to neighboring countries. By 2007, the homicide rate had fallen to its lowest level in twenty years and the rate of kidnappings reached levels not seen since the early eighties. Consistent with these trends, the economy began to recover, with the overall investment rate peaking at 26% of GDP during 2006-2007; growth resumed high rates and unemployment fell. Most importantly, Colombians began to regain confidence in their country.

3. The evolution of kidnapping

As mentioned above, the evolution of kidnapping in Colombia followed the overall cycle of violence that Colombia experienced during the eighties. According to Mauricio Rubio (2004), one of the most well versed academics on Colombian violence, kidnapping in this country is linked to politically-motivated (guerilla) groups, groups which have existed since the 1960s. Through indoctrination and highly centralized decision processes, these political groups have been able to deal with agency problems common to such organizations. Ideological training diffuses personal responsibility, while also reducing individual tendencies to appropriate large cash ransoms. Political motivations also help assimilate kidnapping with the taxing of wealthy Colombians and aliens. According to Rubio, this may explain why non-political groups, unlike guerrilla groups, have not been able to engage in kidnapping in a systematic way. This might also explain why it has been so difficult for authorities to combat such a powerful, illegal industry.

Over the course of the twenty-year cycle of violence, it is possible to observe two structural upward shocks with respect to kidnapping rates, both of which are followed by acute declines. According to Rubio, these cycles have nothing to do with social or economic variables. The first upsurge began during the early months of 1987, and ended around 1991. Rubio argues that it is not clear as to what caused the end of this boom. According to him, against several possible causes, the only explanatory variable that stands up to all statistical tests is the change in the criminal procedure implemented at the beginning of 1987 (Law 50), a change reversed in 1991. As indicated in Figure 1, the boom ended in 1991. Then, the

kidnapping rates fell to a floor significantly higher than the pre-boom level. While the annual kidnapping rate per hundred thousand inhabitants had been below 1 up through 1986, between 1992 and 1997, the kidnapping rate stood at between 3 and 4 per one hundred thousand inhabitants. Rubio does not elaborate as to the reasons for this higher floor.

Starting at this higher level, the second boom began at the end of 1997, and, according to Rubio, had no relationship with any economic or social aggregate variable. Likewise, no relationship can be established between the higher kidnapping rates and any legislative changes or procedural reforms. Moreover, Rubio argues that there is no relationship between this boom and the Pastrana administration's concession to the guerrillas of a Swiss-size demilitarized zone, a concession that initiated a peace process that by 2002 had failed dismally. This second boom began months before the two main guerrilla groups (FARC and ELN) introduced a significant change in their kidnapping methods, namely the implementation of the so-called "pesca milagrosa," whereby they carried out massive abductions on the roads. As a consequence of this, for a couple of years, kidnapping rates soared. . According to Rubio, the share of foreigners (the most sought after kind of hostage) among those kidnapped also increased. This new kidnapping technique, however, soon backfired. Rubio believes that the only reasonable explanation for the emergence of this second boom lies in the dynamics of the kidnapping industry itself—that is, the inevitable reduction in potential high-income victims eventually forced perpetrators to seek higher numbers of hostages. Critical for our understanding of the dynamics of kidnapping in Colombia is what came next. According to Rubio, these massive kidnappings backfired on the guerrillas, as the country's reaction against this second wave of kidnapping was of such magnitude that the criminal industry soon began to decline.

Rubio emphasizes that this decline was an endogenous phenomenon, one that had nothing to do with policy or legal measures. The author defines this phenomenon as the "boomerang effect": as the stock of wealthy hostages began to

decline, the guerrillas were compelled to kidnap less wealthy Colombians. Consequently, during this period, the average estimated income of kidnapping victims continuously decreased. This trend is also consistent with the increasing share of kidnappings that involve vulnerable groups such as infants and elderly people, which Rubio argues became very costly for guerrillas in political terms. According to the author, these kidnappings were costly for guerrillas in another sense as well; given their nature, they facilitated more successful rescue raids by the authorities.

As can be seen in Figure 1, what is clear is that the decline in kidnappings began two years prior to the introduction of President Uribe's democratic security policy. This suggests a complementary hypothesis for explaining the causes of this declining trend. In fact, Rubio himself provides some hints at other complementary explanations for this dramatic fall in kidnapping rates. When attempting to demonstrate that most kidnappings were carried out by guerrillas, and not by common criminals, Rubio elaborates about the difficulties involved in rescuing victims. According to him: a) rescuing a hostage is far more difficult in a rural area than in urban zones; b) the probability of successfully rescuing a hostage decreases exponentially with time; c) successful raids are usually made within hours of the kidnapping; and d) after a critical period the proportion of liberated victims is significantly reduced.

This analysis shows that time is a critical variable, both for a successful kidnapping and, conversely, for a successful rescue on the part of the authorities. The sooner (the later) the police know about a kidnapping, the higher (the less) the probability of a successful rescue. It follows then that should the authorities (be it the police or the army) find a technology that narrows the time that elapses between an abduction and knowledge of it (by the authorities and relatives) the greater the likelihood of a successful rescue. Moreover, the technology would itself become a deterrent against kidnapping, thus generating a virtuous cycle.

In this context, we argue that the extraordinary expansion in mobile digital telecommunication in Colombia has resulted in a significant technological change, one that has allowed authorities—in particular, the police—to know about abductions much sooner than was the case in the past. The massive expansion of handsets has allowed citizens of all types when confronted with an emergency to contact the authorities, either directly or via relatives who in turn were able to communicate with them. The popular press began to provide incidental evidence of this phenomenon a long time ago. For example, on May 29, 1998, the newspaper *El Tiempo* reported that an attempted mass abduction by the FARC in the village of Aguas Blancas in the Cesar department was thwarted because one of the potential victims had been able to make a speedy phone call to the police. The guerrillas had first immobilized and then deviated from the main highway 35 vehicles containing approximately one hundred people. As the caravan was advancing toward the Sierra Nevada de Santa Marta, a counter insurgency patrol was able to intercept the guerrilla commando, which was forced to flee. To give another example³, in 2009, the wife of the mayor of Altamira, in the Huila department, was able to alert her husband via her cell phone about her impending kidnapping, resulting in her being rescued in a timely fashion by the police. More recently,⁴ on May 10, 2009, the Colombian press reported that in La Uribe, in the Meta department, the FARC distributed leaflets prohibiting citizens from using mobile phones. The Minister of Defense responded by traveling to the place so as to freely present handsets to the people. Speaking to the press, Minister Santos declared: “The cellular phone allows people to inform the army of the location of guerrillas.”

We believe that the new security policy and the expansion of mobile communications have complemented one another. High levels of security were a prerequisite for investment in telecommunications and this higher investment has in turn expanded security. Falling kidnapping rates would not have been possible

³ *El Tiempo*, January 29/09.

⁴ Caracol television, May 10/09.

without a police and armed forces trusted by and accessible to the general population. Likewise, they would have not occurred without a security apparatus with a minimum of disposition to act quickly and efficiently. In countries such as Venezuela and Mexico mobile telecommunications also expanded significantly during the same period as in Colombia. However, unlike what occurred in Colombia, in those countries, kidnapping rates went up dramatically. This suggests that an effective security police is a necessary condition in order for rates of violence to fall in general and rates of kidnapping to fall in particular.

In summary, in this paper we attempt to demonstrate our hypothesis that the dramatic fall in kidnapping rates in Colombia during the present decade can be explained by the interaction between an expanding mobile telecommunication network and an effective security policy. In what follows, we test this hypothesis in full.

4. The market for kidnappings and the technology effect

In this section we develop a model for the kidnapping market, one which describes the interactions between potential victims (society) and criminals (kidnappers). The model is based on two key assumptions. First, both parties are assumed to be rational in the sense that they behave in accordance with the rules of optimization behavior. Second, we assume an initial group that decides to participate in an illegal activity—that is, kidnapping—such that the supply of crime they generate (that is, the number of kidnappings) reveals in an implicit way the cost function. In this sense, an explanation of the mobility between legal and illegal activities exceeds the scope of this paper.

a. The supply of kidnappings

From the criminals' perspective, the rational behavior condition implies that the number of kidnappings during time t , S_t , depends on a balancing of the

activity's costs and gains. A straightforward analytical representation of the kidnappers' overall expected net return, π_t , is

$$\pi_t = rS_t - g(P_t A_t; S_t), \quad (1)$$

where r is equal to the expected gross payoff per kidnapping⁵ and $g(\cdot)$ is the criminal cost function. The cost function includes two terms (Ehrlich 1996⁶): the direct costs of planning and executing kidnappings, and the cost of apprehension and conviction (Becker 1968). According to Becker and Ehrlich, these costs are affected by the private and the public sectors' actions aimed at achieving protection against crime. In particular, kidnapping activity should become more costly as the expenditure on policemen and law enforcement, P_t , increases.

We extend this idea by introducing an index of police effectiveness, or what we might call the armed forces' effective protection coverage (A_t) of society against criminal activity—more specifically, from kidnapping. This exogenous variable attempts to capture any technological development that may enhance the protection of common citizens *vis a vis* criminals. In our model, these developments are considered an externality, in the sense that they are not necessarily the result of individuals' actions demanding higher public or private protection. We explain this feature in the next section, where we show the model's demand side. For analytical simplicity, and without any loss of generality, we assume a cost function of the following form [or 'we assume the following cost function']:⁷

⁵ In this case, r is the net payoff discounting failed kidnapping attempts, or kidnappings where victim's family members did not [or 'choose not to'] negotiate. An alternative way of modeling kidnappings is to include the success probability of the crime, as in Mejia 2001.

⁶ No term for the wage rate of an alternative legitimate activity is included, as in this particular model, criminals are dedicated to only illegal activities.

⁷ The equilibrium for this model of kidnapping, as well as the main results, hold for any type of cost function having the following properties:

$$g(A_t e_t; S_t) = \frac{(A_t P_t)^\sigma S_t^2}{2\Omega}, \quad (2)$$

where we include Ω , which represents a geographical variable or any variable of an idiosyncratic type such as favors the kidnapping industry. The optimal number of kidnappings (S_t^O) at any given time is set at a level where there exists a balance between benefits and the marginal cost:

$$S_t^O = \frac{\Omega r}{(A_t P_t)^\sigma}. \quad (3)$$

b. The tolerated demand for kidnappings

The level of kidnappings that a society is willing to tolerate can be derived implicitly from a people's demand for consumption and protection.⁸ Individuals desire protection from crime, but a society's total expenditure on protection diminishes the resources available for the consumption of other goods. In this sense, a society implicitly decides the level of kidnapping it is willing to tolerate.⁹

A society is rational in the sense that it maximizes the total utility of a particular action or good subject to a budget constraint. In particular, a society assigns total income Y_t to the consumption of goods C_t , in order to hire public protection (policemen and law enforcers) A_t and to pay kidnapping ransoms. The budget constraint is thus expressed as:

$$Y_t \geq C_t + P_t + rS_t. \quad (4)$$

(i) $\frac{\partial g}{\partial S} > 0$ and $\frac{\partial^2 g}{\partial S^2} > 0$; and

(ii) $\frac{\partial g}{\partial A} > 0$ and $\frac{\partial g}{\partial e} \geq 0$. This implies that $\sigma \geq 0$.

⁸ For simplicity's sake, we only allow for public protection.

⁹ This is what Ehrlich calls a "tolerance of crime."

In turn, we assume that P_t is a function of the level of kidnappings—that is to say, if the number of kidnappings increase, people will be willing to pay higher taxes for increased and better security. It is straightforward to conclude then that in this model, the opportunity cost of crime for individuals is bimodal. A low level of expenditure on public protection implies high levels of crime and low levels of consumption. Conversely, a greater expenditure on public protection will reduce actual consumption.

For simplicity's sake, we assume that $P_t = \lambda S_t$, where λ is the magnitude of a people's response to a particular level of kidnappings. Under these circumstances, the maximum level of consumption by a society is

$$C_t = Y_t - (\lambda + r)S_t, \quad (5)$$

where λ is the tax paid to the government (as a function of kidnappings) and r , as explained above, is the average ransom fee.

c. Market equilibrium

The aggregate [?] of the conditions related to the behavior of the two relevant parties assure a well-defined equilibrium in our kidnapping model. Based on criminals' optimal "supply" of kidnappings (3) and a society's response function, we derive a net offer [?] of kidnappings by period:

$$S_t^* = \left(\frac{\Omega r}{A^\sigma \lambda^\sigma} \right)^{1/\sigma}. \quad (6)$$

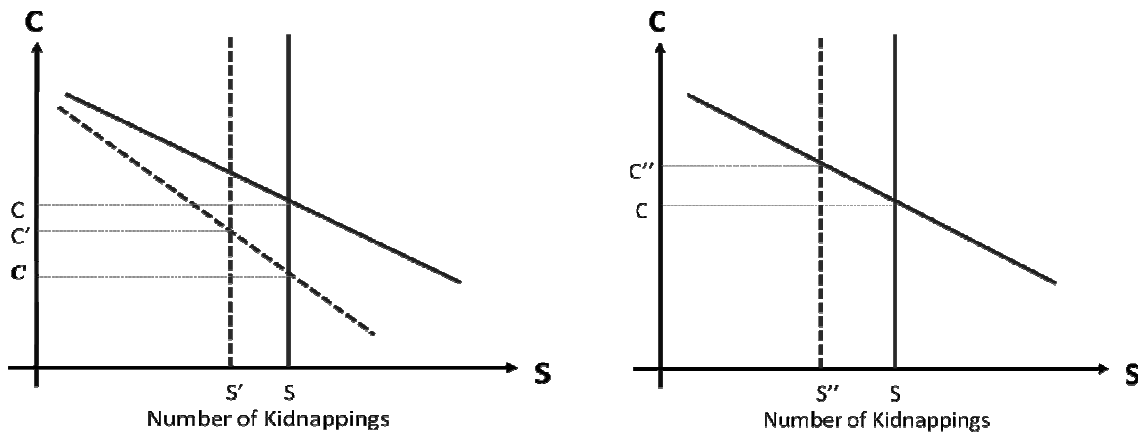
This in turn leads to a specific aggregate consumption profile, $C_t(S_t^*)$. It is a straightforward matter to verify the impact of a society's efforts at reducing kidnappings on the aggregate consumption level $\frac{dC}{d\lambda} = -S^* - (r + \lambda) \frac{dS^*}{d\lambda}$; while the first term accounts for the direct cost of preventing kidnappings (the steeping of the slope in Figure 3a), the second term represents the increase in available income

$\left(\frac{dS^*}{d\lambda} < 0\right)$ due to the reduction in kidnappings brought about by a given protection policy. In other words, the last term is the partial compensation $(C - \bar{C})$ resulting from the decrease in crime due to increased public security.¹⁰

Another interesting result derived of the consumption-kidnapping relationship is that technological developments that promote more effective security policies—such as those discussed in section IV.a—lead to lower levels of observed kidnappings, and thus higher aggregate consumption $\left(\frac{dC}{dA} = -(r + \lambda)\frac{dS}{dA} > 0\right)$, as shown in Figure 3b.

Figure 3. The market for kidnappings equilibrium

- a. The net effect on kidnappings and consumption by a shock in a society's response to crime ($\lambda' > \lambda$) b. The net effect on kidnappings and consumption by a technology shock in a public protection policy ($A' > A$)



$C' < C$ for $\lambda > r$, and $C'' > C$ for every positive technology shock ($e' > e$).

¹⁰ In particular, $\frac{dC}{d\lambda} < 0$ for $\lambda > r$, which can be interpreted as meaning that the marginal propensity to pay for public protection is higher than the marginal propensity to pay for ransoms. This is generally the case.

While this analysis is quite straightforward, it is based on the key assumption that the cost function of kidnappings for criminals takes the general form introduced in section IV.a.

To summarize, the equilibrium level of kidnappings is a consequence of three main factors: first, a society's perception of crime or, alternatively, a society's level of preference for security; second, geographical and other idiosyncratic variables; and third, the level of effective coverage of public protection.

In general, this market-for-kidnapping model is in accordance with the classical "deterrence hypothesis," whereby expenditures on crime control tend to offset changes in criminal behavior, such that an upward shock in kidnappings will trigger a wave of anti-kidnapping expenditures, which in turn will lower the magnitude of the observed shock (Becker hypothesis). Authors like Gaviria (1998) and Rubio (2004) have argued that this type of model does not provide an appropriate framework for studying the evolution of Colombia's criminal explosion of recent years. However, it should be mentioned that these studies have not taken into account the overall crime cycle in Colombia during the last twenty years, in particular, the spectacular reduction in kidnappings that took place during the period 2000-2008.

Consistent with the model developed in this section and with the empirical econometric model that we present in the following section, we argue that Colombia's experience in recent years with respect to criminal-markets—in particular, the accelerated reduction in kidnapping rates to the low levels of the early 80's—has been a consequence of two different but convergent and complimentary forces: (i) changes in people's perceptions about safety and security, which resulted in a dramatic increase in the demand for public protection and for higher levels of expenditure for the armed forces—this shift was encapsulated by the people's massive acceptance of President Uribe's democratic security policy; and (ii) technological breakthroughs, among them the dramatic expansion of mobile communication coverage in Colombia to all regions

of the country, inclusive of rural and urban areas. This expansion has acted as a low-cost implicit extension of the public protection network against criminals and perpetrators of terror.

5. The data and a description of the analysis and estimation method

Our source for official departmental¹¹ kidnapping data as well as the number of police officers for the period 1996-2008 comes from the National Police.¹² The Ministry of Communications of Colombia is our main source of information regarding the total number of mobile phone lines. The latter data is grouped into three regions for the same period (1996-2008). Additional data on “base station antennas” is available by region for the period 1996-2003, and by department for the period 2004-2008.

The panel data is organized as follows: (i) a dataset with 13 years (1996-2008) of observations, and featuring information about kidnappings, the police force and mobile phones lines for three regions; (ii) a five year dataset (2004-2008) of observations and featuring information about kidnappings, the police force and mobile phones antennas for 33 departments. Additional information, like residents and GDP series come from the National Administrative Department of Statistics (DANE)¹³.

a. Empirical evidence concerning the Colombian market for kidnappings

As mentioned in Section II, Colombia saw a rapid growth in kidnapping during the second half of the 90's. Over a three year period (96-99), on average, kidnapping rates rose 2.5 times. This was a generalized phenomenon across the country, with departamentos like Boyacá, Caldas, Casanare, Cundinamarca,

¹¹ Thirty-three (33) departments.

¹² Revista de Criminalidad, the National Police.

¹³ www.dane.gov.co.

Santander, Tolima and Valle experiencing an increase in kidnapping of over 300 percent during the period in question. As shown in Figure 4a, this increase was followed by a substantial decrease in kidnapping rates, a reduction that largely exceeded the initial boom. Again, this downturn trend was common to all regions in the country. A longer-time overview of abduction behavior across regions clearly shows that kidnapping rates throughout the country followed a similar pattern during the period 1996-2008 (Figure 4b).

There is no available disaggregated information on dissuasive expenditure or on public protection expenditure by department or by region. However, as a proxy for such disaggregation, in this paper, we use the regional allocation of the police across the country. From this data, it can be inferred that, while there was a small increase in the number of police agents during the period 1996-1999, the following years saw a generalized public response, one which was private and was highly observable. With the categorical introduction of a strong security policy against terrorism and crime, the Uribe administration increased the number of police officers by 50% between 2002 and 2008 (Figures 5a and 5b.).

Table 4a. Yearly average of kidnappings by department, for the periods 1996-99 and 2000-08.

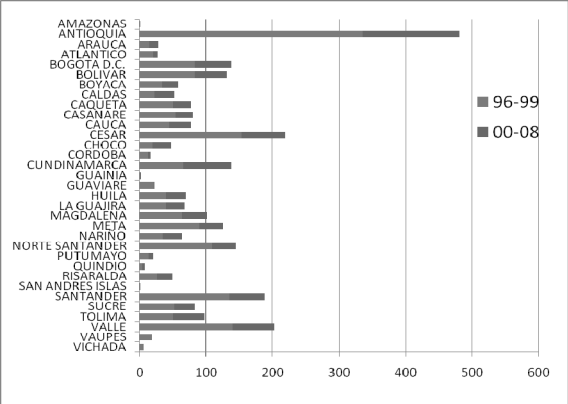
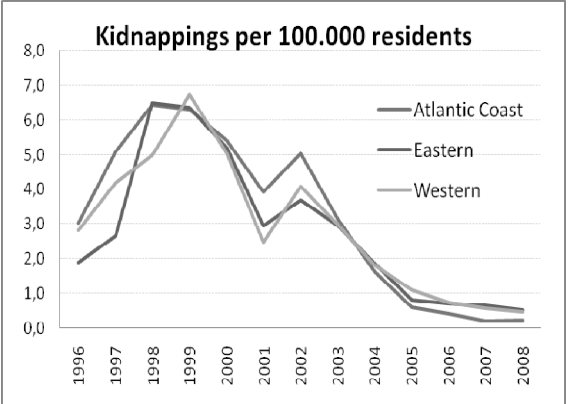


Table 4b. Time evolution of the kidnapping rate by region, between 1996 and 2008.



Source: National Police, Dane, authors calculations.

Table 5a. Net increase in police officers by departments, for the periods 1996-99 and 2000-08.

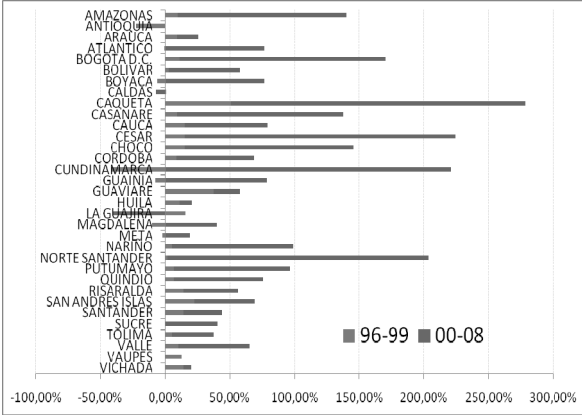
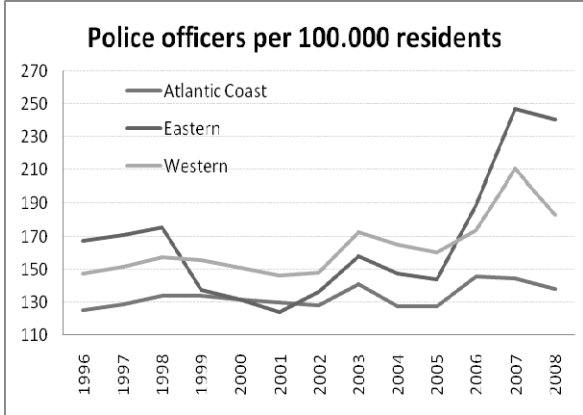


Table 5b. Time evolution of police officers coverage by region, between 1996 and 2008



Source: National Police, Dane, authors calculations.

b. Mobile phone communications in Colombia

In 1993, the Colombian Congress approved Law 37, which regulates the supply and provision of mobile telephone services. On January 22, 1994, the bidding for this service took place. The country was divided into three areas of operation and services: The Eastern Region and Bogotá; Medellín, Cali and the Western Region; and the Atlantic Coast.¹⁴

In order to promote competition, the government established [or ‘reserved’?] two bands or segments of the electromagnetic spectrum allocated to this specific service. Private companies were awarded the “B” band, while the “A” band was awarded to companies representative of a mix of public and private capital. During the second half of 1994, the selected companies initiated their operations: Celumovil (B) and Comcel (A) in the Eastern Region; Cocolco (B) and Ocel (A) in the Western Region; and Celumovil (B) and Celcaribe (A) in the Atlantic Coast region.

¹⁴ The Eastern Region consists of Amazonas, Arauca, Bogotá D.C., Boyacá, Caquetá, Casanare, Cundinamarca, Guainía, Guaviare, Huila, Meta, Norte de Santander, Putumayo, San Andrés Islas, Tolima, Vaupés and Vichada; the Western Region consists of Antioquia, Caldas, Cauca, Chocó, Nariño, Quindío, Risaralda, Santander and Valle; and the Atlantic Coast consists of Atlántico, Bolívar, Cesar, Córdoba, La Guajira, Magdalena and Sucre.

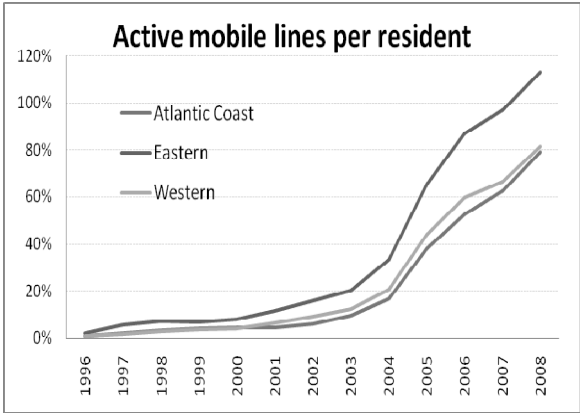
The result was a rapid increase in coverage throughout the country. During the first three years, operators installed new antennas at a speed of 35% per year. In 2004, the country experienced a second push to promote the development of mobile telecommunications, when the Ministry of Communication authorized the expansion of the available electromagnetic spectrum for this service.¹⁵ Thanks to the telecommunications policies promoted by the government, and thanks to the speedy interest and response of the private sector, the country experienced a massive increase in mobile phone area coverage and in the number of total lines. This trend is summarized in Figure 6, which presents the time evolution of total mobile phone lines by region as well as the total number of antennas that were set up.

Figure 6. Mobile phone coverage evolution

a. Total antennas and annual growth

Year	Antennas	% growth previous year
1996	354	55,26%
1997	412	16,38%
1998	549	33,25%
1999	597	8,74%
2000	634	6,20%
2001	720	13,56%
2002	772	7,22%
2003	1823	136,14%
2004	3236	77,51%
2005	4659	43,97%
2006	6.641	42,54%
2007	7.294	9,83%

b. Total lines per number of residents between 1996 and 2008



Source: Ministry of Communications, Dane, authors calculations.

Finally, Figure 7a provides a cross-section comparison between kidnapping rates, the number of police officers, and mobile phone coverage. Notwithstanding the fact that the total number of police officers seems negatively correlate with kidnapping rates, it is quite clear from Figure 6b that there is a much stronger

¹⁵ Decree 4234 of 2004.

correlation between the variables capturing the interaction between technology improvements and the police, on the one hand, and between technology improvements and kidnappings, on the other. In practical terms, Figure 7b shows the long-term relationship between our variables of study—high levels of mobile phone coverage, together with high levels of total police officers is consistent with low levels of crime, particularly kidnappings.

Figure 7a. Kidnapping rates versus the number of police officers

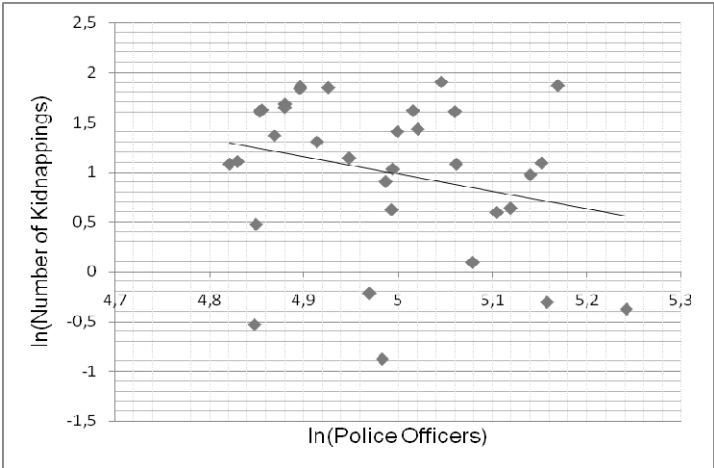
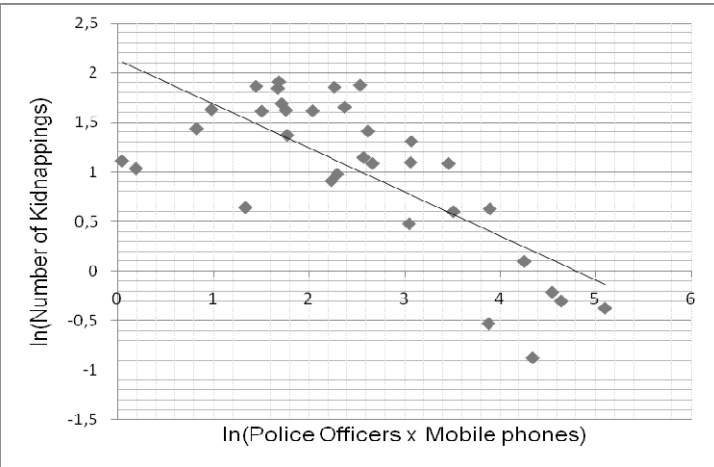


Figure 7b. Kidnapping rates versus the number of police officers x the number of mobile phones



Source: Ministry of Communications, Dane, authors calculations.

c. The estimation method and our results

In this section, we estimate the determinants of kidnapping in Colombia during recent years. Following the theoretical model introduced in Section 3, the dynamics of the kidnapping market are governed by the interaction between the availability and size of public expenditure on security, and household technology. The two combined effectively cover public protection:

$$S_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 A_{it} + \beta_3 P_{it} A_{it} + \beta_4 GDP_{it} + \varepsilon_{it} , \quad (8)$$

where i accounts for each department, and $P_{it} \cdot A_{it}$ is the effective coverage of public protection, defined as the number of police officers per 100.000 residents, (P_{it}), times mobile phone coverage (A_{it}). The GDP per capita by region (GDP_{it}) is included in order to control for economic growth.

The results in Table 1 are for the available departmental data for the period 2004-2008. Table 1 shows that there exists a significant negative relationship between the interaction term *Antennas*Police_officers* and the observed “supply” for kidnappings. This result is in accordance with the main hypothesis of this paper— that greater mobile phone coverage results in a more effective security policy, and thus reduces the level of kidnaps. The coefficients for *Antennas* and *Police officers* should not be interpreted as having marginal effects on the kidnapping rates, since these are conditional on the interaction term discussed above. In particular, the marginal impact of increasing the number of police officers on kidnappings for a specified level of antennas is written as $\frac{dS}{dP} = \beta_1 + \beta_3 A$. This is the solid line in Figure 7. The dashed lines represent the confidence intervals¹⁶ under which the size of the police force has a significant effect on the observed

¹⁶ The significance test on the conditional marginal effect is given by Aiken et al (1991), using the following calculated covariances: $cov(\beta_1 \beta_3) = -0.0337$ and $cov(\beta_2 \beta_3) = -0.0089$.

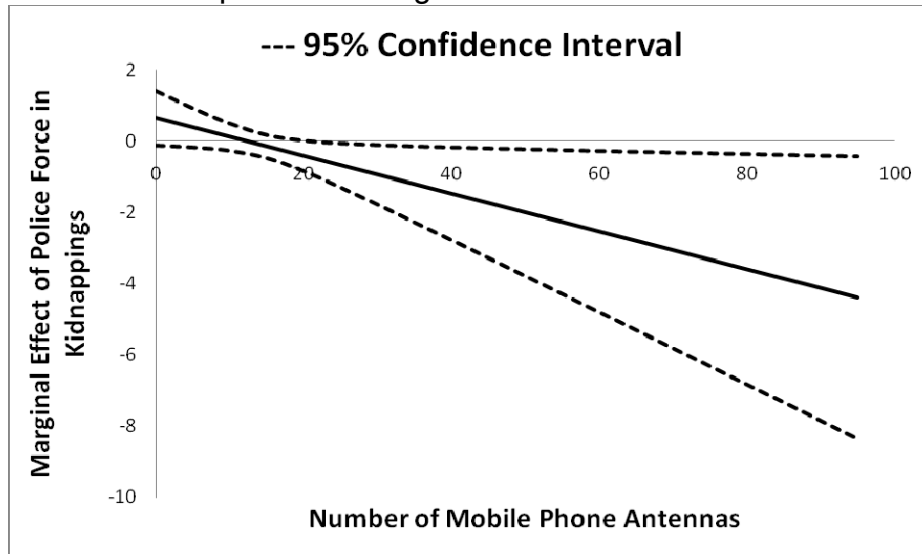
kidnapping rates. It can be inferred from Figure 7 that the police (public protection) have a strong negative effect on kidnapping, whenever there exists a minimum number of antennas. Moreover, mobile phone antennas make the police more effective in their attempt to prevent kidnappings.

Table 1. The impact of technology on kidnapping. Dependent variable: kidnapping per 1.000 residents.

<i>Regressor</i>	<i>Model</i>
Antennas	4.039* (2.187)
Police officers	0.6554 (.3913)
Police officers x antennas	-.0531** (.0249)
GDP	279** (112)
Constant	-175 *** (37)
# of observations	132
R^2	0.12

Note: Standards errors in parentheses. *, **, *** indicate individual significance at the 10, 5 and 1 percent level respectively. Numbers of police officers and antennas per 100.000 residents.

Figure 7. The marginal effect of police force variations in kidnappings conditional on the extent of mobile phone coverage.



Note: Authors calculations.

Finally, we should note that in the absence of increments in the number of police officers ($\Delta P \leq 0$), there is a positive significant marginal effect for increased numbers of antennas on kidnappings. A possible interpretation of this result is the following: since in this scenario there is either a non-existent police force or a reduction in its size, improvements in mobile phone coverage may be beneficial only to criminals, inasmuch as these reduce their costs of operation, regardless of the gain in technology by citizens. Hence, the asymmetry in information between kidnappers and the police might increase even further. A detailed study of this phenomenon could be the focus of future research. Generally speaking then, for a minimal size of police force, increased numbers of antennas will have a negative impact on the kidnapping industry.

For completeness, we estimate a modified version¹⁷ of (8) using the regional information for the period 1996-2008. In this case, mobile phone coverage is

¹⁷ $S_{it} = \beta_0 + \beta_1 P_{it} + \beta_2 A_{it} + \beta_3 P_{it} A_{it} + \beta_4 GDP_{it} + \beta_5 Y + \varepsilon_{it}$, where i stand for region, A is the total active mobile phones per resident, and Y is a dummy variable controlling for presidential election years.

measured as the number of active lines per resident. We control for the presidential election years, 1998, 2002 and 2008. The results are presented in Table 2. These are consistent with the overall estimation for the departmental data. We emphasize again that mobile phone communications could not have reduced kidnappings without a well operating security apparatus.¹⁸

In summary, we found that the expansion of the mobile phone network, together with an increase in public protection, has had a significant impact on the Colombian kidnapping industry. The dramatic pace at which criminals have reduced their supply of kidnappings during the period 2000-2008, and the new level of kidnapping rates obtained, were the result of an increase in effective public protection coverage, modeled through the substantial gain achieved in mobile phone telecommunications. Both the regional information for the period 1996-2008, and the departmental data for 2004-2008, support our hypothesis.

Table 2. The impact of technology on kidnapping. Dependent variable: kidnappings per 100.000 residents.

<i>Regressor</i>	<i>Model</i>
Active celular phones	-.0882 (3.2911)
Police officers	.04860 (.0255)
Police officers x active celular phones	-.3905** (.1947)
GDP	-3.0880* (1.8961)
Presidential election year	1.5464*** (.4779)
Constant	-.2994 (.2890)
# of observations	36
R^2	0.41

Note: Standards errors in parentheses. *, **, *** indicate individual significance at the 10, 5 and 1 percent level respectively. The number of police officers per 100.000 residents; the

¹⁸ There is not enough evidence to reject the null hypothesis that $\frac{dS}{dA} = 0$ in the absence of security improvements ($P=0$).

number of active cellular phones per resident. $\text{cov}(\beta_1\beta_3) = -.1440$. $\text{cov}(\beta_2\beta_3) = -.0040$.

6. Conclusions

In this paper, we attempted to explain why kidnapping rates have fallen so dramatically in Colombia during the period 2000-2008. While considering the democratic security policy as a necessary condition underlying falling kidnapping rates in Colombia, we argue that a complementary condition for this phenomenon during the period in question has been the substantial reduction in information asymmetries between kidnapers and victims. More specifically, kidnapping rates have fallen due to the increasing access of citizens of all backgrounds to mobile digital phones. The telecommunication policy in Colombia has been extremely successful in modernizing that country's infrastructure in recent years; it has also turned out to be a very powerful security tool against organized crime and terrorism.

The security policy and the expansion of mobile telecommunications have reinforced one another. While no significant investment in mobile networks would have been possible without an initial improvement in security, the process has worked in both directions. Thus, the expansion of the telecommunications network throughout the country has had the effect of increasing levels of security.

In this paper, we capture the democratic security policy in terms of the number of members of the police involved during the period studied. It is obvious that such a policy went far beyond the evolution of the police. The efficiency and morale, not only of the police but also of all the components of the armed forces, improved markedly. Moreover, the security policy also included other specific measures, such as the payment of ransoms to people who informed the authorities about criminal and terrorist activities, and the creation of mobile brigades and special new forces like the so-called peasants soldiers. For lack of information concerning these variables, we were unable to construct a more precise and

comprehensive index of security to use in our econometric exercises. Future research along these lines might examine in a more sophisticated manner the consequences of the democratic security policy. It certainly goes without saying that the expansion of mobile telecommunications alone could not have reduced kidnappings in Colombia to the extent that has been the case. For instance, it is well known that mobile phone coverage has also increased in such countries as Venezuela and Mexico, where nonetheless, kidnapping rates have increased.

The policy implications of this paper are quite straightforward. The conclusions reached here reinforce the notion that crime and terrorism prosper where there exist huge asymmetries in information between perpetrators on the one hand and authorities and citizens on the other. Better technology and better intelligence, therefore, becomes critical. The government must also match the improved intelligence and technology with correspondent new recruitment, hiring and staffing processes and flexible personnel and management policies to attract and retain the best possible work force.

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