Forced displacement: legal versus illegal crops*

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Abstract

Anecdotal evidence suggests that, in stateless regions in Colombia, the establishment of oil palm plantations generates more forced migration than the introduction of coca crops. In this paper we provide a theoretical model to study this phenomenon, in the context of an ongoing civil conflict. We consider an agent, allied with the illegal armed group that controls a region, who chooses between buying an agricultural good from peasants or producing it himself by evicting farmers from their lands. We analyze the case of a legal agricultural good (i.e. oil palm) versus an illegal one (i.e. coca). Results indicate that, in the case of the illicit crop, it is more likely that the agent finds it optimal to buy the good from peasants. This is due to the fact that peasants' own labor is more productive than hired labor and that the illegal crop production needs to be carried out in small scale farms in order to avoid detection and eradication from the government. On the contrary, for the legal crop, it is more likely that the agent prefers to carry out production himself, which implies that peasants are forced out from their lands. These results suggest that, in the context of civil conflict, careful attention should be paid to the design of illicit crop substitution programs, since the establishment of some legal crops could increase forced displacement.

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1 Introduction

In the context of civil conflicts, governments usually have difficulties in protecting the entire territory of a country. As a consequence, they focus attention and devote resources to defending the most valuable areas while other regions are left unattended, which is actually the case in Colombia. An accurate description of the situation in this country would be that "... in large parts of rural Colombia and in many peripheral urban neighborhoods, the state does not provide basic services such as health, education, housing, sanitation and security"[1].

These stateless regions are the perfect location for the development of all kinds of illegal activities. In particular, they are used for illicit drug cultivation and production, whose profits are in turn known to be one of the main sources of income for some terrorist organization and illegal armed groups. As summarized by Mejia and Posada (2008) "there is enough evidence of the involvement of guerrilla and paramilitary groups in illegal drug production and trafficking to finance their war against each other and against the Colombian state". Besides, the international community, and specially the U.S., has pressured producing countries to adopt the necessary measures to reduce the supply of illicit drugs. Therefore, the Colombian government, with support of the US through the so-called Plan Colombia, has engaged in a an antidrug war, by implementing a 'stick and carrot' type of policy. The 'stick' comprises eradication (forced or voluntary) and interdiction and the 'carrot' consists of alternative development and crops substitution programmes. Legal crops usually suggested as substitutes for illicit crops are rubber, coffee, cacao and manioc, but one that had received much attention and whose benefits have been emphasized is oil palm, also called African palm.

Oil palm has been promoted by the government, not only as the most attractive substitute for illicit crops, but as the best way to enhance rural development and to improve the living conditions of peasants. The fact that oil palm has the highest yield per hectare of all oil-producing plants together with an increasing international demand for biofuels and for palm oil, certainly make this crop an attractive business. Furthermore, the profitability of the business has been increased by the vast support that the government has given to oil palm cultivation. As a result, Colombia has experienced a boost in oil palm cultivation as evidenced by the fact that the planted area almost doubled in six years (from 2001 to 2007)[2]. At the same time, there is mounting anecdotical evidence linking oil palm cultivation and forced displacement in some areas of the country. One of the most striking examples is the case of the Jiguamiando and Curvaradó communities in the Chocó state. After a long investigation, the government recognized that, following a massive forced displacement of the members of this groups, at least 25.000 hectares of their territories had been illegally appropriated by oil palm companies and were already planted with this crop.

[1] International Crisis Group (2003)

[2] Fedepalma, available at http://www.fedepalma.org/documen/2008/area_cultivada.pdf

It is very interesting to notice that violent land appropriation related to oil palm plantations is not a phenomenon exclusive to Colombia. The Dayaks are indigenous groups that live in the West Kalimantan region in Indonesia and the Sarawak state in Malaysia. They have been evicted from their traditional lands, most of the times by violent means, in order to adapt the territories for oil palm cultivation. Among the reasons that allow this usurpation to take place were cited the "...laws that fail to secure the rights of indigenous peoples while encouraging the expropriation of land for commercial projects in the 'national interest'; an absence of regulations, making procedures for recognizing collective community land rights unclear; weak institutional capacity, both in the national land agencies and in the district bureaucracies, which also makes recognition of customary rights difficult"[3]. This example shares with the one mentioned above the absence of a strong government's presence in some areas, that combined with a land-intensive profitable crop, leads to forced displacement.

In this chapter we provide a theoretical model to study the link between forced migration and certain types of crops. We analyze the production of two kinds of agricultural goods: a legal good whose production is intensive in land (i.e. oil palm) and an illegal good characterized by a labor intensive production function (i.e. coca). We consider an agent who chooses between buying the agricultural good from peasants and producing it himself. In the second case, the agent, who is allied with an illegal armed group, appropriates the land by the use of violence generating forced internal migration. The results from our model indicate that, in the case of the illicit crop, it is more likely that the agent finds it optimal to buy the good from peasants. This is due to the fact that peasant's own labor is more productive than hired labor and that the illegal crop production needs to be carried out in small scale farms in order to avoid detection and eradication from the government. On the contrary, for the legal crop, it is more likely that the agent prefers to carry out production himself, and thus, to exert violence against peasants and force them out from their lands.

An implication of these results is that, in the context of civil conflict, illicit crop's substitution programs can trigger violence against civilians and forced displacement. This result also indicates that subsidizing land intensive crops might exacerbate the problem of forced displacement, at least in the areas that lack a strong government's presence.

The remainder of this chapter is organized as follows. Section (2) characterizes both coca and oil palm crops and their relationship to forced displacement in Colombia. In section (3) the model is described and solved. The results from the model are discussed in Section (4) with some references to the Colombian case. Section (5) discusses the effects of the inclusion of fixed costs in the model. Section (6) contains the relation of this chapter to the existing literature on the subject and section (7) offers some concluding remarks.

[3] http://www.sawitwatch.or.id/index.php?option=com_content&task=view&id=60&Itemid=1

2 Legal versus illegal crops and displacement

2.1 Coca

Coca bushes can grow in a tropical rainforest climate, between 100 and 1700 meters above the see level. It is a short term crop, given that it can be harvested as soon as 6 months after planting. In average, it is harvested 4 times per year.

Cocaine is produced in a process that usually involves the following steps: fresh coca leaf, harvested from coca bushes, is mixed with sulfuric acid and combustibles to produce coca paste, which is in turn processed with other chemical products to obtain coca base. Potassium permanganate is used among others to transform this last product into cocaine hydrochloride, which is sent to the consuming country where it is diluted and sold to the final consumers. It has been estimated that one hectare planted with coca would yield 5 to 6 kilograms of cocaine per year[4]. A comprehensive summary of the existing data on cocaine production and trafficking can be found in Mejia and Posada (2008).

Colombia is currently, and has been for several years now, the largest coca-growing country in the world. Until the early 90's, Peru and Bolivia had the largest coca-cultivated areas and were the largest coca paste producers, that was in turn refined in Colombia and distributed from there to the international markets. Successful aerial interdiction campaigns in the Andean Region resulted in the displacement of cultivation to Colombia starting around 1994[5]. According to the UN[6], the coca cultivated area in Colombia grew from 44.700 hectares in 1994 to 163.300 hectares in 2000, and then declined to 81.000 hectares in 2008. The guerrillas and paramilitaries took advantage of this shift in the location of production by making alliances with the drug cartels. The illegal armed groups would offer protection for the coca production and transit in the country, as an exchange for a share of the business profits[7].

The colombian government has engaged in a an antidrug war, by implementing a 'stick and carrot' type of policy. The 'stick' comprises eradication (forced or voluntary) and interdiction and the 'carrot' consists of alternative development and crops substitution programmes. Starting with the signature of "Plan Colombia" in 1999, the Colombian government has been working together with the U.S. government to fight illicit crops. The "Plan Colombia" consisted in a multibillion aid package given to Colombia by the US Government. It was originally aimed at fighting illicit drug production and trafficking and later on was adjusted to include the fight against terrorism as well. Depending on the plot size, two different strategies have been employed to destroy illicit crops. Aerial spraying is used for the so-called industrial-scale plantations, which are coca-cultivated plots of 3 hectares or more. Subsistence plantations, those smaller than 3 hectares, have been targeted for manual eradication. A percentage of the resources from "Plan Colombia" is devoted to illicit crop substitution and

[4] Mejia and Posada (2008)
[5] Angrist and Kugler (2005)
[6] United Nations Office on Drugs and Crime (2009)
[7] See Thoumi (2003) and Diaz and Sanchez (2004)

alternative development programs which are also financially supported by the United States Agency for the International Development (USAID).

Aerial spraying operations are the most common type of illicit crop eradication although its effectiveness for destroying crops can be diminished under some circumstances. According to the Coca Survey, in 2008, the states of Narino, Putumayo and Guaviare had respectively 19.612, 9.658 and 6.629, hectares planted with coca. The reported sprayed areas for the same states and the same year were 54.050,11.898, and 13.061 hectares. This apparently surprising figures (the sprayed areas larger than the planted areas) are explained by the fact that coca producers either replant bushes or adopt measures to protect crops, so it is often the case that the same area needs to be sprayed several times during a year. Among the strategies to reduce the effectiveness of aerial spraying, Mejia and Posada (2008) report the so-called prune operation, which consists in cutting the coca bush at a foot above the ground after spraying. Since the herbicide attacks only the leaves and not the roots, the bush grows again and can be harvested some months later. Other measures are washing the bushes with clear water immediately after fumigation or covering the foliage with a protective substance like molasses.

It is interesting to notice that the establishment of coca crops is hardly ever listed among the causes of displacement, despite their illegal character. In fact, "in the last few years, new strategies have been adopted by the armed groups; for instance, when the population is under siege and can not move, they are connected by force to illegal productive processes in particular, coca leaf planting and harvesting"[8].

On the other hand, there are reported cases of peasants who decide to migrate as a consequence of aerial spraying. The reason is related to the product used for fumigation, glyphosate, whose real levels of toxicity are highly controversial. The U.S. Drug Enforcement Administration (DEA) and the Colombian government have emphasized that it is not harmful for human health and provided evidence in that sense from studies hired by themselves. Nevertheless, populations living in the sprayed areas complained to the authorities about polluted water and undesirable effects for health and subsistence farming. In the words of the bishop of Tumaco (one of the largest coca producing regions in Colombia): "Fumigation does not end the business, it destroys land, ruins people, damages legal crops and animals"[9].

CODHES[10] reported that between January and June 2008, 13.000 people, from the Antioquia and Vichada regions, were "forced" to leave their lands as a consequence of aerial spraying. In the Putumayo region, according to a report[11] from the National Ombudsman Office, thousands of peasants saw their food security threatened as a consequence of fumigations of areas with subsistence crops (plantain, manioc, corn) where there were no coca crops at all. Besides,

[8] Ibáñez and Moya (2007)

[9] Los planes de Bogota y la realidad de la vida (Bogota's plans and life's reality), article in El Pais newspaper (Spain), 20/05/2009.

[10] CODHES (2008).

[11] National Ombudsman Office (2002).

almost 5000 people from this region have complaint of symptoms, allegedly associated to the fumigations, such as diarrhea, vomiting, skin and respiratory allergies and headaches. In 2008, the Ecuatorian Government filed a complaint against Colombia with the International Court of Justice regarding the aerial spraying with glyphosate. The arguments were in line with those expressed by affected populations in Colombia: fumigations were causing serious damage to the natural environment and the living conditions of ecuatorians living near the common border.

Migrants due to aerial spraying are not counted as IDPs, internally displaced persons, by the government and are not included in the RUPD (Unique Register of Displaced Population)[12]. Actually it could be argued that in their case the migration is not "forced" but rather motivated by economic reasons; the discussion of whether they should be considered IDPs or not is beyond the scope of this chapter. The bottom line is that migration (forced or economic) caused by coca is related not to the establishment of the crops, but rather to the destruction of them and the collateral effects of glyphosate.

2.2 Oil Palm

Oil palm trees grow in tropical humid regions and up to 1300 meters of altitude, although for commercial production the maximum recommended altitude is 700 meters. They are considered a slow maturing (or long term) crop since it takes 4 to 5 years from the planting to the first harvesting; and the crop reaches its full productivity in 8 to 10 years. After 25 years the palm tree is too tall and becomes too difficult to harvest so it is usually cut down.

Oil palm trees produce bunches of fruits that are transformed in two main products: palm kernel oil from the seeds and oil palm from the fruit's pulp. Besides, palms' fronds and the residues of oil extraction are used as livestock feed. Both palm oil and palm kernel oil are widely used in the food processing industry because they are less expensive than most vegetable oils[13]. They are also used in the manufacturing of non edible products such as soaps, detergents, cosmetics, lubricant greases, candles, and more recently, biodiesel. In the Narino state the average annual yield is 16 tones/hectare, but the largest possible productivity is around 30 tones/hectare, from which it is possible to extract 7 tons of palm oil. In fact, according to the FAO "Oil palms can give a higher yield of oil per unit area than any other crop"[14].

Starting in the early 90's, Colombia's National government has encouraged the expansion of oil palm. Several measures have been adopted to promote this crop, and the associated palm oil production, including tax exemptions, credit lines and investment in crop's R&D[15]. Uribe's administration has been

[12] See Ibáñez and Velásquez (2006) for a complete description and analysis on the procedure for registration of internally displaced persons in Colombia.

[13] The competitive prices of palm oil are in part explained by the fact that oil palm oil has the largest productivity among oil seeds crops.

[14] http://ecocrop.fao.org/ecocrop/srv/en/cropView?id=972

[15] El Zar del Agro (The agro czar), article in El Espectador newspaper by Norbey Quevedo

particularly supportive of the expansion of this crop since, in his own words, "the country has in the African palm a huge possibility for economic growth, employment creation, rural participation, access to social security, and it is a very important alternative energy"[16]. In his speeches, he often refers to the oil palm as the best way to enhance rural development and one of the most desirable substitutes for illicit crops, and he has repeatedly urged producers to increase the planted area. The president also passed a law that requires the diesel fuel used in the country to be composed of biodiesel, at least in a 5% starting in January 2008[17], which can be extracted from palm oil. Uribe's critics argue that his support for the palm sector is explained by the fact that palm producers have contributed financially for his presidential campaigns[18].

Oil palm producers have responded to this package of incentives by increasing plantation and production. As a result, oil palm cultivation has dramatically increased in Colombia in the last decade. The planted area almost doubled in a period of five years, going from 160.000 hectares in 2001 to 316.000 in 2007[19]. In 2008, Colombia was the fifth oil palm producer in the world after Indonesia, Malaysia, Thailand and Nigeria, and the first one in Latin America.

Oil palm cultivation has benefited certain regions by providing job opportunities for peasants and by improving infrastructure. At the same time, there has been an increasing concern among NGOs, civil society organizations and the United Nations High Commissioner for Refugees (UNHCR), about the link between African oil palm plantations and forced displacement. There is mounting anecdotical evidence of how areas, previously occupied by peasants who were forced to migrate, become often part of oil palm plantations. The link between paramilitaries and oil palm companies has been largely evoked in the national and international media[20] and by some international organizations[21].

Specially vulnerable to land expropriation are the Afro-descendants and indigenous communities. After decades of struggle, these groups were finally recognized such as ethnic minorities by the Constitution in 1991. The law 70 of 1993 implemented some of the directives of the Constitution and assign legal collective property rights to black communities that traditionally inhabited the Pacific Coast. The aim of giving these lands to ancestral occupants was to assure their survival and to protect their culture and identity. Lands given by this law could not be sold or transferred and were to remain under the administration of 'community councils', who were the only ones empowered to make decisions regarding these territories. The application of this law has proven difficult in

H., 16/06/2007.

[16] President's Uribe speech during the XXXII National Congress of Oil Palm Producers, Santa Marta, 03/06/2004.

[17] Ministry of Environment, Housing, and Territorial Development and Ministry of Mines and Energy, Administrative Acts N. 1180 of 2006 and 180782 of 2007.

[18] El Zar del Agro (The agro czar), article in El Espectador newspaper by Norbey Quevedo H., 16/06/2007.

[19] Fedepalma, available at http://www.fedepalma.org/documen/2008/area_cultivada.pdf

[20] See for instance the article "If Colombia Is Winning Its War, Why the Fleeing?" by John Otis, Time Magazine, 01/09/2009.

[21] See ACNUR (2005), Mingorance (2006).

several cases because of the use of violence by illegal armed groups and the lack of government's intervention.

Consider for instance the case of the Jiguamiando and Curvaradó rivers, in the Chocó state, that has been extensively documented, among others, by the The National Ombudsman Office and the Inter-American Commission of Human Rights (CIDH). Starting in February 1997, several episodes of violence triggered the displacement of more 15.000 members of afrocolombian communities. They sought refugee in nearby towns but continued to be harassed and victimized by paramilitary forces. In 2001 some companies started to establish oil palm plantations in the lands owned and previously occupied by these communities. These companies also received governments loans using the appropriated lands as collateral. After a long process of denunciations and investigations by several institutions, the national government recognized in 2006 that only 8.000 hectares, out of 33.000 that were planted with oil palm, were lawfully acquired. The difference, 25.000 hectares, had been appropriated by illegal means.

Goebertus (2008) discusses the case of the municipality of Zona Bananera, in the Magdalena state where, by the use of violence, peasants were forced to move to more urbanized areas. When some of them returned to check up on their land, they found out it was fenced off and occupied by oil palm plantations. Similar situations have been reported in the Montes de Maria region[22], in Las Pavas[23] (Bolivar state), and in Puerto Wilches (Santander state)[24]. A detailed description of the human rights violations associated to oil palm in Colombia can be found in Mingorance (2006).

3 The model

We consider a two stage game with two players: peasants endowed with land and labor, and an agent R, not endowed with land nor labor, but with access to working capital to transform an agricultural good and commercialize it in the national or international markets. We assume that, in the context of a civil conflict, both players operate in an isolated region, far from cities and markets, and where the lack of government presence allows an illegal armed group to control the territory and exert the monopoly on violence. Besides subsistence agriculture, there are two possible crops to grow in this area: one of them is illegal, such as coca, and the other one is legal, such as oil palm; for simplicity we assume only one crop is cultivated per region. The crop yields are processed and sold afterwards by agent R who counts with the support of and acts in coordination with the illegal actor that controls the region.

[22] Masiva compra de tierras a víctimas en Montes de María y Catatumbo (Massive land adquisition in Montes de Maria and Catatumbo), article in El Tiempo newspaper (Colombia) 30/03/2009.

[23] Más de 120 familias del sur de Bolívar están en litigio con la familia samaria Dávila Abondano (More than 120 families in litigation with the Dávila Abondano family from Santa Marta), article appeared in Cambio Magazine (Colombia), 07/10/2009.

[24] Davila (2007)

The timing of the model is as follows: in the first stage, agent R decides whether to undertake himself the production of the crop or to buy the agricultural input (or raw material) from several peasants. In the first case he steals the land from peasants[25] who become IDPs; in the second case he acts as a monopsonist and sets the price for the input he buys. In the second stage, the decisions regarding output are made and production takes place: if peasants were not forced to migrate, they decide the optimal quantity of labor (own as well as hired labor) devoted to grow the crop; if they were evicted from their lands, it is agent R who decides the amount of labor to hire. The game is solved by backward induction: the second stage is studied first, then the agent's decision in the first stage is analyzed taken as given the choices made in the second stage.

3.1 Second stage: how much to produce

3.1.1 Peasants

At the beginning of the game land is distributed among N homogenous peasants. We assume land has no alternative use other than growing the cash crop. They are also endowed with certain amount of time that they can devote to grow a crop in their land or to work outside the farm. We assume peasants lack the infrastructure or resources necessary to independently transform or commercialize their production, so they can only grow the crop that agent R is willing to buy. We assume there is a perfectly competitive labor market where labor units are hired at a given price w.

Formally, consider a unitary household endowed with one unit of time and one unit of land. Peasants devote a fraction l of their time to work in their own land and $(1-l)$ to work outside his farm for a wage w[26]. Total production is denoted Y_j. Throughout this chapter, the subscript j stands for the type of crop: for illegal crops $j=i$ while for legal crops $j=l$. The technology of production is represented by a Cobb Douglas function that entails the use of land h and total labor which is the sum of own labor l and hired (outside) labor L. Notice that the production technology exhibits constant returns to scale since the sum of the exponents is equal to one.

$$Y_j = h^{\alpha_j}(l+\theta L)^{1-\alpha_j} \tag{1}$$

Following Eswaran and Kotwal (1986), we assume that outside work is less productive than peasant's own labor which reflects the generalized idea that, due to the moral hazard problem, hired workers have incentives to shirk. In particular, we assume that one unit of off-farm labor is θ times as productive as one unit of peasant's labor with $0<\theta<1$. Eswaran and Kotwal (1986) introduce the same idea in a slightly different way. They assume that, in order

[25] As we will show later, when agent R decides to appropriate peasant's land it evicts all peasants from the region.

[26] More generally, the fraction $(1-l)$ can be interpreted as the time devoted to any other activities inside or outside his farm, such as leisure, cattle farming, etc.

to be as efficient as own labor, hired labor needs to be supervised. Therefore, the total cost of hired labor is the wage paid plus the opportunity cost of the peasant's own time devoted to supervision. The bottom line is in any case that outside labor is an imperfect substitute for peasants' labor.

Regarding the intensity in the input use, we assume $\alpha_l > \alpha_i$ which means that the legal crop uses land more intensively than the illegal one, or, in other words, that the illegal crop is more labor intensive. Sanabria (1993) reports that for the coca crops the labor requirements during the operation phase[27] amount to 218 person-days per hectare per year (pd/ha/yr), while for Posada and Mejia coca leaf harvesting may require up to 300 pd/ha/yr. On the other hand, Ginoga et al. (1993) find that during the same phase oil palm requires 83 pd/ha/yr and Papenfus (2002) finds a close figure of 85 pd/ha/yr for oil palm. For the sake of comparison, in this last study it is estimated that rubber needs 157 pd/ha/yr for the operation phase.

We assume that the agricultural output (that agent R uses as a raw material or input) is bought at a price P_j (set by agent R at the first stage) that for now will be taken as given. Peasants obtain utility from the sale of total output Y_j at price P_j and from the fraction of time $(1-l)$ sold in the labor market; and they have to pay the total cost of hired labor wL. The peasant's optimization problem boils down to:

$$\underset{l,L}{Max} \qquad P_j Y_j - wL + (1-l)w \tag{2}$$

$$s.t.\ L \geq 0,\ l \geq 0, 1-l \geq 0$$

where

$$Y_j = h^{\alpha_j}(l+\theta L)^{1-\alpha_j}$$

The optimal time allocation for the peasant (l) and the optimal amount of hired labor (L) are obtained from the standard Kuhn-Tucker conditions[28]. Depending on the parameters values, three cases are possible: the peasants uses only part of his own labor for production ($0 < l < 1$ and $L = 0$), the peasant uses all his labor allocation for production but does not hire external labor ($l = 1$ and $L = 0$) and the peasant uses all his labor and hires outside labor ($l = 1$ and $L > 0$). Figure 1 represents the peasant's equilibrum for different values of $P_{j.}$ The downward-sloping curves represent the value of the marginal product of labor ($P_{j.}(MPl)$). A higher price $P_{j.}$moves the curve towards the north-east. For low values of $P_{j.}$ the peasant uses only his own labor and the marginal cost from using his labor is w. For for large values of $P_{j.}$, the peasant also hires labor. Since hired labor is less productive, the associated marginal cost is w/θ (with $\theta < 1$). There is a subset of intermediate values of $P_{j.}$ at which the peasant uses all his labor but $P_{j.}$ is not sufficiently high to hire labor at cost w/θ.

Replacing the values of l and L in the production function (1) we obtain the peasants' supply function (see the Appendix for calculations):

[27] The establishement period includes land cleaning and preparation, and planting while the operational phase covers weeding and harvesting, among others.

[28] See the Appendix for calculations.

$$Y_j = \begin{cases} h\left(\frac{P_j(1-\alpha_j)}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} & \text{if } P_j \leq \frac{w}{h^{\alpha_j}(1-\alpha_j)} \\ h^{\alpha_j} & \text{if } \frac{w}{h^{\alpha_j}(1-\alpha_j)} < P_j \leq \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)} \\ h\left(\frac{\theta P_j(1-\alpha_j)}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} & \text{if } P_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)} \end{cases} \quad (3)$$

It can be seen from this supply function that a low price for the production (P_j), a larger wage (w), a smaller plot size (h) and a more land- intensive (α_j) type of crop, make it more likely that the peasants find it optimal not to hire outside labor but to use only own labor. Figure 2 represents the supply function for different values of P_j.

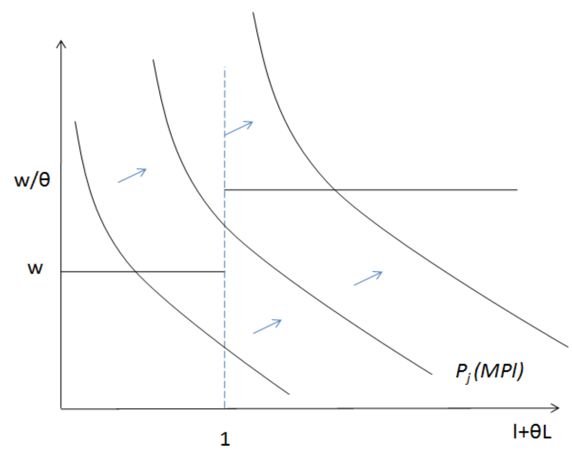

Figure 1: Peasant's equilibrium for different values of P_j

As stated before, peasants grow either a legal or an illegal crop. The peasant's optimization problem is the same for both crops, except for a fundamental difference related to the government's policy for detection and eradication of illicit crops. While legal crops can be cultivated in large-scale plots, illegal crops are easier to detect and eradicate the larger they are. As mentioned in the previous section, the most common strategy for illicit crops eradication, aerial spraying, is specifically targeted at "industrial-scale" plantations (i.e. those larger then 3 hectares). According to the Coca Survey for 2008 from the UNODC "... as a result of government pressure, coca fields are becoming more dispersed and smaller and, therefore, harder to tend, resulting in lower yields". It can be inferred then that there is a restriction on the plot size for coca cultivation. We incorporate this idea in the model by assuming that coca plots larger than a certain threshold $\widetilde{h}$ are detected and eradicated for sure, in which case there is no production at all. On the opposite, if the plot is smaller or equal than $\widetilde{h}$, it is never detected. Therefore the probability of detection is

$$pr(\widetilde{h}) = \begin{cases} 1 \text{ if } h > \widetilde{h} \\ 0 \text{ if } h \leq \widetilde{h} \end{cases} \tag{4}$$

The value $\widetilde{h}$ could be interpreted as the strength of the government detection and eradication efforts: if the government spends more resources on detection and eradication then $\widetilde{h}$ becomes smaller and the maximum feasible plot size is reduced. We assume that $\widetilde{h} < 1$ which implies that peasants growing coca can only use a fraction of their land endowment for the cash crop. The probability function in (4) is rather extreme, however it greatly simplifies the analysis. An alternative, and more realistic, way to model the probability of detection and eradication is to assume it is an increasing and continuous function on the plot size h. Even with this specification the main results of the model would not be altered.

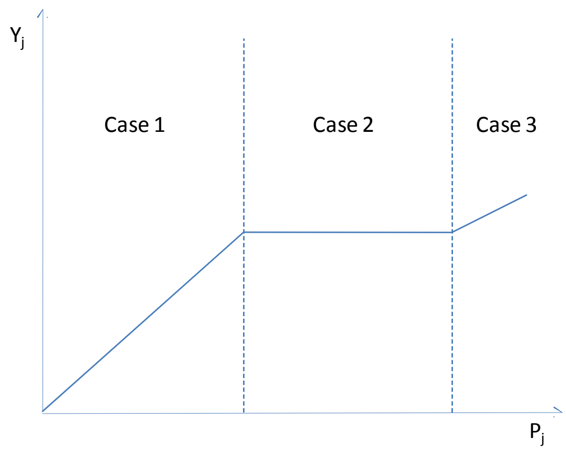

Figure 2: Peasant's supply function

In order to keep the model as simple as possible, we do not consider the effects of credit constraints on production decisions. As discussed by Eswaran and Kotwal (1986), access to credit is closely linked to the possibility to offer collateral. We implicitly assume that, since peasants are endowed with land, this is not a relevant issue for them. Anand (2004) presents an interesting discussion about the effects of access to credit in the peasants' choice between legal and illegal crops in Afganisthan. The idea is that farmers who would otherwise be credit constrained, are able to obtain advances from narco-usurers as long as they decide to grow opium. It is suggested then that guaranteeing access to credit should be a key concern in the design of illicit crop substitution and eradication programs.

3.1.2 Agent R

As stated above, agent R is not endowed with neither land nor labor but has access to working capital. Moreover, we assume he has the support of the illegal armed actor that controls the region. As stated by a United Nations High Commissioner for Refugees (UNHCR) report: " The paramilitary groups ... have in some areas maintained alliances with different economic sectors, and at the same time have deprived thousands of peasants, who became IDPs, of their property rights"[29]. Paramilitaries have been reported to support oil palm companies, while both the guerrillas and paramilitaries protect the drug business that, as stated in section (2), provides them with a significant source of income.

The idea behind this model is that agent R can use the services of the armed group (the monopolist of violence) to threaten or terrorize peasants so as to make them abandon their lands. In reality, it is probably the case that the armed group receives a compensation (maybe a share of profits) for exercising violence on farmers[30]. Nevertheless, for simplicity, we assume in this set up that the illegal group provides these services at zero cost for the agent. Actually when this is the case, agent R decides to displace all peasants in the region. If, for instance, there was a positive cost of displacement per peasant, the agent would no longer decide to displace all peasants, but would choose to evict some of them, up to the point where the marginal cost of displacement equals its marginal gain in terms of profits.

Agent R transforms the agricultural output, that he buys or produces, and sells it at a price q_j which is assumed to be exogenous[31]. In the case of coca for instance, leaves undergo a chemical process that transform them into coca paste which is in turn transformed in coca base. In the case of African palm, fruits are processed in mills so as to extract oils. In order to keep the model as simple as possible, we assume a one to one transformation technology. In other words, one unit of the agricultural good is transformed into one unit of the processed good. Moreover, we assume this transformation is costless.

The agent maximizes his profits Π_j^r where the superscript r denotes the case when agent R is producing, then he solves the following problem:

$$\underset{L}{Max} \quad \Pi_j^r = N\left(q_j Y_j - wL\right) \tag{5}$$

where

$$Y_j = h^{\alpha_j}(\theta L)^{1-\alpha_j}$$

The optimal amount of labor per farm hired by the agent in this case is

$$L_j^r = \frac{1}{\theta}\left(\frac{(1-\alpha_j)hq_j\theta}{w}\right)^{\frac{1}{\alpha_j}}$$

[29] ACNUR (2005)

[30] See for instance Thoumi (2002) and Diaz and Sanchez (2004).

[31] We assume agent R is price taker with respect to q_j, which means he does not have market power on the processed good. This assumption is not necessary for my results but simplifies the analysis.

Replacing L_j^r in Y_j we obtain the following supply function per farm when the agent is a producer:

$$Y_j^r = h\left(\frac{(1-\alpha_j)\theta q_j}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}}$$

In the case the agent R decides to produce himself the illegal crop, he is constrained by the same restriction (4) the peasant faces. Then the maximum plot size is $\widetilde{h}$ while for the legal crop is 1. Replacing L_i^m in agent's R profit function we obtain the maximum profit function for the illegal and the legal production respectively:

$$\Pi_i^r = N\left(q_i^{\frac{1}{\alpha_i}}\widetilde{h}\left(\frac{\theta}{w}\right)^{\frac{1-\alpha_i}{\alpha_i}}\left((1-\alpha_i)^{\frac{1-\alpha_i}{\alpha_i}} - (1-\alpha_i)^{\frac{1}{\alpha_i}}\right)\right) \tag{6}$$

$$\Pi_l^r = N\left(q_l^{\frac{1}{\alpha_l}}\left(\frac{\theta}{w}\right)^{\frac{1-\alpha_l}{\alpha_l}}\left((1-\alpha_l)^{\frac{1-\alpha_l}{\alpha_l}} - (1-\alpha_l)^{\frac{1}{\alpha_l}}\right)\right) \tag{7}$$

3.2 First stage: who is the producer

In the first stage, the agent decides who is in charge of production. In order to do so, he compares his maximum profits when is a producer to those when he buys the input. In the latter case, agent R buys the raw material from N peasants, and behaves as a monopsonist since he is the only possible buyer for the peasants' output. He must choose the optimal P_j so as to maximize his profits, then his problem writes:

$$\underset{P}{Max} \quad \Pi_j^m = N(q_j - P_j)Y_j \tag{8}$$

where Y_j corresponds to the supply function given in (3) and the superscript m stands for monopsonist. Solving this profit we find that the optimal price p_j^m is:

$$p_j^m = \begin{cases} (1-\alpha_j)\, q_j & \text{if } q_j < \frac{w}{h^{\alpha_j}(1-\alpha_j)^2} & \text{(case 1)} \\ \frac{w}{h^{\alpha_j}(1-\alpha_j)} & \text{if } \frac{w}{h^{\alpha_j}(1-\alpha_j)^2} < q_j < \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2} & \text{(case 2)} \\ (1-\alpha)\, q_j & \text{if } q_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2} & \text{(case 3)} \end{cases}$$

The optimal monopsonistic price p_j^m depends on the values of q_j, w, h and α_j. For further reference, the situation in which q_j is lower than $\frac{w}{h^{\alpha_j}(1-\alpha_j)^2}$ (which corresponds to the first line in p_j^m) will be called case 1. We will refer to case 2 when $\frac{w}{h^{\alpha_j}(1-\alpha_j)^2} < q_j < \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2}$ (second line in p_j^m), and to case 3 when $q_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2}$ (third line in p_j^m).

Replacing p_j^m in (3) and subsequently Y_j in (8) we obtain the agent's maximum profit function when he acts as a monopsonist:

$$\Pi_j^m = \begin{cases} Nhq_j^{\frac{1}{\alpha_j}} \left(\frac{1}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \alpha_j \left(1-\alpha_j\right)^{2\left(\frac{1-\alpha_j}{\alpha_j}\right)} & \text{if } q_j < \frac{w}{h^{\alpha_j}(1-\alpha_j)^2} \\ N(q_j - \frac{w}{h^{\alpha_j}(1-\alpha_j)})(h^{\alpha_j}) & \text{if } \frac{w}{h^{\alpha_j}(1-\alpha_j)^2} < q_j < \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2} \\ Nhq_j^{\frac{1}{\alpha_j}} \left(\frac{\theta}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \alpha_j \left(1-\alpha_j\right)^{2\left(\frac{1-\alpha_j}{\alpha_j}\right)} & \text{if } q_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2} \end{cases} \tag{9}$$

Agent R compares the maximum profit functions when he is a producer Π_i^r, given by (6) in the case of the illegal crop, and by (7) for the legal crop, to the profits when he acts as a monopsonist Π_j^m, given by (9). If the latter are greater than the former ($\Pi_j^m \geq \Pi_i^r$), then agent R finds it optimal to buy the raw material from peasants, and therefore, not to displace population. Below we analyze this conditions under which this is the optimal choice for each of the three cases mentioned before.

In case 1 ($q_j < \frac{w}{h^{\alpha_j}(1-\alpha_j)^2}$) agent R will find it optimal not to displace peasants if his profits when he buying, given by 9, are larger than when producing himself, given by 6 or 7:

$$Nq_j^{\frac{1}{\alpha_j}} h \left(\frac{1}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \alpha_j \left(1-\alpha_j\right)^{2\left(\frac{1-\alpha_j}{\alpha_j}\right)} >$$
$$Nq_j^{\frac{1}{\alpha_j}} h \left(\frac{\theta}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \left(\left(1-\alpha_j\right)^{\frac{1-\alpha_j}{\alpha_j}} - \left(1-\alpha_j\right)^{\frac{1}{\alpha_j}}\right)$$

which yields

$$z\left(\theta, \alpha_j\right) = \theta^{\frac{1-\alpha_j}{\alpha_j}} - \frac{1}{1-\alpha_j}\left(1-\alpha_j\right)^{\frac{1}{\alpha_j}} \leq 0 \tag{10}$$

The solid line in Figure 3 represents the values for which $z\left(\theta, \alpha_j\right) = 0$. The combinations of parameters that lie below the line are those for which $z\left(\theta, \alpha_j\right) < 0$, which implies that condition (10) is verified, that is to say that production is assigned to peasants and there are no IDPs. On the opposite, for all the combinations of parameters that lie above the line, agent R finds it optimal to undertake the production himself and therefore to generate forced displacement. It should be noticed that this condition does not depend on the price q_j, which means that it holds for the entire case 1. As can be seen from Figure 3, lower values of α_j (a more labor intensive production function) and of θ (a less productive hired labor) are more likely to verify condition (10).

In case 3 ($q_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2}$) agent R decides to carry on production himself

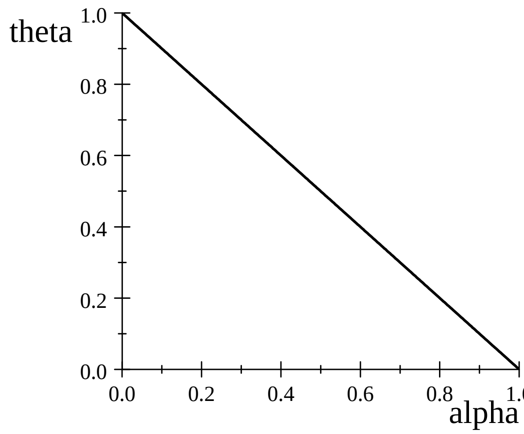

Figure 3: Condition for displacement

if his profits are larger than when he buys:

$$Nq_j^{\frac{1}{\alpha_j}} h \left(\frac{\theta}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \left((1-\alpha_j)^{\frac{1-\alpha_j}{\alpha_j}} - (1-\alpha_j)^{\frac{1}{\alpha_j}}\right) > Nhq_j^{\frac{1}{\alpha_j}} \left(\frac{\theta}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \alpha_j \left(1-\alpha_j\right)^{2\left(\frac{1-\alpha_j}{\alpha_j}\right)}$$

which yields

$$(1-\alpha_j)^{\frac{1-\alpha_j}{\alpha_j}} < 1$$

which is always the case since $0 < \alpha_j < 1$. Therefore, in case 3, it is always convenient for agent R to displace peasants and undertake the production himself, no matter the type of crop considered. The reason is that the initial efficiency gains obtained from using a more productive type of labor (by assigning production to the peasant), are exhausted for larger levels of production. Therefore, agent R finds it optimal to produce himself.

In case 2 ($\frac{w}{h^{\alpha_j}(1-\alpha_j)^2} < q_j < \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2}$) condition (10) is also sufficient to have an interval in which it is still profitable to displace peasants. Since we know that agent R always displaces population in the third case, there is a point in the second interval at which the agent is indifferent between producing himself and given the production to the peasants. This point is given by:

$$q - \frac{w}{(1-\alpha_j)h^{\alpha_j}} = h^{1-\alpha_j} q^{\frac{1}{\alpha_j}} \left(\frac{\theta}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} \left((1-\alpha_j)^{\frac{1-\alpha_j}{\alpha_j}} - (1-\alpha_j)^{\frac{1}{\alpha_j}}\right)$$

As the price goes up, the efficiency gains obtained from assigning the production to peasants are reduced, and they are completely exhausted when all the peasant's labor is used ($l = 1$).

4 Model's Results

To summarize, we have found that when case 1 occurs, it is optimal for the agent to buy the good from the peasants if condition (10) holds, and to have forced migration otherwise. In case 3 it is always optimal to evict peasants from their lands. If condition (10) holds, at some point in case 2, the agent is indifferent between the two choices. The previous findings yield the following propositions.

Proposition 1 *under both the legal and illegal crop production, it is more likely that agent R generates forced displacement when the difference in efficiency between hired and peasant's labor is relatively small (high values of θ).*

The intuition behind this proposition is that the agent's incentives to give production to peasants are stronger the larger the difference between own and hired labor. If peasants are significantly more productive than off farm labor (low θ), the agent is willing to give production to peasant because there is a large efficiency gain in doing so. On the opposite, if the moral hazard problem is not significant and hired hands are almost as productive as peasant's labor (high θ) the efficiency gain of leaving production to peasants is small, thus agent R has more incentives to appropriate their lands.

Proposition 2 *under both the legal and illegal crop production, it is more likely that agent R generates forced displacement when the wage (w) is low and when the plot size (h) or the price of the processed good (q_j) are large.*

Condition (9) implies that, for a given crop, case 3 is more likely to occur for lower levels of wages. The intuition is that when w is small agent R has less incentives to assign production to peasants (which occurs in case 1) because labor costs are smaller and therefore the efficiency gains from assigning production to peasants are less important. In other words, he has more incentives to evict peasants from their lands and cultivate himself when the labor costs are not high.

From condition (9) it is also possible to state that a larger plot size (h) increases the probability that case 3 occurs. Remember that h stands for the size of the plot devoted to the crop; in the case of the legal crop $h = 1$ while for the illegal crop $h = \widetilde{h} < 1$. If the government' efforts in detection of illicit crops increase, and this reduces the threshold value $\widetilde{h}$ such that the crop is not detected, then it is more likely the agent finds it optimal to assign production to peasants rather than to displace them.

A higher price (q_j) makes case 3 more likely. The reason is that since peasants' labor endowment is limited to 1, the efficiency gains from assigning production to them are exhausted for larger plot sizes or for higher prices. This in turn provides more incentives for the agent to undertake production which occurs in case 3. Consider, for instance, a measure that increases palm oil demand, like the one adopted by the Colombian government with respect to biofuels and described in section 2. According to our model, the price rise which is expected to follow the growth in demand would worsen the situation in terms of forced migration for the legal crop.

If coca price is believed to be particularly high, case 3 would become more likely for the illegal crop. Nevertheless we argue this is not the case, that is to say that the actual price for the illegal crop is not very high, for three main reasons. First of all, it is true that cocaine prices in the retail market of consumer countries are very high. Nonetheless coca leaf, whose prices "between 2005 and 2008 remained relatively stable at an average of $1,10 US/kg"[32], represents a negligible percentage of the cost of producing cocaine. Mejia and Posada estimate that a kilogram of cocaine is sold at US$ 150.000 (retailed price in the U.S. for average purity), while the cost of the coca leaf required to produce it, ranges between US$ 300 and US$ 500 in the producer country. Keefer et al. (2008), find close figures: they estimate that the coca leaf necessary to produce one kilo of cocaine costs US$ 370 (farm gate prices in Peru) while that kilo of cocaine sold in the retail market of a large city in the US represents US$ 148.000.

On the other hand and more importantly, given that there is a non negligible probability of loosing the entire coca crop due to the government's eradication campaigns, coca leaf prices should be interpreted as expected rather than as actual prices. In other words, even if coca leaf is paid at a higher price than other cash crops, it is also true that it is a riskier business. Besides the inherent risk associated to agricultural production (climate, plagues, diseases, etc.), the coca producer (the peasant or the agent) faces the possibility of ending up with no income at all if an eradication campaign takes place in the region and destroys crops. The Coca Survey 2008 estimates that the annual potential gross income of coca leaf production was US$ 4.260 per hectare. A cooperative of peasant families growing oil palm reported average annual net income of around US$ 2.400 per hectare in the same year[33]. Comparisons are unfortunately not straightforward given that we have estimates on net income for oil palm and on gross income for coca. Nevertheless, as suggested before, the income from coca should be interpreted as an expected income, in the sense that there is a positive probability of loosing completely the crop due to the detection and eradication campaigns from the government. Then, even if coca had a relative high price, the fact that there is an addittional risk associated to this crop, would decrease the total expected income. This would in turn reduce the gap between profits from the legal and the illegal crop.

Finally, the government's interdiction efforts, or an increase in the borders' surveillance, are also likely to reduce coca leaf prices. The Coca Survey 2008 states that "in general, it was observed that repressive interventions of the national army have a significant decreasing impact on the prices".

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[32] UNODC (2008)

[33] Desplazados y productivos (Displaced and productive), article in El espectador newspaper (Colombia), 18/02/2008.

Proposition 3 *for a given value of θ, it is more likely to observe forced displacement with legal than illegal crops since $\alpha_l > \alpha_i$ and $\widetilde{h} < 1$.*

As can be seen from figure 3, for the same θ, larger values of α imply that forced displacement is more likely to occur. The intuition is that for a certain level of moral hazard problem (θ) the efficiency gains of allowing peasants to produce are more important, the more labor intensive the production technology is. When the production function is less labor intensive (higher α), the efficiency gains of allowing peasants to cultivate are less important and therefore agent R has more incentives to produce himself and to generate forced displacement.

Since the plot size for illicit crops is smaller than for legal crops $\left(\widetilde{h} < 1\right)$, it is more likely that case 3 occurs $\left(q_j > \frac{w}{\theta h^{\alpha_j}(1-\alpha_j)^2}\right)$, everything else equal, for legal crops. Therefore, the more active the government is in the antidrug war, the smaller the plots in which coca can be cultivated, and the larger the efficiency gains from using peasant's own labor. This in turn reduces the agent's incentives to displace population.

Proposition 4 *a subsidy to the production of oil palm is likely to increase the number of forced migrants.*

As explained in section (2) the Colombian government has adopted several measures to support the oil palm expansion. For instance, it recently implemented a program to lease machinery to oil palm companies at prices below the market level. In our model, we could interpret this as an increase in the price (q_l) perceived by palm growers. A larger price makes case 3 more likely and therefore increases the probability that the agent finds it more convenient to displace peasants.

5 The effects of Positive fixed costs

We now discuss briefly the implications of the inclusion of fixed set up costs per farm (K_j) in the model. Compared to the model without fixed cost, the existence of these set up costs generates two effects for both the legal and the illegal crop. First of all, if the fixed costs are high enough, it might be the case that it is no longer profitable for peasants, for the agent or for both to produce. If peasants were, for instance, unable to produce due to large fixed costs, agent R would have to undertake himself the production, and therefore evict peasants from their lands. This is more likely to be the case for oil palm since this crop is characterized by large fixed set up costs[34]. The second effect is that, by not displacing population, agent R can save up the fixed costs and therefore the existence of these costs provides him with more incentives not to displace population.

[34] According to Fedepalma, fixed cost amount to almost half of the total cost of production of oil palm fruit. On the contraty, Mansfiel (1999) reports that for coca labor costs represent between 64% and 92%.

Actually, with set up costs, agent R would find it optimal not to displace population when the following condition holds:

$$\left(\theta^{\frac{1-\alpha_j}{\alpha_j}} - \frac{1}{1-\alpha_j}\left(1-\alpha_j\right)^{\frac{1}{\alpha_j}}\right) \leq \frac{w^{\frac{1-\alpha_j}{\alpha_j}}}{hq^{\frac{1}{\alpha_j}}} K_j \tag{11}$$

The difference between condition (11) and condition (10) is that, with fixed costs, the number in the right hand side of the equation (11) is positive instead of zero. Therefore, condition (10) continues to be a sufficient condition for no displacement but it is no longer necessary. The dashed line in Figure 4 corresponds to the case when condition (11) holds with equality, for all the combinations of parameter's values laying below the line, the agent decides not to displace. The solid line in Figure 4 still corresponds to condition (10). The area under the dashed line is larger than the area below the solid line. This confirms the intuition that with fixed set up costs, and as long as the peasant is still able to produce, agent R chooses not to displace for a larger range of parameters values. The dotted line in Figure 4 correspond to the case when condition (11) holds with equality, but for a larger value of K_j. With larger set up costs, the agent saves up even more by assigning production to peasants (as long as they are ablo to produce), therefore he has less incentives to displace population.

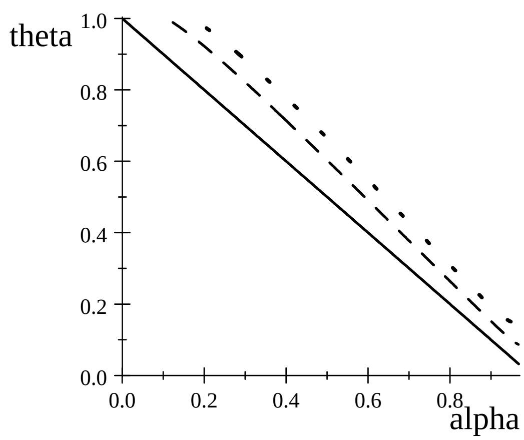

Figure 4: Condition for displacement with fixed costs

It is clear that for both types of crops, the agent has less incentives to displace. An interesting question that can be raised is for which kind of crop this effect is larger. The fixed set up costs needed for oil palm seem to be larger than those required by coca. For instance, according to Fedepalma, fixed cost amount to almost half of the total cost of production of oil palm fruit because the land needs to be prepared and irrigation systems need to be built. Coca producers instead do not incur considerable fixed costs. We introduce this idea by assuming $K_l \geq K_i$.

With set up costs per farm, the producers of both types of crops have incentives to produce in the largest possible scale per farm. When the agent himself produces oil palm, he prefers to produce in one large farm of size Nh, so he incurs in a total fixed cost K_l. An agent who produces coca would like to do the same, but the restriction imposed by the probability of detection and eradiction, given by equation (4), prevents him from doing so. Thus he produces in N farms of size h and incurs in a fixed cost of K_i per farm. This difference in the scale of production implies that, by assigning production to peasants, the oil palm producer saves K_l while the coca producers saves NK_i. If we assume the number of peasants is sufficiently large so that $K_l < NK_i$, then the savings in set up costs are larger for an agent producing coca compared to one producing oil palm. This would imply that, even though for both types of production there are less incentives to displace, this effect is probably stronger in the case of the illegal crops since the savings for the agent are larger.

6 Relation to the literature

This paper is related to the strand of the literature concerned with the causes of forced displacement in a context of civil conflict. Azam and Hoeffler (2002) propose a model in which forced displacement caused by the government plays a military role. The reason is that displacement diminishes the rebels' efficiency at fighting by making it harder to obtain support and hide. In this setting, no resources are obtained from violence. On the contrary, Azam (2002) considers a model where the aim of victimizing civilians is looting. The model presented here is in line with the latter, rather than with the former, view since violence is also used as a strategy to appropriate resources from peasants.

Azam (2006) analyzes the case of the population forced to migrate from the Niger Delta states. In his model, pollution reduces the productivity of farming, which in turn gives more incentives to civilians to devote to bunkering and other illegal activities. In order to reduce the level of illegal activities, which reduce its revenue, the government has the possibility of investing in preventing pollution or simply forcing population out from the region. The Nigerian government chose to displace civilians, but due to the violence inflicted on migrants in destination cities, they came back to the, already polluted, oil producing regions which generated an escalation in violence. Our example of legal crop, oil palm, shares with oil production a relative low labor intensity. Our results are in line with his, in the sense that an economic activity, characterized by a low labor-intensity, is likely to trigger forced displacement in the context of violent conflict, be it an exhaustible or a non exhaustible resource.

The micro-determinants of forced internal migration in Colombia are studied by Engel and Ibañez (2007) at the household level. They show empirically how the households' decision about migration, when faced to violence, is not only affected by security considerations, but is as well influenced by socioeconomic characteristics (age, education, etc), and estimate the determinants of the probability of being threaten by an armed actor. According to the authors, land size has two opposing effects in the migration decision. On the one hand, it increases the opportunity cost of migration, and therefore reduces the incentives to migrate. On the other hand, it increases the probability of being threaten, so it increases the motives for migration. They find that land owners are more likely to migrate the landless households, when facing high levels of violence. In this paper, we analyze the motives for forced displacement from a different and complementary perspective. Instead of focusing on the victims' (households) behavior, we study the victimizer's decision-making process about forcing peasants to migrate.

Oslender studies the causal relation between the oil palm expansion in the Colombian Pacific coast and the forced migration of black rural communities, from a geopolitical perspective. The author states that, by associating to outlaw groups, palm oil producers have managed to evict Afrocolombians from the collectively owned lands. Our paper shares the interpretation of the relation between oil palm and forced migration and provides a theoretical model to study this phenomenon.

The coca expansion and the antidrug war in Colombia have been extensively studied by authors such as Diaz and Sanchez (2004), Mejia and Restrepo (2008), Thoumi (2002), Angrist and Kugler (2005) and Grossman and Mejia (2008). Grossman and Mejia (2008), for instance, propose a theoretical model in which a state fights against drug producers in two fronts. On the one hand, they struggle over the control of arable land. On the other hand, the government devotes efforts to the eradication of illicit crops and the interdiction of drugs. There is a third party which employs 'the carrot and the stick' to reinforce the government's efforts in the fight against drug producers. They calibrate their model for the Colombian case and find that the money from the "Plan Colombia" in 2003 would have yielded better results in the war against drugs if more resources had been allocated to gaining control over arable land rather than to eradication and interdiction. In our set up, the role of the government is restricted to the detection and eradication strategies, that limit the maximum plot size for the illicit crops.

Finally, Guidolin and La Ferrara (2005) study the effects of civil war in the stock returns of diamond companies in Angola. They show empirically that the value of these companies fell, following the death of the rebels' leader that resulted in the end of the internal conflict. The authors interpret this result as a proof that these firms benefited from operating in a conflict environment, probably because of barriers to entry, reduced government's bargaining power and less transparent licensing procedures. Although in a completely different setting, in this paper we also suggest that it is possible for some firms to benefit from civil conflict in the sense that, by the use of violence, they can appropriate almost for free large extensions of land.

7 Concluding remarks

In this paper we provide a theoretical model to study the link between forced migration and certain types of crops. We analyze the production of two kinds of agricultural goods: a legal good whose production is intensive in land and an illegal good characterized by a labor intensive production function. We consider an agent who chooses between buying the agricultural good from peasants and producing it himself, in which case he generates forced internal migration in order to appropriate the land.

The results from our model indicate that, in the case of the illicit crop, it is more likely that the agent finds it optimal to buy the good from peasants. This is due to the fact that peasant's own labor is more productive than hired labor and that the illegal crop production needs to be carried out in small scale farms in order to avoid detection and eradication from the government. On the contrary, for the legal crop, it is more likely that the agent prefers to carry out production himself, and thus, to exert violence against peasants and force them out from their lands.

According to the model presented here, subsidizing land intensive crops, such as oil palm, might exacerbate the problem of forced displacement at least in the areas that lack a strong government's presence. This finding is particularly important given the mounting concerned about global warming and the generalized (although controversial) idea that agrifuels are preferable to fossil fuels in that respect[35]. The consequent increase in international demand for palm oil has boosted oil palm production in many countries, including Colombia. In the light of our results, the strong support given by the Colombian Government to oil palm expansion could be indirectly hurting its own civilians.

Our results also imply that, in the context of civil conflict, illicit crop's substitution programs can trigger violence against civilians and forced displacement. Therefore, careful attention should be paid to the design and implementation of such a programs.

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8 Appendix

In this section I provide the computation for the supply function of the peasants. For a given price P_j, the peasant solves the following problem

$$\underset{l,L}{Max} \quad P_jY_j - wL + (1-l)w - K_j$$

$$s.t.\ L \geq 0,\ l \geq 0, 1-l \geq 0$$

$$Y_j = h^{\alpha_j}(l+\theta L)^{1-\alpha_j}$$

I apply the Kuhn-Tucker conditions to solve this problem. The lagrangean is given by

$$L = \quad P_jY_j - wL + (1-l)w - K_j + \gamma L + \delta l + \lambda(1-l)$$

The first order conditions are

$$P_j(1-\alpha_j)\frac{h^{\alpha_j}}{(l+L\theta)^{\alpha_j}} + \delta - \lambda - w = 0 \tag{12}$$

$$P_j(1-\alpha_j)\theta\frac{h^{\alpha_j}}{(l+L\theta)^{\alpha_j}} + \gamma - w = 0 \tag{13}$$

$$L \geq 0,\ l \geq 0, 1-l \geq 0 \tag{14}$$

and the complementary slackness conditions are

$$\gamma\ L = 0 \tag{15}$$

$$\delta l = 0 \tag{16}$$

$$\lambda(1-l) = 0 \tag{17}$$

Conditions 12-17 define several cases to be analysed. Here I present only those relevant to the supply function.

- CASE 1: $\gamma > 0 \rightarrow \ L = 0,\ \ \delta = 0 \rightarrow l > 0,\ \ \lambda = 0 \rightarrow 1-l > 0$

  From 12 we have that

  $$\left(P_j(1-\alpha_j)\frac{h^{\alpha_j}}{w}\right)^{\frac{1}{\alpha_j}} = l \tag{18}$$

  Since $\lambda = 0$, then $l < 1$ so 18 is valid as long as

  $$P_j < \frac{w}{(1-\alpha_j)h^{\alpha_j}}$$

- CASE 2: $\gamma > 0 \rightarrow \; L = 0, \; \delta = 0 \rightarrow l > 0, \; \lambda > 0 \rightarrow 1 - l = 0$
  Since $\lambda > 0$ and $\gamma > 0$ then from condition 12 and 13 we have

$$\begin{aligned} \lambda &= P_j(1-\alpha_j)h^{\alpha_j} - w > 0 \\ \gamma &= w - P_j(1-\alpha_j)\theta h^{\alpha_j} > 0 \end{aligned}$$

  Then $L = 0$ and $l = 1$ if

$$\frac{w}{(1-\alpha_j)h^{\alpha_j}} < P_j < \frac{w}{\theta(1-\alpha_j)h^{\alpha_j}}$$

- CASE 3: $\gamma = 0 \rightarrow \; L > 0, \; \delta = 0 \rightarrow l > 0, \; \lambda > 0 \rightarrow 1 - l = 0$
  Since $\lambda > 0$ then $l = 1$. Using this in condition 13 we obtain

$$L = \frac{1}{\theta}\left(\left(P_j(1-\alpha_j)\theta\frac{h^{\alpha_j}}{w}\right)^{\frac{1}{\alpha_j}} - 1\right)$$

  given that $\gamma = 0$ then $L > 0$ so

$$P_j > \frac{w}{\theta(1-\alpha_j)h^{\alpha_j}}$$

Using the production function and results from cases one to three, we obtain

$$Y = \begin{cases} h\left(\frac{P_j(1-\alpha_j)}{w}\right)^{\frac{1-\alpha_j}{\alpha_j}} & \text{if } P_j < \frac{w}{(1-\alpha_j)h^{\alpha_j}} \\ h^{\alpha_j} & \text{if } \frac{w}{(1-\alpha_j)h^{\alpha_j}} < P_j < \frac{w}{\theta(1-\alpha_j)h^{\alpha_j}} \\ h\left(\frac{\theta P(1-\alpha_j)}{w}\right)^{\frac{1-\alpha_j}{\alpha}} & \text{if } P_j > \frac{w}{\theta(1-\alpha_j)h^{\alpha_j}} \end{cases}$$