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Does land titling matter? The role of land property rights in the war on illicit crops in Colombia

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Abstract. This paper analyzes the role of formalization of land property rights in the war against illicit crops in Colombia. We argue that as a consequence of the increase of state presence and visibility during the period of 2000 and 2009, municipalities with a higher level of formalization of their land property rights saw a greater reduction in the area allocated to illicit crops. We hypothesize that this is due to the increased cost of growing illicit crops on formal land compared to informal, and due to the possibility of obtaining more benefits in the newly installed institutional environment when land is formalized. We exploit the variation in the level of formalization of land property rights in a set of municipalities that had their first cadastral census collected in the period of 1994-2000; this selection procedure guarantees reliable data and an unbiased source of variation. Using fixed effects estimators, we found a significant negative relationship between the level of formalization of land property rights and the number of hectares allocated to coca crops per municipality. These results remain robust through a number of sensitivity analyses. Our findings contribute to the growing body of evidence on the positive effects of formal land property rights, and effective policies in the war on drugs in Colombia.

Keywords. Land property rights; Coca crops; War on drugs.

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1. Introduction

The distribution and definition of land property rights play a crucial role in the transition from an agricultural to an industrial economy (Easterly, 2007; Barraclough, 1970). A more formalized scheme of land property rights has through the literature often been associated with higher levels of investment, income growth, accumulation of human and physical capital and poverty reduction, among other social and economic outcomes (Besley & Burgess, 2000; Dercon & Krishnan, 2010; Banerjee, Paul J Gertler, & Ghatak, 2002; Deininger & Nagarajan, 2009). In contrast, high levels of informality might lead to an important hurdle in the development process (Acemoglu & Robinson, 2006; Dercon & Krishnan, 2010; Barraclough, 1970). In fact, many scholars have suggested that a lack of formal land rights could hinder law enforcement of government bodies, increase social tensions, facilitate illegal recruitment, forced displacement, land appropriation, and boost illegal activities in conflict areas (Grossman & Kim, 1995; Ibanez & Carlsson, 2010; André & Platteau, 1998). Despite the empirical evidence on social and economic outcomes associated with either formal or informal land property rights systems, relatively little attention has been focused on the relationship between the strength of land property rights and illicit activities.

In Colombia, on average, around 22 per cent of all private rural land has not a formal title, from which 89 per cent are small plots with less than 20 hectares –ha– (Ibáñez & Muñoz-Mora, 2010). These territories are mainly characterized by weak law enforcement, abundance of natural resources, and a high prevalence of poverty, which creates a perfect breeding ground for illegal activities like coca cropping (Dávalos et al., 2011). During nineties, Colombia became in the biggest coca producer in the world (Angrist & Kugler, 2008). In response, the Colombian and US governments launched the program *Plan Colombia* which was meant to increase the strength of the military, increase social cohesion and strengthen justice. Nonetheless, despite the billions of dollars spent, the coca production economy seemed hardly damaged by *Plan Colombia*. Instead, because of a constant adapting behavior of coca growers, almost the same amount of cocaine is being produced on only half of the land that was being used for the cultivation of coca crops before the beginning of *Plan Colombia* (Mejía, 2010; GAO, United States Goverment Accountability Office, 2008). This failure therefore generated a need to thoroughly understand which policies of Plan Colombia are most effective in reducing the coca production, and under which circumstances.

In this paper, we analyze the role of the level of formality of land property rights on the war against illicit crops in Colombia after 2000, where an important increase of state presence and visibility took place as a result of the implementation of *Plan Colombia* and counter-insurgency policies. We argue that the low presence of the state in most of the Colombian territory before 2000 boosted the spread of coca crops across all the territory. However, once the rule of law increased, policies towards reduction of coca crops were more effective in those municipalities with more formalized property rights

over land. Two main mechanisms might explain this interaction. First, the increase of the probability of being caught led to an important increase in the cost of cropping coca in Colombia, in particular, for those peasants with assets that could be expropriated by the government (e.g. land). Second, better institutional conditions due to the increase of state presence (e.g. *Plan Colombia*, but also institutions related to higher development), could be more attractive for peasants with legal titles because they are able to benefit more from alternative programs (both within *Plan Colombia* and outside the scope of this counter-drug policy), such as land as collateral to obtain credit, but also low-risk crop substitutes, among others. In sum, we argue that improved land rights create microeconomic incentives to change risk taking behavior once law enforcement is guaranteed and more visible. Under this argumentation, two effects are expected. In more formalized municipalities the land plot owners will have fewer incentives to grow coca crops (i.e. direct effect). Additionally, the war against illicit crops through *Plan Colombia* is more effective (i.e. indirect effect).

We use a unique data set of all Colombian municipalities from 2000 to 2009. As a proxy for formalization of land property rights, we build an index based on the share of small plots ($\leq$ 20 ha) without legal deeds, using plot-level census data from the Colombian Geographical Institute Agustín Codazzi –IGAC, *Spanish acronym*– and the regional Goverment of Antioquia. Often, the strength or safeness of property rights is measured through an index based on the risk of expropriation (Knack & Keefer, 1995; Acemoglu, Johnson, & Robinson, 2001). Although having a formal title or deed on land does not guarantee a person is protected from becoming a victim of expropriation when law enforcement is weak, we argue that titling guarantees the possibility to use formal mechanisms to regain the lost land through legal enforcement in effective judicial institutions. In addition, we use information on coca crop fields provided by the United Nations Office on Drugs and Crime -UNODC-. Moreover, we include the five main programs embedded in *Plan Colombia*: (i) seizure of coca leaves in kilograms; (ii) Number of coca labs destroyed; (iii) manual and aerial eradication; (iv) program forest warden families; and, (v)alternative development programs. All data is provided by the UNODC and Colombian Drugs Information System -SIDCO-. Finally, we include a number of cadastral controls, provided by IGAC.

Endogeneity is our main concern in our attempt to prove the relationship between the strength of land property rights and coca crops. It could be the case that in municipalities with more productive conditions to crop coca, illegal actors may prevent the implementation of formalization policies, or coca growers could simply be uninterested in claiming a title to avoid visibility (i.e. never takers). As a consequence, the variation in land property rights may only take place in those municipalities with less productive conditions. Hence, a reduction of coca crops here would not be due to the strength of land property rights but unonbservables. Albeit we cannot entirely get rid of this bias, we propose to exploit the variation provided by a set of

policies launched between 1994 and 2000, which were installed to increase the coverage of the cadastral information across all Colombian territory. As a result, between 1994 and 2000, around 17 percent of the Colombian villages saw their first plot-census, which were mainly villages located in the former agricultural frontier of Colombia (Ramos, 2003). Apart from establishing a reliable land tenure information system, the plot-census allowed land holders to clarify unregistered existing titles and start the administrative process to claim a formal title. Therefore, we can guarantee reliable data quality in this sample, and a source of temporal variation due to the the resolution of these administrative claims. Unfortunately, the data does not allow us to control for other sources of temporal variation, such as titling programs or other behavior and/or activities that could be correlated with coca crops. We therefore propose a fixed effect model in which we control for different levels of unobservables that could bias our estimates. Although our results do not constitute a string casual relationship, we argue they do provide strong evidence on the existence of the hypothesized relationship.

Our findings suggest that stronger structures of property rights have a negative effect on the percentage of land allocated to coca leaf plantations. In general, we found that an increase of one standard deviation of the formality index for small land plot owners is related to a decrease of the area allocated to coca crops per municipality by 0.566 standard deviations. Furthermore, Plan Colombia policies have a potential reducing effect of 0.025 standard deviations on coca crops presence in municipalities with a higher than average level of formality of land property rights. These findings support our two mechanisms, in which the former robust variable explains the increased risk of getting caught, and the latter the mechanism of benefiting from development programs. We do not find spill-over effects on neighboring municipalities. Other sensitivity analyses using different samples and land formality approaches reveal confirming results. Moreover, by performing a dynamic specification (i.e. control for lagged dependent variable) through the System GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998), we find similar results.

To the best of our knowledge, this is the first study to provide empirical evidence on the relationship between different levels of formalization of land property rights and incentives for illicit activities such as coca crop production. Hence, our study contributes to the economic literature in two distinctive ways. Firstly, we contribute to the debate on the importance of institutions concerning micro- and macro-economic and social performance. Secondly, our results provide technical support in favor of policies focusing on the strength of institutions as an effective alternative to counter illicit behavior like the coca production in Colombia.

The structure of the paper is as follows. Section two discusses the economic framework of land property rights and illicit activities. In section three, we provide a brief institutional context of Colombia. Section four introduces

the data and our identification strategy. The econometric results are discussed in section five. Section six concludes.

2. Land property rights and illegal crops: an economic framework.

Land property rights form a key component in the institutional setting, establishing the rules over the use and access of land (North, 1990; Dercon & Krishnan, 2010). A well-defined land property rights scheme should guarantee a private, exclusive, transferable, alienable, and enforceable right to appropriate any rent or benefit from the land (Demsetz, 1967; Feder & Feeny, 1991). It therefore implies a social and political scheme to enforce these rights. In most western societies, formal titles or deeds constitute a physical representation of a property rights system (i.e. *de facto*), whereby the state enforces the complete enjoyment of land rights. In contrast, in many developing countries, land property rights still fall within the realm of informal customary law, which is often based on ethical or religious principles. Within such a system, rather than the physical representation of land titles, people or communities hold symbolic and intangible rights over land (i.e. *de jure*) (Dercon & Krishnan, 2010; Besley, 1995). In general, these systems are considered less efficient as their formal counterpart, due to their less strict characteristics, in combination with weak law enforcement and limited transferability (Demsetz, 1967; Feder & Onchan, 1987; Hafer, 2006; Besley & Persson, 2009; Deininger, Ali, & Yamano, 2008).

A number of positive economic and social outcomes are commonly associated with formal and well defined land property rights systems. Firstly, several scholars find positive effects towards rural investment. Two mechanisms are considered here. On the one hand, as a direct consequence of a reduction in the risk of expropriation (i.e. decreases uncertainty), the expected returns might increase. Consequently, peasants and external investors are more inclined to invest in the short, medium and long term, resulting in higher productivity and therefore rural welfare (Besley, 1995; Deininger et al., 2008). On the other hand, because formal titles over land could easily be utilized as collateral, credit markets are more easily accessible for land owners, increasing potential investment (Feder & Onchan, 1987; Deininger et al., 2008). Although these arguments are susceptible for endogeinity (i.e. more investment could incentivize a demand for improved land rights), results seem to be robust after controlling for this potential bias (Besley, 1995). Secondly, formal land property rights prompt efficiency in the land market. The marketability gains could lead to an important increase in land transactions (Conning & Robinson, 2007). This new dynamic modifies not only the equilibrium prices in the land market, but also matching efficiency in the land rental markets, resulting in a significant increase in productivity (Macours, Janvry, & Sadoulet, 2010; Deininger & Chamorro, 2004). Third, in addition to the mechanisms pointed out, a growing body of evidence has shown

positive effects on income growth and accumulation of human and physical capital (Deininger & Nagarajan, 2009; Besley & Burgess, 2000), poverty reduction (Galiani & Schargrodsky, 2010), labor supply (Field, 2007), political empowerment (Goldstein & Udry, 2008), reduction of social confrontations (Albertus & Kaplan, 2013) and an increase in bargaining power of the less wealthy in a region (Banerjee et al., 2002).

Nevertheless, formal land property rights schemes are not necessarily the best option in every context. Multiple studies have found counter-evidence on the positive effects pointed out above (Pande & Udry, 2006; Brasselle, Gaspart, & Platteau, 2002). Brasselle et al. (2002) find in Burkina Faso that traditional, more customary, communal and informal institutions create a good small-scale investment climate just as well as their codified and secure counterpart. Deininger and Jin (2006) find similar ambiguous evidence related to productivity and investment with data from Ethiopia, arguing that the increased percentage of formal land property rights through the number of planted trees had discouraged productivity and enhanced investments such as terracing. Nonetheless, as these authors point out, these findings are mainly due to effectiveness of the informal enforcement mechanisms (e.g. religious punishment), which are found to be as effective as their formal counterpart only when well established (Goldstein & Udry, 2008; Besley, Burchardi, & Ghatak, 2012; Brasselle et al., 2002).

An important implication of the strength of land property rights is the increase of risk of expropriation, which could affect the portfolio choice. The absence of a title or effective mechanisms to enforce them, deprive poor families of having a valuable insurance and saving tool that could provide protection during bad times and retirement (Galiani & Schargrodsky, 2010). Hence, scatters usually choose for other insurance alternatives, preferring a short time horizon and risky portfolio (Besley, 1995). This might create opportunities for illicit behavior to emerge, especially in rural areas with weak law enforcement and the natural conditions to develop profitable and illegal crops. Nevertheless, little is known about the potential implication of the strength of land property rights on illicit behavior.

3. Land property rights and coca crops in Colombia: an institutional background.

In Colombia, the land property rights system can be characterized as dual[1]. On the one hand, a large portion of land plots with formalized titles were the result of land distribution during the colonial period, as well as the different polices of assignation of public land during the last two centuries (Ibáñez &

[1] Ample of literature can be found on land issues in Colombia. Machado (2009) reviews the different land institutions and policies from the colonial period until the late twentieth century. Social confrontation and colonization have been important topics for both LeGrand (1988) for the period of 1850-1950, as well as Oquist (1980) for the period 1940-1960. Recently, Ibáñez and Muñoz-Mora (2010) provide a general overview.

Muñoz-Mora, 2010)[2]. The remaining land stayed mainly informal due to unplanned expansion of the agricultural frontier. This dual and unequal scheme has become not only an important hurdle to the development of the region and country, but also one of the main sources of social conflict (LeGrand, 1988). The Colombian government has launched several attempts to resolve this duality in the property rights scheme[3]. Nevertheless, after multiple attempts of implementing land reforms, the old structure remained firmly in place (Binswanger, Deininger, & Feder, 1995; Machado, 2009). Two explanations are primarily responsible for this failure: (i) poor design and low state capacity; and, (ii) the power of large landowners, who blocked and transformed the reforms in their benefit (Ibáñez & Muñoz-Mora, 2010). Recently, Law 160 issued in 1994, was designed to boost rural development through the promotion of land markets, which positioned the responsibility to clarify property rights with the peasant. Supply-oriented formalization programs in which the state promoted titling, making it more easy for landowners to obtain titles, and in which the state verified and reconfirmed existing titles, have been rare, with the latest one between 1997 and 2002. This program, led by the IDB and the Colombian government, gave over 250,000 households a formal title[4].

The 1980s saw the rise of coca cartels, in a country torn by political conflict with unsolved historical land issues. Although Colombian drug dealers were initially rather drug intermediaries than producers[5], during 1990s coca crops rapidly spread across all Colombian territories (Mejía & Rico, 2010)[6]. Several facts explain this expansion. Firstly, due to the effective counter drug production policies in Peru and Bolivia, Colombian drug dealers were left with no other option than to find new locations for their coca growing and

[2]After independence most of the colonial institutions remained in place, with the land titles which originated during the Spanish rule enforced by the new sovereign state (Machado, 2009). This set the initial conditions of land property rights in Colombia, with large formalized land plots based on former semi-feudal structures (LeGrand, 1988; Ibáñez & Muñoz-Mora, 2010).

[3]For a detailed description of those policies see Machado (2009) and Ibáñez and Muñoz-Mora (2010)

[4]This program called "Program for land titling and modernization of the registry of deed and cadastre" was designed to consolidate and strengthen an open, transparent, and efficient land market that would make access to the financial system easier for urban and rural property owners. Registered titles would be awarded to approximately 100,000 parcels of land in 200 rural municipalities and 150,000 parcels of urban property in 50 municipalities (Colombian Goverment - IDB, 1997).

[5]The cocaine production process usually consists of four stages: (i) growing and cropping the coca leaves; (ii) extraction of coca paste; (iii) transformation into cocaine base; and (iv) the conversion of cocaine base into cocaine hydrochloride, a process that due to its complexity usually takes place in local laboratories. The final stage is trafficking or commercialization (Mejía & Rico, 2010)

[6]Mejía and Posada (2010) point out: "In 1990, Peru had the largest number of hectares under coca cultivation (about 62 percent of the total), and Colombia the lowest (14 percent). By 1999, these shares had completely reversed, with Peru having 21 percent of the total, Bolivia, 12 percent, and Colombia 67 percent."

producing activities (Angrist & Kugler, 2008). Secondly, as demand for cocaine grew in the world, which increased potential profits of this illicit industry, illegal groups started participating actively in the production of coca crops. The strategy of these groups was to use most of the territories under their control for coca production, where small scale coca growers were obliged to sell their output to these groups exclusively in return for protection and technical support.

The expansion of coca crop fields mainly took place on the agricultural frontier, where the lack of law enforcement, the weak definition of land property rights, the abundant natural resources and the high prevalence of poverty generated a perfect environment to establish the coca production industry, which is mainly based on small coca growers (i.e. small land plots) [7] (Dávalos et al., 2011; Mejía & Rico, 2010; Angrist & Kugler, 2008). Albeit only a small portion of total profits stays with the small coca growers, this profit is relatively higher than any other alternative crop(Mejía & Rico, 2010). Over the years, Colombia has seen many policies to reduce coca production, with *Plan Colombia* as the most comprehensive[8]. This program had three pillars: strengthen the military power, increase social cohesion and development, and strengthen justice[9]. Seizure of raw materials for coca production, manual and aerial eradication of coca fields, land expropriation, destruction of laboratories, interdiction of drug shipments and promotion of alternative development programs formed frequent tactics within this policy (Mejía, 2010; GAO, United States Goverment Accountability Office, 2008). *Plan Colombia* was complemented with an intense counter-insurgency policy, launched by the president Alvaro Uribe (2002-2010). Despite an important increase of law enforcement in all national territories[10] and putting a stop to the expansion of coca fields, the production side was hardly touched upon. In fact, almost the same amount of cocaine is being produced on half the land that was being used for the cultivation of coca crops before the start of *Plan Colombia* (Mejía, 2010).

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[7] As is indicated by Dávalos et al. (2011, p. 1225): "The expansion of coca itself is an indication that these municipalities constitute the agricultural frontier, where settled land ends and new inroads begin. If so, these municipalities should have a greater proportion of their surface in forest because socio-political integration and economic development have produced massive forest loss in Colombian history."

[8] *Plan Colombia* originated between 1998 and 1999 as a bilateral cooperation program between the governments of Colombia and the United States to counter illegal drugs and organized crime. The program demanded combined average annual spending of US$ 1.7 billion (2011 US dollars) between 1999 and 2005 (GAO, United States Goverment Accountability Office, 2008)

[9] For a complete technical overview and evaluation of the *Plan Colombia* see Mejía (2010) and Mejía and Restrepo (2008), or from an political point of view see GAO, United States Goverment Accountability Office (2008)

[10] Before 2002, almost 5 % of Colombian municipalities (i.e. 50) did not have police presence. During the government of president Uribe, in 18 % of the Colombian municipalities the presence of police and army was increased (Cortés, Vargas, Hincapie, & del Rosario Franco, 2012)

These mixed results might be explained through a number of reasons. Firstly, because drug producers' capacity to counteract anti-drug policies is much larger than the capacity of drug traffickers, policies were less effective towards the production side (Mejía & Restrepo, 2008). Small coca growers appeared to be able to learn and adapt fast, thereby evading the rule of law and re-allocating their crops (Mejía & Rico, 2010; Mejía & Restrepo, 2008). Secondly, it seems to suggest that small coca growers follow a persistent risk-taking behavior pattern, whereby coca cultivation becomes inelastic to increases in perceived risk. Ibanez and Carlsson (2010) point out that this behavior cannot only be explained in terms of monetary reasons. Non-monetary variables, such as experience with coca cultivation, legitimacy of authorities, and religion, could be important factors in this decision making procedure of coca growers as well. Hence, an increase of law enforcement is efficient if and only if the policies generate microeconomics incentives to change the risk taking behavior of coca growers, thereby restoring the link between small coca growers and the state. In such a context, the strength of land property rights might have had an important role on the efficiency and effectiveness of the war on illegal crops in Colombia.

4. Empirical framework

We use a ten year longitudinal data set for all Colombian municipalities over the years 2000-2009. Based upon satellite information, the United Nations Office on Drugs and Crime –UNODC– provides the net area allocated to coca crops in each Colombian municipality over time[11].

As our main variable of interest, we build an index for formal land property rights in small plots (≤ 20 ha)[12], based on the cadastral information provided by the Colombian Geographical Institute Agustín Codazzi –IGAC, *Spanish acronym*– and the regional Goverment of Antioquia[13]. These plot census gather information on the owner, the physical characteristics of the

[11] Because coca fields could change within the same year, UNODC uses a cut-off date at the end of each year to estimate the area under coca cultivation. Some potential measurement errors need to be taken into account. First, albeit satellite images are corrected for meteorological conditions, some bias such as mountain slopes and recognition of abandoned fields could persist. Second, the method of data collection on the coca fields could rule out the detection of short term coca plantations. Some of these drawbacks are partially handled with auxiliary information from the Colombian Government and correction through verification overflights ("World Drug Report 2011", 2011).

[12] There is an open debate about the definition of the size for small plots in developing countries (Among others, see Eastwood, Lipton, and Newell (2010), Berry (2010) and Carter (1984)). We opted for a conservative definition of small farms, using 20 ha as the threshold. Nonetheless, results are qualitatively similar using other thresholds such as $\leq$ 10 ha and ≤ 5 ha.

[13] Although these institutions gather the information using different instruments, both are based on Colombian Law which makes them comparable. For further information about this process see Ibáñez, Muñoz-Mora, and Gafaro (2012) and Muñoz-Mora and Zapata (2011). This data is only available from 2006 onward. We re-estimate our equations excluding this information from the initial specification and we did not find an important difference in

land and, specifically, on the registration of any formal title or deed at the local registry offices[14]; it allows us to categorize every single plot as *formal* or *informal*. Thereby, our land tenure formality index for small-holders (≤ 20 ha), f_{it}, is defined as:

$$f_{it} = \frac{\text{Area (ha) of formal properties for small land-holders } (\leq 20\text{ha})_{i,t}}{\text{Private cadastral area (ha) for small land-holders } (\leq 20\text{ha})_{i,t}}$$

The cadastral municipality information could be in two different states: (i) If no collection of data has been carried out, people are obliged to declare their land themselves without any technical verification. It creates very vague information known as a *fiscal cadastral*. (ii) Once the plot census has taken place, all the information about location, ownership, physical characteristics and size are verified by a technician from IGAC. From this point onward, municipalities are considered as *formed cadastral*. Since it is impossible to carry out a plot census every year, owners are obliged to report any land transactions, in a process called *cadastral conservation*. According to Colombia's law, a given municipality is updated within five years after being formed, after which a new census plot must be carried out. Whereas the first plot census or *cadastral formation* is a centralized decision taken by IGAC and the Colombian government, the updating process is generally a combined decision of local and central authorities[15]. Given this structure of the cadastral information, several concerns might arise. Firstly, given the fact that additional information after the official plot census is self-reported by the owner, it could generate a measurement error due to miss-reporting. That is, our index could be under-estimating the real state of land property rights due to unobserved owners' characteristics which might disincentivize the registration of new titles or deeds. Secondly, given the high demands in terms of costs organization required for the updating process, only well-motivated politicians will promote such policies. Furthermore, illegal actors or large owners could manipulate the local institutions to block the implementation of titling programs or the updating of the cadastral information to keep the *status quo*(Fergusson, 2013). This might generate an important selection problem whereby a systematic difference could arise between municipalities with different cadastral information quality, which could be correlated with the persistence of coca crops.

Although we cannot entirely isolate these potential sources of bias, we propose to use a sample of municipalities that had their first census plot (i.e. cadastral formation) carried out between 1994 and 2000. During this period,

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our results. Therefore, we have decided to include it, in order to increase the number of observations

[14]Despite the fact that under Colombian law, a tenant without a title could claim some basic rights over land, only registered titles are considered as *formal*

[15]For further details about the process and the different administrative duties from Local and Central Governments, see Resolutions 2555 of 1988 and 70 of 2011 of the Geographical Institute Agustín Codazzi.

different policies and programs were launched to improve the coverage of the cadastral information, embedded in the law 160 of 1994[16]. This resulted in the modernization of the census data, with a 17 percent increase of formed land-plot status in the municipalities in this period, which were mainly located in the former agricultural frontier (Ramos, 2003). Graph 1 shows the distribution of municipalities by year when the cadastral data set was formed (i.e. first census plot) for all Colombian municipalities that either have natural conditions to crop coca (i.e. altitude 500 to 2000 mts over sea) or ever had coca during the period 2000-2009. Although after 1990 an increase of cadastral coverage took place in all Colombian municipalities, what made this process different between 1994 and 2000 was the fact that, for the first time, cadastral census was considered as the key instrument to boost local development (Ramos, 2003). Therefore, we can guarantee a common baseline for a set of municipalities with similar reliable data quality[17].

Regarding the policies of *Plan Colombia*, we use information provided by the UNODC and the Colombian Drugs Information System –SIDCO, *Spanish acronym*–. For the interdiction policies we consider two variables: Number of kilograms of coca leaves seized and Number of laboratories destroyed[18]. Furthermore, we include the number of hectares eradicated both by aerial spraying and manually[19]. Regarding the alternative development policies we use the presence of Forest Warden Family programs[20] and Productive Projects programs[21]. Finally, we include extra cadastral controls provided by IGAC. These include the land quality gini index, share of cadastral area of public

[16]For instance, Law 388 of 1997 stated that the central government is obliged to carry out plot census for all *fiscal cadastral* land plots within one year and the "Program for land titling and modernization of the registry of deed and cadastre" which provided financial support to carry out these programs

[17]Municipalities with low quality cadastral information generally have an important difference between geographical and cadastral areas, which means that not all plots were visited by the cadastral census. In the municipalities that were selected in our sample, both the mean and median of the cadastral areas is 97 per cent of the physical area, which reconfirms the quality of the data.

[18]As we pointed out above, there are different stages in the coca production process, we sum up all the types of laboratories destroyed without distinction.

[19]This information is the sum of the hectares manually eradicated by national policy, army and the mobile groups of eradication –GME, *Spanish Acronym*–

[20]This program has been implemented in seven phases: (i) *Phases I-II*: three years of intervention during 2003-2006, with 36.222 households in 35 beneficiary municipalities; (ii) *Phase III*: three years of intervention during 2006-2009, with 17.406 households in 25 beneficiary municipalities; (iii) *Phase IV*: one and half years of intervention during 2007-2009, with 33.546 households in 39 beneficiary municipalities; (iv) *Phase V*: one and half years of invention during 2008-2010, with 19.743 households in 24 beneficiary municipalities; (v) *Phase VI*: two and half years of intervention with 7.401 households in 5 beneficiary municipalities; (vi) *Phase VII*: two and half years of intervention with 7.759 households in 21 beneficiary municipalities(UNODC & Colombian Goverment, 2011). In our analysis we include municipalities which benefited during phase I to IV.

[21]In 1996, Colombian Government launched the National Program for Alternative Development –PLANTE, *Spanish acronym* –, which sought to support productive projects in coca affected municipalities. After 2003, all these projects were embedded in the module of Alternative Development programs of Plan Colombia. Therefore, albeit officially Plan

land, share of cadastral area of indigenous communities and share of cadastral area of natural parks.

Our baseline sample considers all municipalities for which the cadastral information was formed between 1994 and 2000 and either have natural conditions to crop coca(i.e. altitude 500 to 2000 mts over sea), Potential Producers –PP–, or ever had coca during that period, Coca Producers –CP–. Table 1 reports the descriptive statistics. The total hectares of coca crop fields per municipality, is clearly highly concentrated in a small areas, as shown by the high standard deviation and the ninetieth and ninety-ninth quantile. This is also reflected in the low share of municipality area devoted to coca crops. As expected, smaller land-plots are on average less formalized than the median-size land plots, which might echo the larger visibility of the median-size land owners. The statistics of the Plan Colombia variables reflect the policies as elaborated upon in the context section, with a clear focus on aerial spraying, anti-narcotic operations and manual eradication. The alternative development projects have only received minor attention in the years of observation. The four remaining variables complement the data description, exhibiting large differences in land quality over the municipality land, but low shares of public and indigenous land, as well as natural reserves. We also report the statistics on the time-invariant covariates.

[Table 1 goes about here]

Graph 2 shows the kernel distribution of our main variable of interest for two years: 2000 and 2009; we see that the variable his concentrated on the right-hand side, around 0.95. Notwithstanding only minor changes between the points of observation (i.e. Kolmogorov-Smirnov test could not reject the null hypothesis), we confirm the increasing tendency over time towards formality.

[Graph 2 goes about here]

Graphs 3 and4 show the spatial distribution of the average share of municipality area allocated to coca fields and the number of years with coca field presence over the period of 2000 -2009 respectively. All Colombian municipalities are included, highlighting our baseline sample. In general, we found that, on average, in most of the coca producing municipalities less than 0.02 % of the land was allocated to coca production, with only few cases in the upper tercile. When we look at the average number of years of growing coca, we found more spatial heterogeneity; albeit most coca producing municipalities produced coca between 2 and 6 years (i.e. middle tercile), we also found a large portion of municipalities with more than 6 years of positive allocation to illegal crops. At first glance, we did not find any spatial patterns between coca producers included in our sample and those excluded.

[Graphs 3 and 4 go about here]

Colombia only started supporting projects from 2003 onwards, information on productive projects is available since 2000.

In table 2, a more detailed picture can be obtained of the differences between the excluded municipalities and our sample. We could not reject the null hypothesis of equality of the share of municipality area allocated to coca fields and the *Plan Colombia* policies between the coca-producing municipalities included and excluded in our sample. As expected, we do find difference in the levels of formality , cadastral related variables and the persistence of the coca crops. We provide further evidence about the difference between municipalities in the next section.

[Table 2 goes about here]

4.1. Identification Strategy

The empirical strategy pursued in this paper can be described as follows. Before *Plan Colombia* was launched, the low presence of the state in most of the Colombian territories boosted the spread of coca crops across all areas. However, once the rule of law was increased due to the implementation of *Plan Colombia*, reduction of coca crops was more effective in those municipalities with more formalized land property rights. Two main mechanisms might explain this interaction. Firstly, as we pointed out, the increase of the probability of getting caught led to an important increase in the cost of cropping coca in Colombia, in particular, for those peasants with assets that could be expropriated by the government. For most individuals in these areas, land is one of the most important assets. Loss of these assets would therefore have severe consequences. Secondly, better institutional conditions due to the increase of state presence, could be more beneficial and therefore attractive for peasants with legal titles because their formal title allows them to use the land more in institutional settings, become more visible, and take more advantage of alternative programs. This not only holds for the programs offered through *Plan Colombia*, but also in general through positive externalities of formal property rights (e.g. higher productivity, investment, social capital), allowing the peasant to choose for low-risk and legal crop substitutes. In sum, we argue that improved land rights create microeconomic incentives to change risk taking behavior once law enforcement is guaranteed. Under this identification strategy, two effects are expected. More formalized municipalities not only grow less coca crops (i.e. direct effect), but also the war on illicit crops though *Plan Colombia* is more efficient (i.e. indirect effect).

We exploit the variation of the level of formalization in a sample of municipalities that had their first census between 1994 and 2000. As we have pointed out above, we argue that the institutional setting during that period led to a coordinated government initiative to implement cadastral formation programs in those municipalities with *fiscal cadastre*. This expansion of cadastral coverage was exogenous to local decision and took place across all Colombian territories, in particular, in the former agricultural frontier[22].

[22] An interviewed technician from IGAC stated that even municipalities with high presence of guerrillas were included in this initiative. Nevertheless, not all municipalities initially planned to be subject of a census plot were included. A small number of cases were ruled out due to budget constraints and an additional small number due to ongoing conflict.

Unlike the other similar process, cadastral formation between 1994 and 2000 offered land holders with informal titles (i.e. unregistered deeds) the opportunity to register their deed at local authorities and start administrative process to claim for a formal title when absent. Hence, since our formality approach is bounded and increasing, three main source of variation will help us to identify the hypothesized relationship[23]: (i) resolution of administrative process started in the formation process; (ii) self-motivated peasants claiming new titles; and, (ii) new titling programs. Two main concerns arise from this strategy. First, since the final decision of going to formality still relies on the scatters, some peasants could decide to stay in informality to crop coca. If this were the case, municipalities with more suitable conditions to grow coca would have less variation in their formality index than the less coca growing municipalities. Although we strongly believe that peasants will always pursuit a title, we propose several robustness checks to control for this strategic behavior. Second, a systematic difference might be present between our sample and other municipalities. To test this, we run a basic quasi-random assignment test to check the presence of any systematic differences between our baseline sample and other potential coca producers (PP) and coca producing municipalities (CP). In particular, we estimate the following equation:

$$c_i = \alpha_0 + \alpha_2 D_i + v_i$$

where c_i is the characteristics of village g, D_i is a dummy variable indicating whether the municipality was formed between 1994 and 2000 and v_i stands for the error term clustered at the department level. If this cadastral formation process is uncorrelated with municipality characteristics, then α_1 would be small and statistically insignificant for all characteristics. We use information from Colombian National Census in 1993 and other socioeconomic information for 1993-1200 provided by the data set from Universidad de los Andes - Colombia. Table 3 shows the result for 24 different characteristics. We found that municipalities included in our sample were more populated, were located closer to Bogota, had less incidences of poverty (1993) and less municipality area covered by natural forest. In contrast, we did not find differences in other characteristics related to violence, institutional strength, among other characteristics. Therefore, although no systematic difference is observed, our results here do suggest the existence of a potential source of bias due to the absence of complete randomness in the application of cadastral formation. Therefore, we control for different potential unobservable characteristics that could potentially bias our estimates. The equation to estimate is:

[23]Since our index is a rate, an alternative source of variation is when the denominator changes (i.e. Private cadastral area (ha) for small land-holders). Nevertheless, as graph 5 shows, this proportion is stable over time.

$$\begin{aligned} \textit{Coca crops}_{i,j,t} = \quad & \alpha \textit{Formality land}_{i,j,t} + \mathbf{P}_{i,j,t}\beta + \textit{Formality land}_{i,j,t} \times \mathbf{P}_{i,j,t}\delta \\ & + \textstyle\sum_{k=2000}^{2009} \theta_k dT_k + \rho_{j,t} + \textit{update}_{i,j,t} + c_i + u_{i,j,t} \end{aligned}$$

where the sub-index i refers to the municipality, j refers to coca region[24] and t the time period. The dependent variable is the proportion of municipality area allocated to illicit coca, and our main variable of interest is the index for formal land property rights for small plots ($\leq$ 20 ha), $\textit{Formality land}_{i,j,t}$. Furthermore, the vector $\mathbf{P}_{i,j,t}$ denotes the set of controls from Plan Colombia; in particular, we include: (i) aerial spraying (ha), (ii) manual eradication (ha), (iii) presence of program of Forest Warden Families (yes=1), (iv) presence of alternative productive projects (yes=1), (v) Number of laboratories destroyed; and, (vi) Seizure of coca leaves (kg). In order to identify whether the effectiveness of *Plan Colombia* depends on the strength of land property rights, we include three interactions terms with the different types of policies. Under our identification strategy, we expect a negative direct effect of the strength of land property rights on coca crops (i.e. $\alpha < 0$); furthermore, we expect *Plan Colombia* policies to be more effective in those municipalities with more formalized land property rights (i.e. $\delta_z < 0 : \forall \delta_z$).

We control for different potential unobservable characteristics. Firstly, c_i stands for fixed municipality conditions (e.g. natural conditions, roads, among others) that could be correlated with the presence of coca crops, making some municipalities more prone than others to grow illegal crops[25]. Secondly, we control for common shocks across years using year-fixed effects $dT_k = 1 \ \forall k = 2000, ..., 2009$. Thirdly, $\rho_{j,t}$ represents coca region-year fixed effects to control for common events that affected all municipalities within a given region in a specific year. Examples here would be productivity shocks and input prices, among other aspects that have been identified homogeneously in these regions ("World Drug Report 2011", 2011). Fourthly, since the cadastral updating process depends on local decisions, we include the dummy variable $\textit{update}_{i,j,t}$ that takes the value 1 when updating took place in that given year and stays 1 the subsequent years. This variable allow us to control for unobservable effects which could be the result of more motivated politicians or better institutions, among others. Finally, $u_{i,j,t}$ is clustered on two levels: municipality and department-year. This two-way clustering allow us to improve the estimation of the standard errors in presence of bias associated with time-variant department level characteristics (Cameron, Gelbach, & Miller, 2011).

We propose a set of robustness checks. First, we introduce a new set of covariates trying to explore alternative explanations for our estimates. As

[24]The "World Drug Report 2011" (2011) identified seven regions in which production, techniques and input prices in the coca market were homogeneous.

[25]Therefore, very formalized municipalities before 2000 (i.e. $\textit{Formality land}_{i,j,t} = 1 \forall t$) and municipalities with a fixed level of formality (i.e. $\textit{Formality land}_{i,j,t} = c \forall t$) will be naturally excluded from our identification strategy.

the "World Drug Report 2011" (2011) points out, one of the main challenges of the war on drugs in Colombia is the mobility of coca growers; hence our results could be explained by the fact that coca growers move to other locations, leaving their original locations. Therefore, a reduction of coca crops in one municipality could be explained by an increase of coca crops in neighboring areas. Albeit we are already controlling for time-variant unobservable effects within coca regions, we include three variables which try to capture the spillover effects of such behavior. In particular, we include the change of coca crops presence between the current and the subsequent year considering three distances: 25km, 50km and 100km [26]. Other alternative explanations would be the presence of natural parks, indigenous communities and idle public land, as well as issues related to land concentration (gini land index).

Additionally, we test the sensibility of our results using different samples. In particular, we repeat our baseline results using all municipalities that were either formed or updated between 1990 and 1970; then, we re-estimate using only those municipalities that have had their data updated (i.e. between the five years after the last plot census). Finally, we estimate using all municipalities. In all cases we consider first, municipalities that ever had coca crops during the period of study, and second, an extended sample including all municipalities that have the natural conditions for coca cropping.

We run a placebo test using a sample of large-sized land owners (i.e. larger than 20 ha); if our results are driven only by a general trend of developing institutions, we would find similar effects using this index. Furthermore, despite of having multiple controls for unobservables, the persistence in the allocation rule to illegal crops across years in some Colombian municipalities, might generate a dynamic relationship in the data. In other words, the proportion of area allocated to illicit coca fields in a given year might affect the presence of coca fields in the following years (Bray et al., 1983; USDJ, 1991; Moreno-Sanchez, Kraybill, & Thompson, 2003). Under this setting, traditional methods such as pooled OLS or the within transformation estimator are biased and inconsistent (Arellano & Bond, 1991; Bond, 2002; Arellano & Honoré, 2001; Baltagi, 2008). To deal with these challenges, we use the System GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) [27].

5. Empirical results

Our findings show a significant negative relationship between the level of formalization in land property rights and the number of hectares allocated

[26] Distances were computed using the main urban center of each municipality. We chose to use this instead of the centroid of the municipality polygon because it provides a better approach of real distance. We estimate the euclidean distance.

[27] This technique allows us to obtain efficient estimations with a small sample over time and to control different endogeneity sources. Moreover, System-GMM proposes an ingenious staked dataset which makes it possible to filter out the individual fixed effects and to include time-invariant controls (Blundell & Bond, 1998).

to coca crops per municipality. These results are robust to the introduction of additional controls, the use of different samples and the performance of a placebo test, as well as the implementation of an alternative specification in a dynamic setting.

5.1. Baseline Results

Table 4 presents our baseline results using a panel of Colombian municipalities over the period 2000 to 2009. We present seven different specifications, including multiple controls and interaction terms between our main variable of interest and the separate policies of *Plan Colombia*. The point estimate of the formality index of property rights for small land-owners is negative and significant in all specifications. Furthermore, this coefficient barely changes as more controls are included, which suggests a robust relationship between coca production and the levels of coca crops. In general, we found that an increase of one standard deviation (i.e. 0.19) of the formality index for smallholders is related to a reduction in the area allocated to coca crops by 0.581 standard deviations (i.e. 0.0023). These findings strongly support the first element of our primary hypothesis; once the state became more present and visible after 2000, municipalities with more variation in their land property rights of small land plots had significantly less coca crops.

When looking at the coefficients of the main policies of *Plan Colombia*, as expected, we do not find a strong average effect towards the presence of coca crops. Nevertheless, the presence of the program for Forest Warden Families has a consistent negative effects on the level of coca crops. Nevertheless, no more significant effects were found regarding other policies of *Plan Colombia*, which supports other studies regarding the ineffective policies implemented through *Plan Colombia* (see for instance Mejía (2010)). When we look at the interaction terms, we find that in those municipalities where all the interdiction policies were one standard deviation above the mean, the higher formality index increased the effectiveness. Morever, when we interact all the plan colombia policies, we found again they were more effective in more formal municipalities. This confirms our second hypothesis, with respect to the effectiveness of the war on drugs in highly-formalized municipalities.

[Table 4 goes about here]

5.2. Sensitivity Analyses

In this section we present four additional sensitivity analyses to confirm the robustness of our results. We re-estimate our baseline results using additional controls and different samples. We perform a placebo test to check whether our results are driven by a general trend of institutions. Finally, we consider a dynamic specification to account for the persistence in the allocation rule to illegal crops across years in some municipalities.

First, in order to account for alternative explanations for the reduction of coca crops, we consider additional covariates. In particular, we include three variables in an attempt to capture the spillover effect of the policies implemented through *Plan Colombia*. Table 5 presents the results. The point

estimate of the formality index for small-holders remains negative and statistically significant. Furthermore, we do not find any spill-over effects at any distance.

[Table 5 goes about here]

Second, we repeat the estimations using alternative samples. This allows us to check the sensibility of our results regarding the quality of the data. These alternative samples include: (i) Our baseline results considering only municipalities that ever had coca crops. (ii) Municipalities that either had their first census plot or the last cadastral update after 1990. (iii) Municipalities that either had their first census plot or the last cadastral update after 1970. (iv) Municipalities for which the cadastral information is considered to be up to date, which means a follow-up census plot has been carried out after five years of the last data collection moment. (v) All municipalities. For each sample the analysis considers two subsamples: municipalities with coca crops in at least one year of our period of study plus municipalities with the natural conditions to grow coca crops (CP+PP) and only the municipalities with coca crops in at least one year of our period of study (CP). Table 6 shows the results. In general, notwithstanding an important increase of the magnitude possibly due to bias introduced in the different samples, the point estimate of the formality index for small land plot owners remains negative and statistically significant for most of the regressions, confirming the robustness of our results. When we introduce all the municipalities in the sample, even those with *fiscal cadastral*, the main effect losses significance but the intereaction terms continue to confirm our hypothesis.

[Table 6 goes about here]

Third, in order to analyze whether our findings correspond to a general effect of institutional improvement in the area allocated to coca plantations in Colombian municipalities, we perform a placebo test. This test adapts the formalization index of land property rights to median sized land-holders. Table 7 shows the results. As expected, no significant effect is found for the point estimate of the formality index in all regressions, which once over confirms the robustness of our results.

[Table 7 goes about here]

Finally, we consider a dynamic specification which accounts for the persistence in the presence of coca plantations across years in Colombian municipalities. Table 8 presents the results. We report the pooled OLS and the fixed effect estimations (columns I and II) as benchmark; a consistent estimate for the dynamic component (i.e. the parameter associated with the lagged variable) should fall between the upper and lower bound determined by these two estimators respectively (Nickell, 1981; Bond, 2002), and should be smaller than one so that the dynamic process can converge. Furthermore, we check the validity of this approach through the Hansen test of overidentification restrictions (Hansen, 1982), the Difference-in-Hansen test (Newey, 1985), and autocorrelation tests (Arellano & Bond, 1991). Results of the tests

prove a correct specification of the dynamic model. Despite the fact that the main effect disappears, the indirect effect through the interaction terms has a similar magnitude and sign as found in our baseline results, backing up our main findings.

[Table 8 goes about here]

6. Conclusions

This article provides empirical evidence on the influence of formalization of land property rights on the presence of illegal crops in Colombia. Despite the growing body of empirical and theoretical evidence on the positive effects of well-defined land property rights, little is known about the importance of these crucial institutions on illicit behavior. This is particularly relevant in a context of a large scale war against drugs, like in Colombia, where the interaction between a persistent drug economy and a dual land property rights scheme has boosted the spread of illegal crops across the territory.

We used an unique panel data set spanning from 2000 to 2009, containing detailed information on coca crops, land titling, and the implementation of *Plan Colombia* policies. We exploit the temporal variation on the informality index in a sample of municipalities which had their first cadastral census carried out between 1994 and 2000. During this period, Colombian Goverment launched a centralized initiative to increase the coverage and quality of the cadastral information, leading to a sample in which the quality of the information was exogenous to local characteristics. Furthermore, this census was complemented with strategies to promote formalized land property rights, initiating programs that enabled scatters to claim for a formal title on their land. This mainly took place between 2000 and 2007, creating the needed temporal variation under which our identification strategy holds. Nevertheless, since several sources of bias might persist, we control for different sources of uonbservable variation.

We argue that, given the increase of the visibility of the state due to the implementation of *Plan Colombia*, the cost of growing coca rose in response to the increased risk of being caught. This cost was relatively higher in municipalities with a higher land formality index, given the severe potential consequences of expropriation of assets when caught. This mechanism is supported through our findings. A reduction of 0.581 standard deviations of area allocated to coca fields per municipality is related to one standard deviation increase in the land formality index. Furthermore, as a consequence of the more formalized land rights, the well documented positive effects on investment, higher productivity, land market, and credit access, among others, create legal and sustainable alternatives for small peasants to use their land, increasing the expected income out of legal crops (direct effect). This agricultural portfolio choice would balance even more to legality when able to benefit from the alternative development programs of *Plan Colombia* (indirect effect). Our results support this second mechanism as well. These results

remain robust under different specifications, with alternating samples, and under alternative explanations.

Our mechanisms are embedded in the framework on property rights, and consequently institutions in general. In this sense, our results are aligned with the positive effects of improved land institutions on development and growth, adding another positive effect to this growing list. More specific, this study contributes to the limited body of literature evaluating policies against coca cultivation, and we do consider our evidence relevant for these policy purposes.

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Tables and Figures

TABLE 1. Summary statistics

	Observations	Mean	Std. Deviation	Q25	Q50	Q90	Q99
Coca crops (ha)	2238	88.288	507.034	0.000	0.000	121.000	1529.000
Share of municipality area on coca fields	2238	0.001	0.004	0.000	0.000	0.001	0.013
Formality land property rights for small-holders ($\leq$20ha)	2234	0.827	0.197	0.780	0.905	0.978	1.000
Formality land property rights for median-holders (>20ha - $\leq$200ha)	2238	0.844	0.182	0.793	0.909	0.994	1.000
Rate Cadastral Areal (total)/Geographical Area	2238	0.974	0.284	0.908	0.969	1.099	2.345
Share of private cadastral area on small plots ($\leq$20ha)	2238	0.407	0.265	0.191	0.375	0.800	0.963
Aerial Spraying (ha)	2238	205.144	1029.102	0.000	0.000	0.000	6447.000
Manual coca erradication (ha)	2238	163.095	810.492	0.000	0.000	122.000	4487.000
Number of laboratories destroyed	2238	2.624	16.847	0.000	0.000	4.000	39.000
Seizure of coca leaves (kg)	2238	766.709	6198.039	0.000	0.000	380.000	15654.200
Forest Warden Families (yes=1)	2238	0.038	0.190	0.000	0.000	0.000	1.000
Alternative Productive Projects (yes=1)	2238	0.104	0.306	0.000	0.000	1.000	1.000
Land quality gini index	2238	0.691	0.107	0.624	0.698	0.828	0.903
Share of cadastral area on public land	2238	0.089	0.156	0.007	0.023	0.274	0.736
Share of cadastral area on indigenous	2238	0.027	0.118	0.000	0.000	0.013	0.806
Share of cadastral area on natural parks	2238	0.002	0.012	0.000	0.000	0.001	0.037
Longitude (in degrees)	2238	-74.580	1.431	-75.747	-74.394	-73.102	-72.574
Latitude (in degrees)	2238	5.393	2.049	4.190	5.692	7.651	10.812
Altitude (Height above mean sea level) (mts)	2238	1244.828	611.462	950.000	1382.000	1900.000	2475.000
Municipality area (ha)	2238	65437.064	1.75e+05	11400.000	24300.000	1.37e+05	1.32e+06

Notes - We include all the municipalities for which the cadastral information was formed between 1995 and 2000 and either have natural conditions to crop coca(i.e. altitude 500 to 2000 mts over sea) or ever had coca during that period. Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013.

TABLE 2. Difference between excluded municipalities and our sample.

	CP			*CP+PP*		
	Excluded	Our sample	Difference	Excluded	Our sample	Difference
Share of municipality area on coca fields	0.002	0.002	0.000	0.001	0.001	0.001***
	[1.299]	[0.194]	[0.000]	[3.796]	[0.000]	[0.000]
	(1519)	(804)		(2677)	(2234)	
Number of years with coca crops	6.396	5.644	0.752***	3.629	2.031	1.598***
	[4.884]	[0.000]	[0.154]	[14.541]	[0.000]	[0.110]
	(1519)	(804)		(2677)	(2234)	
Formality land property rights for small-holders (≤20ha)	0.575	0.713	-0.139***	0.677	0.827	-0.150***
	[-10.590]	[0.000]	[0.013]	[-19.925]	[0.000]	[0.008]
	(1519)	(804)		(2677)	(2234)	
Formality land property rights for median-holders (>20ha - ≤200ha)	0.598	0.743	-0.145***	0.694	0.844	-0.150***
	[-11.791]	[0.000]	[0.012]	[-21.062]	[0.000]	[0.007]
	(1519)	(804)		(2677)	(2234)	
Rate Cadastral Areal (total)/Geographical Area	0.795	0.967	-0.171***	0.884	0.974	-0.090***
	[-9.881]	[0.000]	[0.017]	[-8.325]	[0.000]	[0.011]
	(1519)	(804)		(2677)	(2234)	
Share of private cadastral area on small plots (≤20ha)	0.270	0.234	0.036***	0.343	0.407	-0.064***
	[3.516]	[0.000]	[0.010]	[-8.542]	[0.000]	[0.008]
	(1519)	(804)		(2677)	(2234)	
Aerial Spraying (ha)	533.453	565.409	-31.955	302.695	205.144	97.551**
	[-0.463]	[0.644]	[69.073]	[3.034]	[0.002]	[32.155]
	(1519)	(804)		(2677)	(2234)	
Manual coca erradication (ha)	459.283	409.597	49.686	263.990	163.095	100.896***
	[0.912]	[0.362]	[54.510]	[3.886]	[0.000]	[25.967]
	(1519)	(804)		(2677)	(2234)	
Number of laboratories destroyed	6.775	6.701	0.073	3.966	2.624	1.343**
	[0.069]	[0.945]	[1.061]	[2.750]	[0.006]	[0.488]
	(1519)	(804)		(2677)	(2234)	
Seizure of coca leaves (kg)	2157.826	1851.229	306.597	1255.369	766.709	488.660*
	[0.664]	[0.507]	[461.716]	[2.293]	[0.022]	[213.146]
	(1519)	(804)		(2677)	(2234)	
Land quality gini index	0.644	0.658	-0.014**	0.670	0.691	-0.022***
	[-2.609]	[0.009]	[0.005]	[-6.662]	[0.000]	[0.003]
	(1519)	(804)		(2677)	(2234)	
Share of cadastral area on public land	0.110	0.158	-0.048***	0.086	0.089	-0.003
	[-6.058]	[0.000]	[0.008]	[-0.608]	[0.543]	[0.004]
	(1519)	(804)		(2677)	(2234)	
Share of cadastral area on indigenous	0.139	0.038	0.101***	0.087	0.027	0.060***
	[9.954]	[0.000]	[0.010]	[11.533]	[0.000]	[0.005]
	(1519)	(804)		(2677)	(2234)	
Share of cadastral area on natural parks	0.010	0.003	0.007**	0.006	0.002	0.004***
	[0.072]	[0.017]	[0.003]	[0.054]	[0.012]	[0.001]
	(1519)	(804)		(2677)	(2234)	

Notes - Standard errors in brackets, number of observation in parenthesis. * Significant at 10%, ** significant at 5%, and *** significant at 1%. Two-side mean test significance reported. "CP" refers to the sample restricted to only coca produces (i.e. at least one year with coca), "PP" refers to the sample including potential coca producers (i.e. between 500 and 2000 meters over see). Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013.

TABLE 3. Different between excluded municipalities with characteristics 1995)

PANEL A				
	Distance to Bogota (km)	Distance to Provincial Capital (km)	Altitude (Height above mean sea level) (mts)	Population (1993)
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	-40.067**	168.733*	-32.132***	11389.639***
	[18.787]	[84.470]	[8.837]	[2559.591]
N	558	558	558	548
Adjusted R2	0.017	0.014	0.060	0.014
PANEL B				
	Poverty (%) (1993)	Income Gini Index (1993)	School Attendance (1993)	Unsatisfied Basic Need -UBN- (1993)d
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	-0.032*	0.002	-0.601	-13.034***
	[0.016]	[0.005]	[0.653]	[2.496]
N	533	533	530	558
Adjusted R2	0.014	-0.001	0.002	0.110
PANEL C				
	Rural population index (Rural/Urban) (1993)	Average Homicide Rate (by 100 person) (average 1990-2000)	Average Number of Displaced people (average 1990-2000)	Average Number of attacks to civilians (average 1990-2000)
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	-1.321**	0.126**	19.093	-0.018
	[0.545]	[0.054]	[65.926]	[1.026]
N	547	558	558	558
Adjusted R2	0.022	0.019	-0.002	-0.002
PANEL D				
	Average Number of massacres (average 1990-2000)	Presence of Agrarian Bank	Presence of High-School	Average public income per-capita (average 1990-2000)
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	0.051	0.125	2.965*	0.023**
	[0.043]	[0.135]	[1.589]	[0.009]
N	558	558	558	558
Adjusted R2	0.006	0.000	0.005	0.025
PANEL E				
	Indigenous communities (yes=1)	Afrocolombian communities (yes=1)	National Park (yes=1)	Forest Reserve (yes=1)
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	-0.121**	-0.055	-0.063	-0.075***
	[0.053]	[0.052]	[0.047]	[0.023]
N	558	558	558	558
Adjusted R2	0.018	0.007	0.004	0.013
PANEL F				
	Hectares allocated to coffee (1997)	Municipality area covered by natural forest (%)	Municipality area covered by crops (%)	Municipality area with human intervention (%)
	(I)	(II)	(III)	(IV)
Cadastra Formation 1995-2010	479.388***	-0.126***	0.022	0.008
	[126.545]	[0.038]	[0.023]	[0.021]
N	558	558	558	500
Adjusted R2	0.026	0.048	0.004	-0.002

Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. Robust standard errors in brackets, clustered by department level. Data source: National Census (1993) and CEDE (2013)

TABLE 4. Land property rights and coca crops: Baseline results.

Dependent variable: Share of municipality area on coca fields

	(I)	(II)	(III)	(IV)	(V)	(VI)
Formality land property rights for small-holders (≤20ha)	-0.491***	-0.576***	-0.577***	-0.574***	-0.575***	-0.581***
	[0.162]	[0.212]	[0.214]	[0.212]	[0.214]	[0.213]
Forest Warden Families (yes=1)		-0.285**	-0.278**	-0.283**	-0.276**	-0.276**
		[0.120]	[0.128]	[0.120]	[0.128]	[0.120]
Alternative Productive Projects (yes=1)		0.190	0.192	0.187	0.189	0.195
		[0.191]	[0.196]	[0.191]	[0.196]	[0.192]
Aerial Spraying (ha)		0.018	0.018	0.015	0.015	0.019
		[0.025]	[0.025]	[0.024]	[0.024]	[0.025]
Manual coca erradication (ha)		0.035	0.035	0.036	0.036	0.035
		[0.058]	[0.058]	[0.058]	[0.058]	[0.058]
Number of laboratories destroyed		0.073*	0.073*	0.079**	0.079**	0.076*
		[0.041]	[0.041]	[0.040]	[0.040]	[0.043]
Seizure of coca leaves (kg)		0.013	0.014	0.011	0.011	0.013
		[0.034]	[0.035]	[0.038]	[0.038]	[0.034]
Formality * Productive Projects * Forest Warden Families			0.023		0.024	
			[0.125]		[0.124]	
Formality * Aerial and Manual erradication * Laboratories * Seizure of coca leav				-0.001**	-0.001**	
				[0.001]	[0.001]	
Formality * all policies						-0.023**
						[0.011]
Observations	2234	2234	2234	2234	2234	2234
Municipalities	270	270	270	270	270	270
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Coca Region-year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	No	No	No

Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. * Significant at 10%, ** significant at 5%, and *** significant at 1%. Robust standard errors in brackets, clustered by municipality and by department-year. Variable not shown included the updating cadastral dummy. Sample is composed by all the municipalities that had coca crops (i.e. at least one year) between 2000-2009 and had their first census plot between 1995 and 2000. Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013. All variables were standardized to have mean zero and standard deviation one.

TABLE 5. Land property rights and coca crops: Baseline results including extra controls.

Dependent variable: Share of municipality area on coca fields

	(I)	(II)	(III)	(IV)	(V)	(VI)
Formality land property rights for small-holders (≤20ha)	-0.529***	-0.608**	-0.611**	-0.606**	-0.608**	-0.613**
	[0.190]	[0.241]	[0.245]	[0.241]	[0.245]	[0.242]
Change on coca crops around 25km	0.010	0.004	0.005	0.004	0.004	0.004
	[0.029]	[0.034]	[0.034]	[0.034]	[0.034]	[0.034]
Change on coca crops around 50km	0.002	0.001	0.001	0.001	0.001	0.001
	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Change on coca crops around 100km	0.000	0.001	0.001	0.001	0.001	0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Forest Warden Families (yes=1)		-0.284**	-0.270**	-0.282**	-0.267**	-0.275**
		[0.122]	[0.129]	[0.122]	[0.129]	[0.121]
Alternative Productive Projects (yes=1)		0.183	0.187	0.180	0.185	0.189
		[0.186]	[0.192]	[0.185]	[0.192]	[0.187]
Aerial Spraying (ha)		0.018	0.018	0.014	0.014	0.019
		[0.025]	[0.025]	[0.025]	[0.025]	[0.025]
Manual coca erradication (ha)		0.036	0.036	0.037	0.037	0.035
		[0.058]	[0.059]	[0.058]	[0.059]	[0.058]
Number of laboratories destroyed		0.072*	0.072*	0.079**	0.079**	0.075*
		[0.039]	[0.039]	[0.038]	[0.039]	[0.041]
Seizure of coca leaves (kg)		0.011	0.011	0.009	0.009	0.011
		[0.034]	[0.034]	[0.037]	[0.037]	[0.034]
Formality * Productive Projects * Forest Warden Families			0.046		0.047	
			[0.141]		[0.141]	
Formality * Aerial and Manual erradication * Laboratories * Seizure of coca leav				-0.001*	-0.001	
				[0.001]	[0.001]	
Formality * all policies						-0.024**
						[0.012]
Observations	2234	2234	2234	2234	2234	2234
Municipalities	270	270	270	270	270	270
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Coca Region-year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes

Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. Robust standard errors in brackets, clustered by municipality and by department-year. Variable not shown included the updating cadastral dummy. Additional controls include: (i) Land quality gini index, (ii) Share of cadastral area on public land, (iii) Share of cadastral area on indigenous, (iv) Share of cadastral area on natural parks. Sample is composed by all the municipalities that had coca crops (i.e. at least one year) between 2000-2009 and had their first census plot between 1995 and 2000. Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013. All variables were standardized to have mean zero and standard deviation one.

TABLE 6. Robustness Check: Using different samples.

Dependent variable: Share of municipality area on coca fields

	Baseline Sample		*Cadastral from 1990*		*Cadastral from 1970*		*Only updated municipalities*		*All municipalities*	
	CP	CP+PP	CP	CP+PP	CP	CP+PP	CP	CP+PP	CP	CP+PP
Formality land property rights for small-holders (≤20ha)	-0.595***	-0.581***	-5.798**	-4.867**	-4.960*	-3.390*	-0.425***	-0.182*	-1.728	-1.162
	[0.197]	[0.212]	[2.711]	[2.463]	[2.580]	[2.080]	[0.156]	[0.099]	[1.342]	[0.893]
Forest Warden Families (yes=1)	-0.393**	-0.276**	-0.225	-0.148	-0.210	-0.205	-0.222	-0.244	-0.187	-0.196
	[0.176]	[0.120]	[0.186]	[0.162]	[0.186]	[0.162]	[0.195]	[0.181]	[0.197]	[0.156]
Alternative Productive Projects (yes=1)	0.364	0.195	0.400	0.425*	0.379	0.300	-0.033	-0.004	0.344*	0.272*
	[0.372]	[0.192]	[0.258]	[0.234]	[0.252]	[0.200]	[0.139]	[0.063]	[0.195]	[0.148]
Aerial Spraying (ha)	0.023	0.019	0.026	0.026	0.021	0.020	0.043	0.043*	0.007	0.009
	[0.025]	[0.025]	[0.034]	[0.031]	[0.032]	[0.027]	[0.030]	[0.026]	[0.022]	[0.020]
Manual coca erradication (ha)	0.035	0.035	0.038	0.034	0.019	0.014	-0.009	-0.008	0.010	0.007
	[0.063]	[0.057]	[0.042]	[0.037]	[0.036]	[0.032]	[0.019]	[0.015]	[0.028]	[0.026]
Number of laboratories destroyed	0.067*	0.076*	0.174*	0.168**	0.165**	0.159**	0.101*	0.079*	0.131*	0.129**
	[0.042]	[0.043]	[0.090]	[0.079]	[0.082]	[0.072]	[0.056]	[0.043]	[0.067]	[0.066]
Seizure of coca leaves (kg)	0.004	0.013	-0.053	-0.030	-0.037	-0.002	-0.096**	-0.067*	0.017	0.027
	[0.039]	[0.034]	[0.170]	[0.144]	[0.153]	[0.118]	[0.042]	[0.036]	[0.082]	[0.068]
Formality * all policies	-0.021*	-0.023**	-0.044	-0.047	-0.046	-0.047	-0.009***	-0.011***	-0.002**	-0.002**
	[0.012]	[0.011]	[0.043]	[0.037]	[0.039]	[0.033]	[0.003]	[0.002]	[0.001]	[0.001]
Observations	804	2234	1616	4014	1726	4214	476	1278	2331	4923
Municipalities	100	270	183	451	194	471	146	382	266	560
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coca Region-year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional Controls	No	No	No	No	No	No	No	No	No	No

Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. Robust standard errors in brackets, clustered by municipality and by department-year. "CP" refers to the sample restricted to only coca produces (i.e. at least one year with coca), "PP" refers to the sample including potential coca producers (i.e. between 500 and 2000 meters over see). *Baseline Sample*: All the municipalities that had their first census plot between 1995 and 2000. *Cadastral from 1990*: All the municipalities that had either first census plot or updating process after 1990. *Cadastral from 1970*: All the municipalities that had either first census plot or updating process after 1970. *Only updated municipalities:* All the municipalities whom cadastral information is updated (i.e. at least five years after the last census plot). Variable not shown included the updating cadastral dummy. *All municipalities:* All Colombian municipalities were considered, with any cadastral formation. Variable not shown included the updating cadastral dummy. Additional controls include: (i) Land quality gini index, (ii) Share of cadastral area on public land, (iii) Share of cadastral area on indigenous, (iv) Share of cadastral area on natural parks. Sample is composed by Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013. All variables were standardized to have mean zero and standard deviation one.

Table 7. Robustness Check: falsification test.

Dependent variable: Share of municipality area on coca fields

	(I)	(II)	(III)	(IV)	(V)	(VI)
Formality land property rights for large-holders (≥20ha)	-0.066	-0.071	-0.071	-0.072	-0.072	-0.071
	[0.052]	[0.051]	[0.051]	[0.051]	[0.050]	[0.051]
Forest Warden Families (yes=1)		-0.326**	-0.323**	-0.324**	-0.321**	-0.315**
		[0.141]	[0.134]	[0.140]	[0.134]	[0.141]
Alternative Productive Projects (yes=1)		0.126	0.121	0.123	0.118	0.129
		[0.173]	[0.173]	[0.173]	[0.173]	[0.175]
Aerial Spraying (ha)		0.017	0.016	0.013	0.012	0.017
		[0.025]	[0.025]	[0.024]	[0.025]	[0.025]
Manual coca erradication (ha)		0.035	0.035	0.036	0.036	0.036
		[0.058]	[0.058]	[0.058]	[0.058]	[0.058]
Number of laboratories destroyed		0.073*	0.074*	0.078**	0.079**	0.075*
		[0.041]	[0.041]	[0.040]	[0.040]	[0.043]
Seizure of coca leaves (kg)		0.012	0.011	0.009	0.008	0.012
		[0.034]	[0.035]	[0.037]	[0.038]	[0.034]
Formality * Productive Projects * Forest Warden Families			0.236		0.241	
			[0.175]		[0.175]	
Formality * Aerial and Manual erradication * Laboratories * Seizure of coca leav				-0.002*	-0.002*	
				[0.001]	[0.001]	
Formality * all policies						-0.085
						[0.066]
Observations	1810	1810	1810	1810	1810	1810
Municipalities	270	270	270	270	270	270
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Coca Region-year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yess
Additional Controls	No	No	No	No	No	No

Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. Robust standard errors in brackets, clustered by municipality and by department-year. Variable not shown included the updating cadastral dummy. Additional controls include: (i) Land quality gini index, (ii) Share of cadastral area on public land, (iii) Share of cadastral area on indigenous, (iv) Share of cadastral area on natural parks. Sample is composed by all the municipalities that had coca crops (i.e. at least one year) between 2000-2009 and had their first census plot between 1995 and 2000. Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013. All variables were standardized to have mean zero and standard deviation one.e.

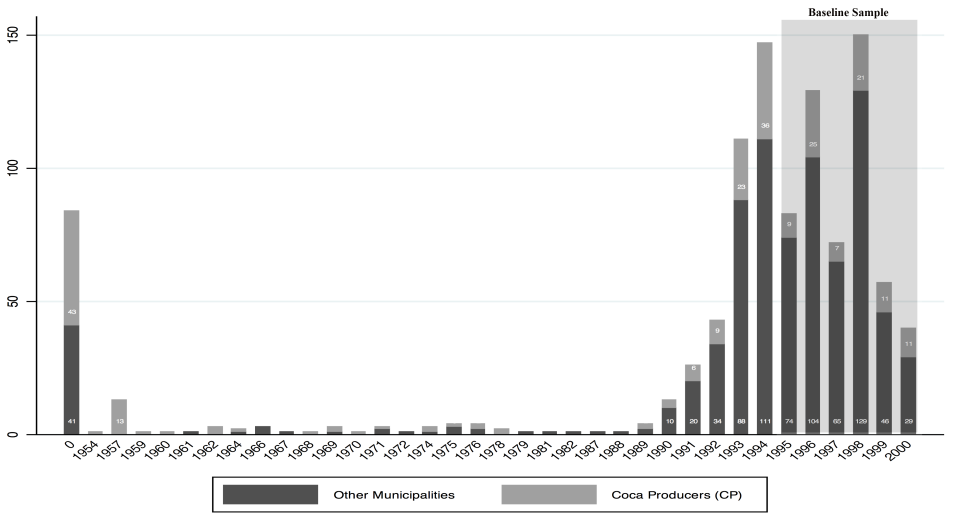
TABLE 8. Robustness Check: Dynamic specification

Dependent variable: Share of municipality area on coca fields

	Pooled OLS	OLS FE	System GMM					
			(I)	(II)	(III)	(IV)	(V)	(VI)
L.Share of municipality area on coca fields	1.059***	0.902***	1.110***	1.033***	1.033***	1.032***	1.032***	1.031***
	[0.147]	[0.246]	[0.124]	[0.139]	[0.139]	[0.139]	[0.139]	[0.138]
Formality land property rights for small-holders (≤20ha)	0.018	0.282*	0.027	0.025	0.025	0.028	0.028	0.026
	[0.030]	[0.150]	[0.026]	[0.026]	[0.025]	[0.026]	[0.026]	[0.026]
Forest Warden Families (yes=1)				-0.079*	-0.067	-0.072*	-0.060	-0.070*
				[0.042]	[0.047]	[0.043]	[0.048]	[0.042]
Alternative Productive Projects (yes=1)				0.117*	0.121*	0.111*	0.114	0.120*
				[0.067]	[0.070]	[0.066]	[0.069]	[0.067]
Aerial Spraying (ha)				-0.006	-0.006	-0.011	-0.011	-0.005
				[0.018]	[0.018]	[0.018]	[0.018]	[0.018]
Manual coca erradication (ha)				-0.002	-0.002	-0.002	-0.002	-0.002
				[0.021]	[0.021]	[0.022]	[0.022]	[0.021]
Number of laboratories destroyed				0.000	-0.000	0.008	0.008	0.003
				[0.021]	[0.021]	[0.021]	[0.021]	[0.023]
Seizure of coca leaves (kg)				0.021	0.021	0.018	0.019	0.020
				[0.014]	[0.014]	[0.016]	[0.016]	[0.015]
Formality * Productive Projects * Forest Warden Families					0.042		0.039	
					[0.052]		[0.051]	
Formality * Aerial and Manual erradication * Laboratories * Seizure of coca leav						-0.002***	-0.002***	
						[0.000]	[0.000]	
Formality * all policies								-0.020**
								[0.008]
No. of observations	1965	1965	1965	1965	1965	1965	1965	1965
No. of groups		270	270	270	270	270	270	270
No. of instruments			19	28	29	29	30	29
F test			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Arellano-Bond test for AR(1)			(0.101)	(0.108)	(0.108)	(0.107)	(0.107)	(0.110)
Arellano-Bond test for AR(2)			(0.262)	(0.265)	(0.264)	(0.244)	(0.243)	(0.269)
Hansen J test of overidentifying restrictions			(0.107)	(0.113)	(0.113)	(0.131)	(0.131)	(0.114)
Difference-in-Hansen test			(0.098)	(0.115)	(0.114)	(0.092)	(0.091)	(0.110)

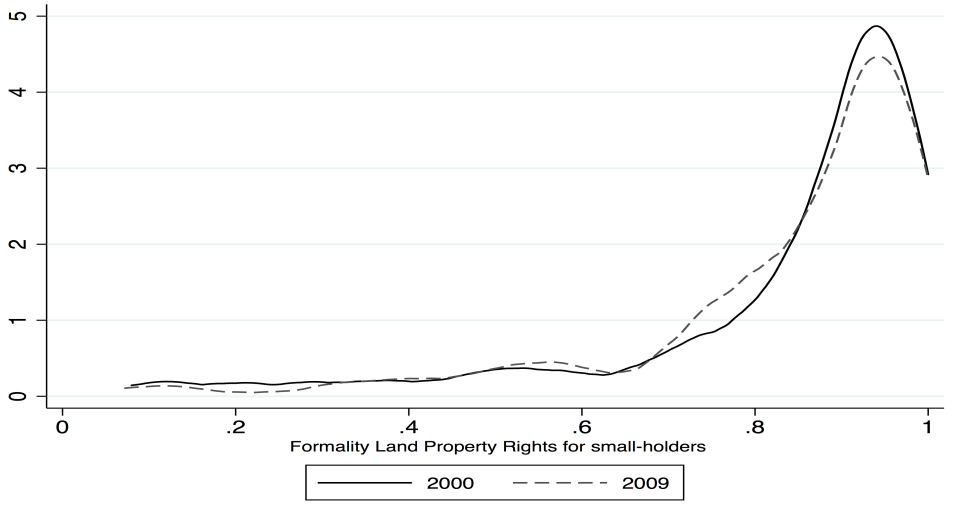
Notes - * Significant at 10%, ** significant at 5%, and *** significant at 1%. * Significant at 10%, ** significant at 5%, and *** significant at 1%. Standard errors are in brackets, p-values in parentheses. Sample is composed by all the municipalities that had their first census plot between 1995 and 2000. Two step System GMM is implemented. We use the forward orthogonal deviations proposed by Arellano and Bover (1995). The Windmeijer (2005) finite sample correction for standard errors is employed. We use two lags instruments in the collapsed instrument matrix. The time-invariant controls include: Altitude, longitude and latitude. The Hansen J-test reports the p-values for the null hypothesis of instrument validity. The values reported for the Diff-in-Hansen test are the p-values for the validity of the additional moment restriction necessary for system GMM. The values reported for AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations. All variables were standardized to have mean zero and standard deviation one.

GRAPH 1. First Plot Census: Cadastral formation



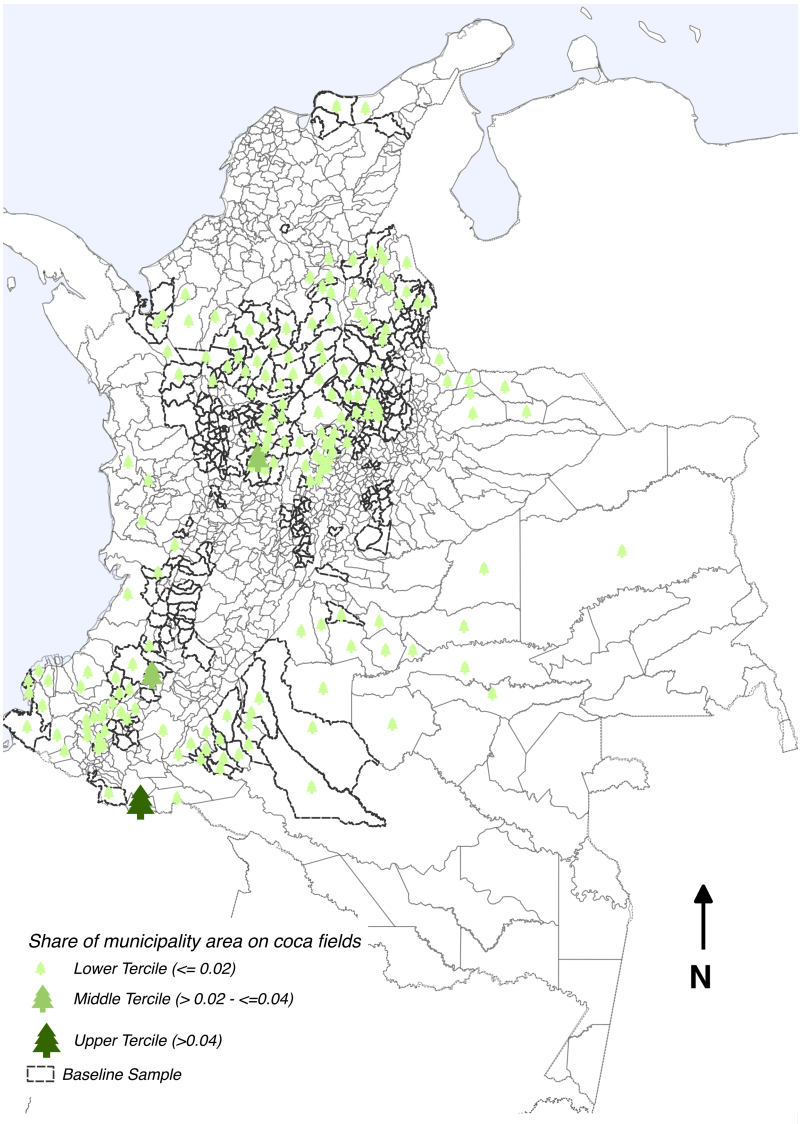
Notes– We include all the municipalities that either have natural conditions to crop coca(i.e. altitude 500 to 2000 mts over sea) or ever had coca during that period. Data source: IGAC, 2013; Antioquia Goverment, 2013.

GRAPH 2. Kernel distribution for the Formality Land Property Rights for small-holders ($\leq 20ha$) in 2000 and 2009.



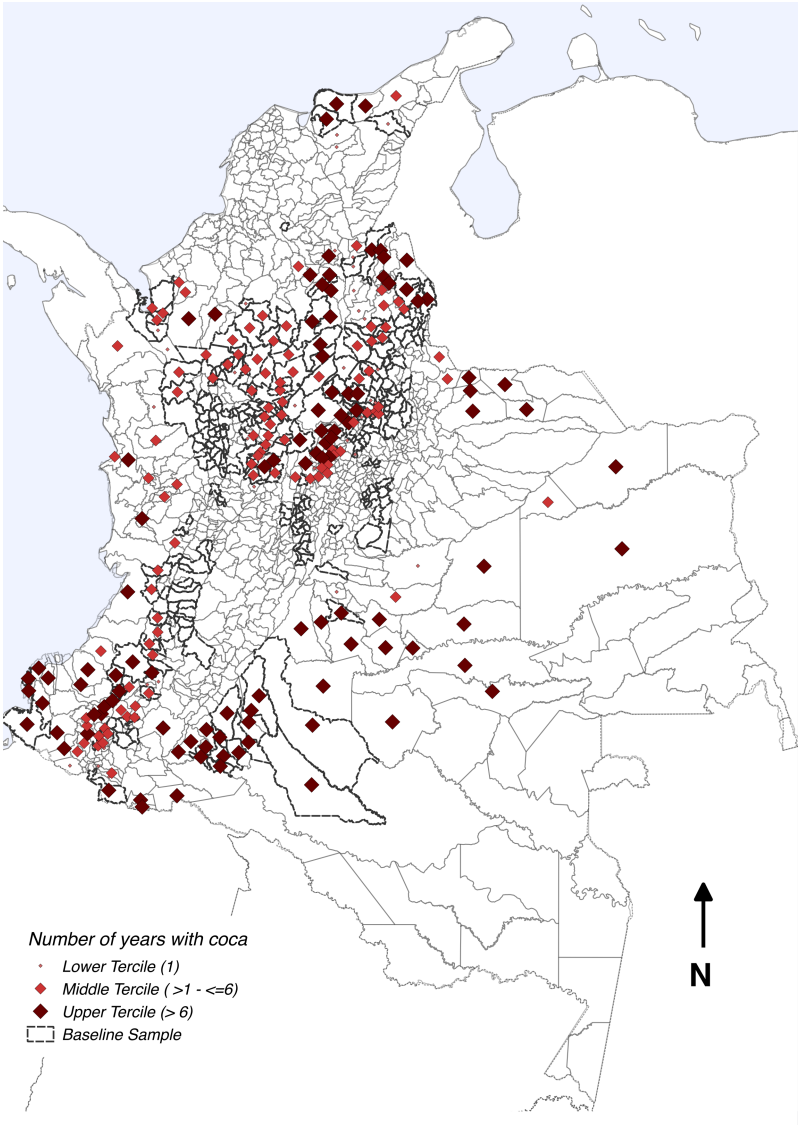
Notes– We include all the municipalities for which the cadastral information was formed between 1995 and 2000 and either have natural conditions to crop coca(i.e. altitude 500 to 2000 mts over sea) or ever had coca during that period.. Two-sample Kolmogorov-Smirnov test [p-value= 0.640].Data source: IGAC, 2013; Antioquia Goverment, 2013.

GRAPH 3. Spatial distribution for the average share of municipality area on coca fields over 2000-2009.



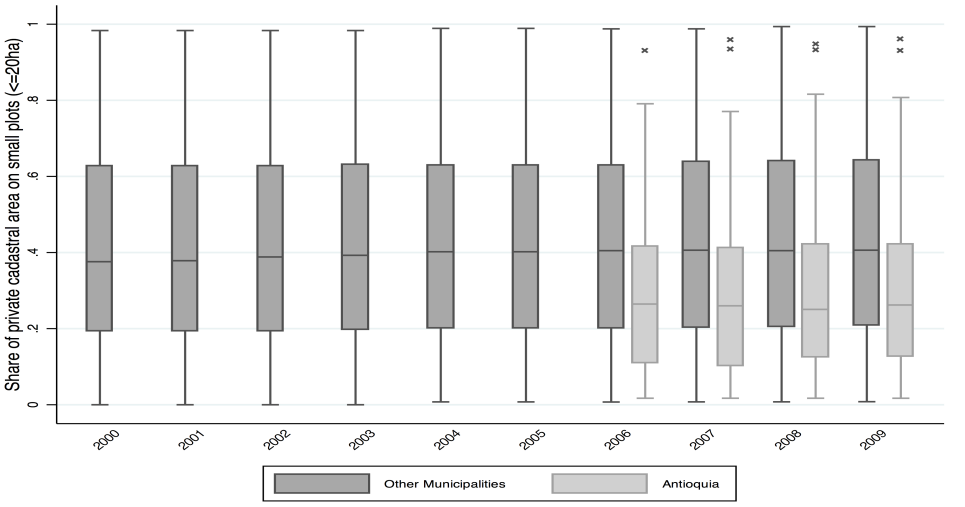
Notes– Mean= 0.05%; Std Dev=.296. The map includes all Colombian municipalities. The baseline sample refers to all the municipalities that fulfill three conditions: (i) had their first census plot between 1995 and 2000 and had Coca crops (i.e. at least one year) between 2000-2009; (ii) had their first census plot between 1995 and 2000 and are naturally prone to havecoca crops (i.e. between 500 and 2000 meters over see). Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013.

GRAPH 4. Spatial distribution for the number of years with coca fields over 2000-2009.



Notes– Mean= 1.592 ; Std Dev=3.179. The map includes all Colombian municipalities. The baseline sample refers to all the municipalities that fulfill three conditions: (i) had their first census plot between 1995 and 2000 and had Coca crops (i.e. at least one year) between 2000-2009; (ii) had their first census plot between 1995 and 2000 and are naturally prone to havecoca crops (i.e. between 500 and 2000 meters over see). Data source: UNODC, 2013; IGAC, 2013; Antioquia Goverment, 2013.

GRAPH 5. Temporal distribution of the share private cadastral area on small plots (≥20ha) .



Notes– We include all the municipalities for which the cadastral information was formed between 1995 and 2000 and either have natural conditions to crop coca(i.e. altitude 500 to 2000 mts over sea) or ever had coca during that period. Two-sample Kolmogorov-Smirnov test [p-value= 0.640].Data source: IGAC, 2013; Antioquia Goverment, 2013.