World Development 162 (2023) 106130

Contents lists available at ScienceDirect

World Development

journal homepage: www.elsevier.com/locate/worlddev

Oiling up the field. Forced internal displacement and the expansion of palm oil in Colombia

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ARTICLE INFO

Article history:
Accepted 15 October 2022
Available online 18 November 2022

JEL:
D74
F14
O13
O15
Q17

Keywords:
Income shocks
Conflict
Commodity prices
Forced displacement

ABSTRACT

Widespread analysis of the link between natural resources and conflicts has shown how positive income shocks in agriculture usually reduce violence (opportunity cost effect), while positive shocks in extractive commodities intensify it (rapacity/lootability effect). However, recent works have found cases where positive income shocks in agriculture lead to more violence. We examine the expansion of palm oil in Colombia to document another case where higher expected profits in agriculture led to more violence. Furthermore, we explore the institutional framework that explains the direction of this effect. Using a difference-in-difference strategy, we find that a 1 log point increase in palm oil prices raises the forced internal displacement rate in palm municipalities by 0.42 standard deviations. We show evidence supporting the hypothesis that the need for new lands explained the violence linked to the palm expansion within a framework in which weak property rights and illegal institutions were predominant. Likewise, we shed light on how the institutional framework shapes the relationship between income shocks and conflict.

> *Thus, the paramilitary expansion project was guided by a logic of land accumulation for projects such as the planting of palm oil, a sector on the rise due to the development policy promoted by the State that promoted bio-fuels as a strategy of competitive insertion in the world market for the national economy . . .* (Centro Nacional de Memoria Histórica, 2015).

1. Introduction

Many academics have studied the ambiguous relationship between natural resources, income shocks, and civil conflict or violent crime. There are three main ways in which income shocks can increase or decrease violent conflict. First, there is the opportunity cost effect, when better labor markets from an income shock result in a higher opportunity cost of committing a crime or joining insurgency. Second, there is a rapacity effect, when positive price shocks increase the incentives to obtain a share of the unexpected additional income, intensifying the fight to control the resources linked to the price shock. In other words, the larger the prize, the greater the incentives to fight for it. Third, there is the lootability effect, when goods with a high value-to-weight ratio (for example, diamonds), can be plundered by armed groups to finance their activities.

There is plenty of evidence supporting the three hypotheses. Miguel, Satyanath, and Sergenti (2004), Brückner and Ciccone (2010), Dube and Vargas (2013), Hodler and Raschky (2014), Dube and García-Ponce (2016), Harari and La Ferrara (2018) show evidence of the opportunity cost, mostly studying agricultural commodities. Collier and Hoeffler (2004), Fearon (2005), Humphreys (2005), Dube and Vargas (2013), Idrobo, Mejía, and Tribin (2014), Lei and Michaels (2014), Berman, Couttenier, Rohner, and Thoenig (2017) show strong evidence supporting the rapacity effect, focusing in capital-intensive minerals such as gold and oil. Finally, Rigterink (2020) shows evidence supporting the lootability effect for the case of diamonds.[1]

In contrast, a new generation of papers documents cases where positive income shocks in agricultural commodities lead to more

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[1] Blair, Christensen, and Rudkin (2021) show robust evidence to support all three cases; the opportunity cost, rapacity, and lootability effect.

https://doi.org/10.1016/j.worlddev.2022.106130
0305-750X/

violent conflict (Crost & Felter, 2020; Bandiera, 2021). This paper joins this new branch by analyzing the relationship between African palm and violent conflict in Colombia. Specifically, we show that the positive income shock linked to the African palm led to an increase in forced internal displacement (FID) rates in palm-producing regions. Thus, we investigate the scope in which the presence of illegal armed groups (IAG) and weak property rights shape the palm market such that during its expansion, a land-grabbing rapacity effect superseded the traditional opportunity cost effect.

From 2002 international demand for palm oil increased sharply, pushing world prices. In addition, the Colombian government introduced multiple incentives to promote African palm cultivation as part of a policy to reduce coca cultivation and increase welfare levels in rural areas (Marin-Burgos, 2014; Grupo Semillas, 2010). As a result, from 2001 to 2017, African palm crops rose from 161,210 to 516,960 hectares (ha), a cumulative increase of 220%, and production rose from 544 to 1,627 thousand metric tons (tmt), a total increase of 199% (Fedepalma, 2018). By comparison, coffee production, the principal Colombian agricultural export, only grew 29% in the same period (Federación Nacional de Cafeteros de Colombia, 2021). Besides the economic benefits of the expansion of palm crops, multiple reports denounced an alliance between palm producers and right-wing paramilitary armies, which intensified violence in palm-producing regions (Ballvé, 2012; Centro Nacional de Memoria Histórica, 2015). This coalition aimed to allow palm producers to acquire new lands owned by small farmers, who were violently forced to leave their properties by IAG. Many authors like Goebertus (2008), Grupo Semillas (2010) and Gómez Sánchez-Ayala, and Vargas (2015) provide anecdotal evidence to document the existence, extent, and methods of this palm-producer-IAG alliance in palm-producing regions in Colombia. Furthermore, Hurtado, Pereira-Villa, and Villa (2017) and Maher (2015) describe some regional cases and estimate a positive relationship, possibly causal, between African palm cultivation and FID. However, to our knowledge, there is no systematic evidence of a causal effect between better conditions in the palm oil market and violent conflict in Colombia.

In this article, we test the hypothesis that in areas with palm crops, the income shock brought about by the rise in international demand for palm oil and the benefits offered by the national government created incentives for palm producers and IAG to use violence to drive out small farmers. To identify the causal effect of the palm income shock on FID rates, we use a difference-in-difference (DID) strategy in the fashion of Dube and Vargas (2013) and others. We combine exogenous time variation in international palm oil prices with the presence of African palm crops at the municipality level to estimate differential trends in FID rates in palm- and non-palm municipalities. In addition to municipality fixed effects that control for unobservable time-invariant characteristics, to deal with the fact that the decision to cultivate palm is endogenous, we define as treated municipalities those that already had African palm before the expansion, as these are more likely to be affected by the exogenous income shock.[2] Strictly speaking, our estimates capture changes in FID rates in municipalities where African palm crops were profitable before the expansion in response to an increase in the international price of palm.

Our results are conclusive. A one log point increase in international palm oil price led to an increase of 0.42 standard deviations (SD) in FID rates in palm-producing municipalities, relative to similar non-producing ones in the same region. According to our calculations, the price increase between 2002 and 2007 accounted for 73% of the differences in FID between municipalities with and without palm cultivation. What is more, we show that the effect of palm prices on FID rates took place (i) in areas with a strong right-wing paramilitary presence, (ii) before the paramilitary forces completed their demobilization process, (iii) where land was better distributed but where property rights were weaker, and (iv) in the period and areas in which the national government strongly supported palm production as a substitute for coca cultivation. Additionally, we show evidence that land distribution worsens in the regions where the estimated effect of palm prices on forced displacement was stronger. All these results suggest that the positive palm income shock only increased violence when legal institutions were replaced by illegal ones from the paramilitary armies, and in places where palm producers were able to acquire additional lands to benefit from the new market conditions. Our results and the mechanism we describe in this article corroborate the predictions made by the theoretical framework of Palacios (2012).

Our main contribution is to assess the extent to which the production function, the presence of IAG, and weak property rights shape how a positive income shock in agriculture can increase or decrease violent conflict. In our case, we do not deny the positive impact of better palm oil prices on labor market conditions. However, we found that the rapacity effect was more prominent. Given that the palm crop is capital-intensive (land-intensive) and has increasing returns to scale to land, higher expected returns gave a greater incentive to palm plantation owners to enlarge their total capacity (area for cultivation). In this work, we show that due to weak institutions and the presence of IAG, landowners opted to use violence to bring down the price of new lands in their region instead of paying the market price. Hence, in this case, when prices rise, the rapacity effect on additional land superseded the opportunity cost effect of better labor market conditions, thereby intensifying violence. Furthermore, in line with McGuirk and Burke (2020), factor control (land) seems to explain the increase in conflict.

We also contribute to the literature about the factors that explain FID, focusing on the long-lasting Colombian internal armed conflict. By 2018, internally displaced persons (IDP) accounted for more than 5.7 million, the second-largest figure worldwide, only behind Syria with 6.3 million IDP (Internal Displacement Monitoring Center, 2019). There is extensive literature about the causes of forced migration, where conflict and violence play a role (Kuhnt, 2019) see [for a review]. Most previous works place violence as a trigger or push factor in the decision to migrate, both within and between countries (Davenport & Moore, 2003; Engel & Ibáñez, 2007; Melander & Öberg, 2007; Ibáñez & Vélez, 2008; Dueñas, Palacios, & Zuluaga, 2014). However, our work adds the work of Ibáñez (2008) and Bandiera (2021) by pointing out FID as a strategy of palm producers and IAG to increase their profits and not only as a by-product of the political violence of the Colombian conflict.[3]

Finally, this article builds on the literature about land, property rights, and violent conflict (Cramer & Richards, 2011). For the case of Colombia, we complement the work by Grajales (2011, 2015), who studied the role paramilitary armies played in the relationship between land conflicts and violence in the country.

The closest article to our own is the study of Bandiera (2021) of banana cultivation, land grabbing, and FID in Colombia. Her work also shows how, in the case of bananas, another land-intensive crop, FID was used to gain access to cheap lands to increase banana cultivation and raise the profits of banana producers. Our work

[2] We follow works such as Angrist and Kugler (2008) and Miller and Urdinola (2010).

[3] We follow the definition of political violence of Besley and Persson (2011) and Bosi and Malthaner (2015).

complements her analysis and delves deeper into the required conditions and mechanisms under which the opportunity cost effect is weaker than the rapacity effect. Furthermore, our findings are similar to Kenny, Shrestha, and Aspinall (2020) in their recent work on the case of palm oil in Indonesia. However, the mechanisms underlying the increase in crime in their work and ours are different. They show evidence of a lootability effect, as illegal mafias increase extortion of rents from palm profits. Meanwhile, in our work IAG use violence to allow palm producers to acquire additional land, supporting the rapacity effect hypothesis.

This paper has the following structure. Section 2 describes the palm oil market in Colombia and the possible negative effects of its expansion throughout the 2000s. Section 3 describes our strategy and Section 4 the data we use. We show and discuss our results in Section 5 and Section 6 shows our conclusions.

2. Institutional context

2.1. African palm, palm oil, and its expansion in Colombia

African palm grows under specific conditions. First, it requires a median monthly temperature between 26 °C and 28 °C, with a minimum that does not fall below 21 °C. Second, annual precipitation should be between 1800 mm to 2300 mm. Third, the monthly average relative humidity should be around 75%. Finally, it grows below 500 meters above sea level (masl) (Info Agro, 2018). These features concentrate international palm oil production in a few tropical countries such as Indonesia, Malaysia, and Thailand. By 2013 these three countries represented 88% of total worldwide production.[4] Another distinctive feature of African palm is its production cycle. Progression from seedlings to production takes around 5 years, which implies that palm producers need large swathes of land in order to maintain regular, annual production (Info Agro, 2018). What is more, African palm has the largest yield per ha among natural oils, increasing the incentives to obtain extra lands when a positive income shock occurs.[5]

From the early 2000s, international production rose rapidly due to strong changes in demand such as the worldwide increase in consumption of natural oils and fuels. For instance, between 2000 and 2018, Indonesia's production increased from 8,300 to 41,500 tmt, and Malaysian production increased from 11,937 tmt to 20,800 tmt. In addition, domestic consumption in the US rose from 175 tmt to 1,501 tmt, while in China consumption rose from 2,028 tmt to 7,012 tmt over the same period.[6]

Colombia has also seen a substantial increase in production since 2002. In addition to the rise in international demand, the Colombian government has put a great effort into developing this market. As part of a strategy to reduce coca cultivation, the government gave palm producers subsidies, tax discounts, and preferential access to land, specifically in areas with coca cultivation (Grupo Semillas, 2010).[7] This rapid increase in cultivation and production from 2002 is what we refer to in this article as the "*Colombian palm oil expansion.*"

Fig. 1 shows the size of the expansion. By 2001, the total area cultivated was 161,000 ha, the total production was 544 tmt and only 68 municipalities were cultivating palm. By 2017, the total area cultivated covered 430,000 ha, total production reached 1627 tmt, and 124 municipalities were involved in the market (see panels A, B and C respectively). Fig. 1 also shows that market trends broke in 2002. Cultivation prior to 2002 grew at a rate of 4.5 thousand ha per year, while from 2002 the annual increase rate rose to an average of 23.3 thousand ha per year. The annual increase also doubled for total production and the number of municipalities involved. It is important to note that these changes were unique to the palm market as the agricultural sector as a whole only grew just 13.8% from 2002 to 2014 (SAC, 2018).

The expansion of African palm crops happened in different ways. In some areas, the government supported the creation of productive alliances between small farmers who joined large producers and owners of extraction plants. These alliances were more likely to receive government subsidies and credit, becoming a relevant component of the efforts to substitute coca crops with palm production. In other cases, palm producers took advantage of weak legal regimes to expand their crops by overtaking empty plots (sometimes left behind by displaced households), lands with unclear property rights, and public lands, or by changing the local regulation on the use of lands (Marin-Burgos, 2014).

It is worth noting again the role of the national government in the palm expansion. However, as noted by Goebertus (2008), "*the testimonies collected show that the institutional incentives created by the government for the exploitation of palm oil have not been accompanied by the necessary controls to prevent some producers, with the support of illegal armed groups, from causing the forced displacement of small farmers, in order to acquire land for the cultivation of oil palm.*"[8]

2.2. Problems linked to palm oil

The palm oil industry produces large positive returns for farmers, producers and even has an impact at national level. In 2016 for example, palm oil contributed USD 2.6 billion to the Colombian GDP (Fedepalma, 2018). However, there are some social costs associated with this market that have aroused the attention of academics and policy makers. Previous studies have described the link between the palm oil industry and environmental issues, labor market conflicts, and problems related to land property rights (Castiblanco, Etter, & Ramirez, 2015).

First, given that land is the main input in the African palm production function its expansion is strongly correlated with an increase in deforestation in palm-producing countries. By 2013 the crop expansion in Indonesia, Malaysia, and Papua New Guinea replaced 32% of their total area of secondary forests (Gunarso, Hartoyo, Agus, & Killeen, 2013). In Colombia, Fergusson, Romero, and Vargas (2014) documented the extent to which paramilitary expansion increased deforestation. Among the activities associated with the link between paramilitary armies and deforestation are coca crops, illegal mining and palm oil production.

Second, the production of palm oil has been linked with poor labor market conditions. In Indonesia and Malaysia, problems related to forced child labor are frequently featured in the media and reports from international agencies (e.g. Amnesty International, 2016). Additionally, McCarthy (2010) described how contracts between farmers and firms in Indonesia expose poor farmers in large numbers to economic insecurity, due to price volatility. In Latin America, Verité (2013) described similar issues, pointing to weak contracting and poor labor conditions in Guatemala. Nevertheless, a more systematic analysis by Kubitza et al. (2019) did not find evidence supporting the idea that the palm expansion amplified labor market inequality in Indonesia but

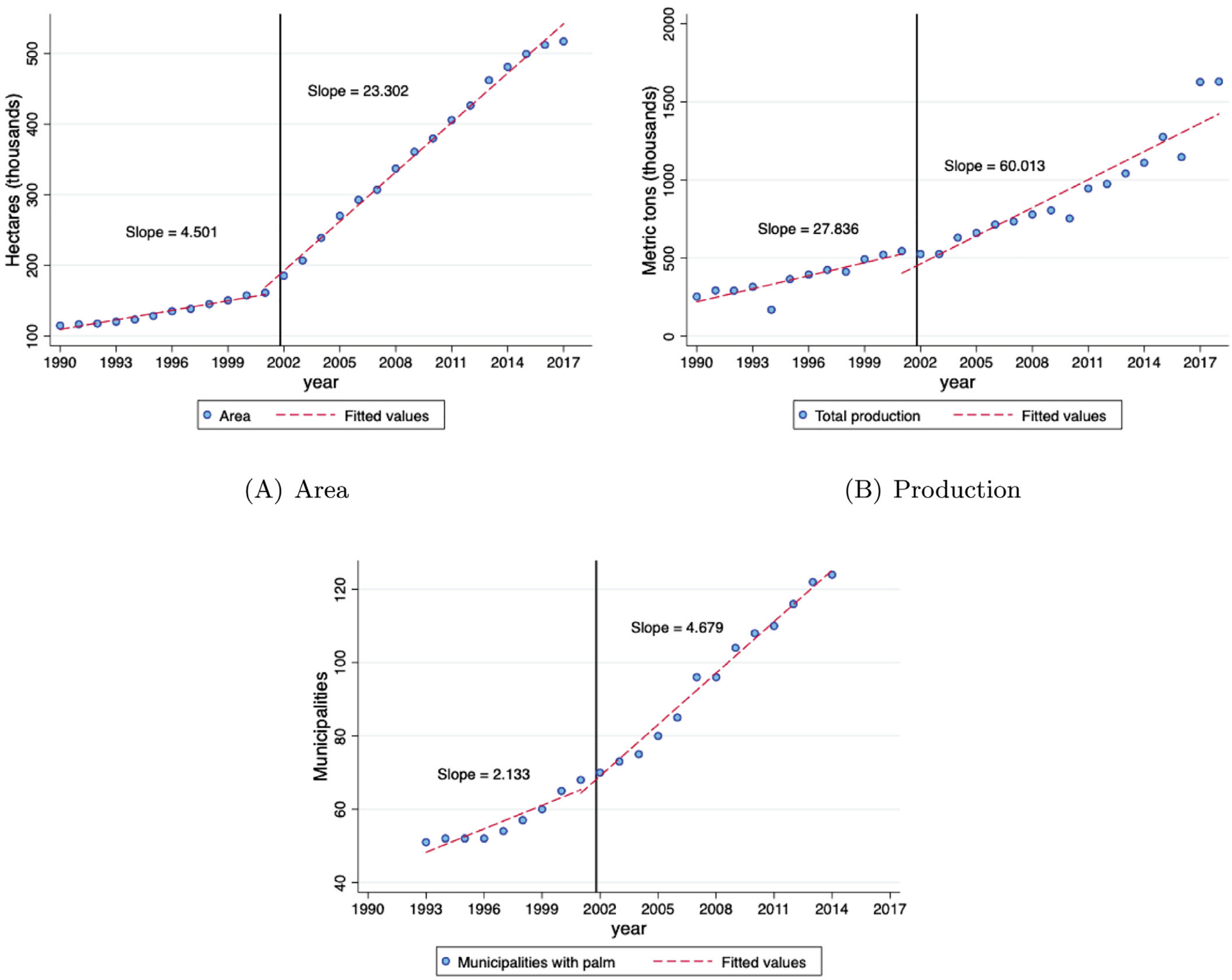
[4] Information from oil world June 2016 database.

[5] The average palm oil yield is 3.74 metric tons per ha per year while the yields for rapeseed, sunflower, and soybean are only 0.67, 0.48, and 0.38 metric tons per ha per year respectively (information from Green Palm Oil).

[6] Information from www.indexmundi.com.

[7] African palm was already a crop of interest for Andrés Pastrana's government (1998–2002); however, it was only under Alvaro Uribe's government from 2002 that palm producers started to receive heavy governmental support (Marin-Burgos, 2014)

[8] Goebertus (2008) page 168.



(A) Area

(B) Production

(C) Municipalities with palm

Fig. 1. Total land area of palm trees, palm oil production and municipalities with palm (1990 – 2017). (Source: FEDEPALMA and www.indexmundi.com).

showed that wages and small farmers' income did increase following the expansion of palm crops.

Finally, there have been allegations regarding land property rights issues alongside the palm expansion, including reports of violence against small informal farmers. A lack of legal regulations and weak rural institutions enable large producers to displace farmers with little leverage on their small plots (McCarthy, 2010; Castiblanco et al., 2015). For example, Castiblanco et al. (2015) documents 630 conflicts over land property rights between palm oil firms and local communities in Indonesia. In some cases, these conflicts lead to using violence to get additional lands where weak institutions exist. In Colombia, Grupo Semillas (2010) describes contract violations used by firms to overcome the claims of forcefully displaced individuals when they return to their lands (e.g., tampered signatures or payments below the official appraised land value). Additionally, numerous studies and reports present evidence from multiple sources about the relationship between IAG (mainly paramilitary armies), violence against small farmers, and the acquisition of lands by palm producers (Mingorance, Minelli, & Du, 2004; Oslender, 2007; Goebertus, 2008; Rettberg, Rivas, Arboleda, & Cajiao, 2011; Gómez et al., 2015). This relationship between weak institutions, violent groups, and the acquisition of lands for African palm is the central hypothesis we aim to test in this work.

2.3. FID in Colombia

FID is one of the main outcomes of the continuing conflict in Colombia. According to official statistics, the confrontation among different IAG and the national government resulted in more than 5 million individuals displaced from their hometowns. By 2009, more than 90% of Colombian municipalities had been affected by displacement, either by the outflows or inflows of displaced individuals (Ibáñez, 2009).

According to Ibáñez and Vélez (2008), on average, in Colombia a household which has been forcefully displaced suffers a 37% loss of their lifetime consumption. For the poorer households, this loss can be around 80%. These welfare losses are only part of the total loss, which includes the negative effects on local economies which have inflows and outflows of IDP.[9] Fig. 2 shows the rate of expulsions by year over the period of our analysis. From 1993 to 2002, FID increased constantly until reaching a historic peak, close to 800,000 expulsions. The rate of expulsion fell over a period of two years after 2002, and once again fell from 2007 to 2010, due specifically to the demobilization of paramilitary armies. The figure also shows the large dispersion of FID rates especially from 2000 to 2002. In this period, the top 10% of FID rates imply that in a given year some municipalities lost more than 8% of their total population.

Previous literature has studied the main causes of FID in Colombia (Ibáñez, 2008, for a review). Summarizing, IAG displaced individuals in order to: (1) obtain lands and territorial control, (2) gain control of crops and trafficking of illegal drugs and (3) prevent civil resistance movements, weaken social networks and frighten the population. What is more, there is evidence showing that the relationship between land conflicts and displacement goes further than the use of land for coca cultivation. Previous works have documented the alliance between IAG and landowners in order to gain control over new lands after violence reduced its price Ibáñez (2009).

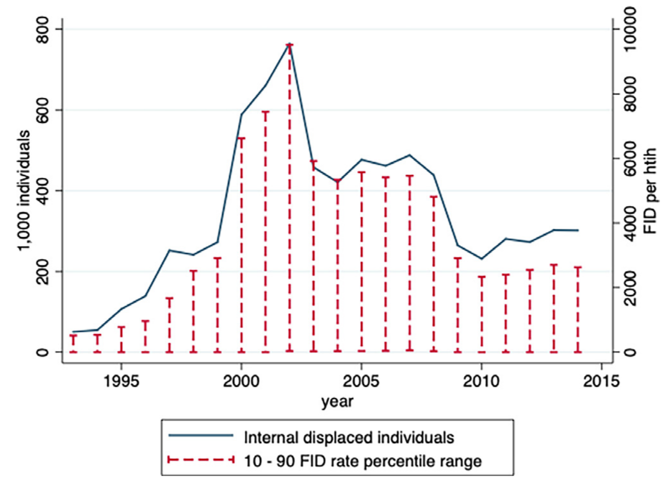


Fig. 2. National FID by year. Total expulsion headcount and municipality FID rate dispersion (1993–2014). (Source: RUV-CEDE.).

3. Estimation strategy

Our main hypothesis states that under weak institutions the palm oil expansion, driven by larger expected returns, used violence as a mechanism to obtain new lands. To test this hypothesis, we use changes in international prices of palm oil to assess the differential changes in FID rates between municipalities with and without African palm crops, in a continuous DID style.

FID_{it} is defined as the FID rate at municipality i and year t. Given that displacement in year t affects the total population in year $t+1$, we fixed the population in 2001, the year before the palm expansion began. Then, $FID_{it} = (\text{displaced individuals}_{it}/\text{total population}_{i2001}) \times 100,000$.[10] Therefore, our main specification is summarized in the following equation.

$$FID_{it} = \alpha_1 + \alpha_2 C_i \times Ln(P_{t-1}) + X_{it} + T_t \times R_i + M_i + \eta_{it} \quad (1)$$

Where, $C_i = 1$ if municipality i has palm trees, P_{t-1} is the international price of palm oil in the year $t-1$, X_{it} are some time-variant municipality characteristics that could affect the FID rate, $T_t \times R_i$ are region-year fixed effects. Palm producers are unionized by the National Federation of Oil Palm Growers – FEDEPALMA. FEDEPALMA divides palm-producing municipalities into four regions – North, Central, Southwest and East – taking into account access to natural resources, land characteristics and palm oil distribution chains (Fedepalma, 2011; 2017).[11] Thus, using region-year fixed effects we allow each FEDEPALMA region to follow its own time trend. Finally, M_i are municipality fixed effects to control for some other unobserved factors that may be correlated to FID behavior. Estimating Eq. 1 may not capture the causal effect of palm income shocks on FID because the decision to grow palm is endogenous and may respond to certain time-variant variables that are not observable. Specifically, if a municipality decides to harvest palm to enter the market as a response to increasing prices, our estimates for α_2 would be upper biased.

Thus, to categorize a palm-producing municipality we follow Angrist and Kugler (2008). We define $C_i = 1$ if the municipality i had African palm trees before the palm expansion. As we showed in the previous section, market dynamics radically change from 2002, hence the decision to cultivate earlier was not directly driven by national and international changes in 2002. In addition, following Angrist and Kugler (2008) logic, the municipalities that had palm before 2002 are the ones where it is more likely to find a larger increase in palm cultivation as a response to international and national shocks.

3.1. Validity of the estimations

Eq. 1 is analogous to a DID estimation where changes in the international price of palm oil represent a continuous treatment. Hence, in order to be able to compare the effect of changes in prices between municipalities with and without palm, we need to look for control municipalities where the parallel trend assumption holds (Abadie, 2005).

Fig. 3 compares the FID level for treated (with palm before 2002) and non-treated (without palm before 2002) municipalities, using different definitions of the non-treated group. In Panel A we do not set any constrain to the control group, and the common trends assumption appears not credible. To improve comparability, we reduced the control group to municipalities in FEDEPALMA regions with lands below 500 masl. This control group includes areas that were able to grow palm before 2002 but did not. Fig. 3.B shows FID trends for this definition of treatment and control groups. In this case, the average FID rates before 2002 are more similar between treated and control, but more importantly, showed similar trends.

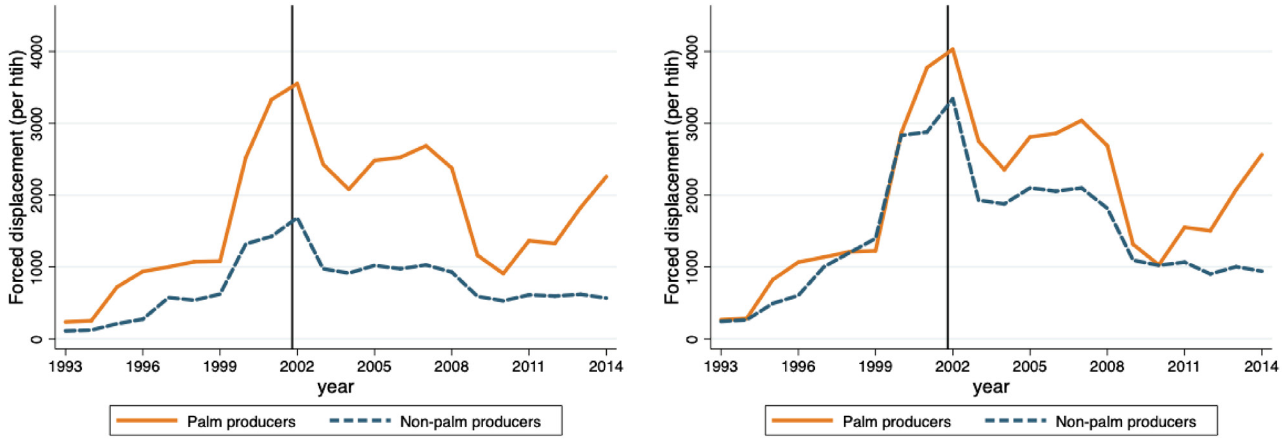
Therefore, given that the parallel trends assumption holds, an estimation of α_2 will capture the difference in the average change of FID rates in municipalities with palm before 2002 in contrast to the average change of FID rates in municipalities with no palm before 2002 due to an increase in the price of palm oil the previous year. If α_2 is significantly larger than zero, one can say that palm municipalities suffer more FID than municipalities without palm due to an income shock from increases in the price of palm oil.

An estimation of α_2 would be biased if Colombian palm producers could affect the international price of palm oil when their profits are affected by internal conflict. Colombia is among the top ten international palm oil producers, although, even after its rapid expansion, by 2014, the country only accounts for less than 4% of

[9] Moya and Carter (2019), Few, Ramírez, Armijos, Hernández, and Marsh (2021) document other costs for displaced households in Colombia. For a revision about the costs of forced migration see Becker and Ferrara (2019), Ruiz and Vargas-Silva (2013).

[10] FID rates are measured as displacements per hundred thousand inhabitants (dphtih).

[11] FEDEPALMA excludes lands in natural parks, indigenous and African-descendant reservations, and the Amazon and Pacific jungles. There are some documented cases of the use of violence and palm cultivation outside FEDEPALMA's area (Oslender, 2007; Vargas & Uribe, 2017). However, due to data restriction we do not include them as palm producers in our analysis.



(A) All

(B) Only municipalities with land lower than 500 masl in FEDEPALMA regions

Fig. 3. FID rate for palm- and non-palm producing municipalities. (Source: RUV-CEDE, FEDEPALMA and IGAC.).

worldwide production, showing little (or no) market power to affect prices.

According to Fig. 1.C part of the palm expansion occurred in municipalities that did not grow African palm before 2002 (the number of towns with palm doubled from 2001 to 2014). The latter will undermine our analysis because α_2 will only capture the effect of changes in palm oil prices on FID when IAG aimed to claim more land in municipalities where palm was already being grown. However, it will not capture the effect of searching for land in new municipalities. In other words, we are capturing the intensive margin of the expansion but not the extensive margin. Nevertheless, Fig. 13 in Appendix A shows that the palm area in new palm-producing areas is around a fourth of the palm area in places that were growing African palm before 2002. We will also show strong evidence that the violent part of the palm expansion was driven by municipalities that had palm crops before the expansion, rather than in the new palm-producing municipalities.

Another relevant point for our analysis is the structural changes between 2007 and 2008. As we explained previously, paramilitary armies were the key armed actor behind the violence linked with the expansion of palm crops. In 2002 the Colombian government opened peace talks with the Autodefensas Unidas de Colombia (AUC), the largest paramilitary organization in the country. The negotiations ended in 2007 with the demobilization of more than 30,000 paramilitary soldiers, changing the institutional framework in the areas where those armies had control.[12] Therefore, if the AUC were the predominant armed force behind the African palm expansion, the effect of palm prices on local economies should have diminished once the AUC was not in control anymore.[13]

In addition, the use of oil production changed (see Fig. 14 in Appendix A). In 2002 most African palm was for local consumption. As expected, the rise in international demand inflated exports, which added up to 49% of the outcome by 2007. However, since 2008, in response to new incentives by the national government, oil producers have been switching to the commercialization of biodiesel for local markets (Grupo Semillas, 2010).[14] As a result, the share of biodiesel continued increasing to turn into the main resulting product from African palm, with a 39% share of the total production by 2014. Thus, one can expect the income shock from international oil prices to weaken from 2008 onwards. For these two reasons, we divide all our estimations into two temporal groups – 2002 to 2007 and 2008 to 2014.

Finally, even though features such as altitude, temperature, and rain determine the feasibility of palm crops, estimates from a regression discontinuity design (RDD) do not capture the essence of this paper's hypothesis.[15] First, estimating changes in FID around the cutoffs does not directly take into account the income shock. Second, one could think of a fuzzy regression discontinuity (FRD) estimation instrumenting palm crops with the discontinuity around the cutoff (using altitude or temperature as a continuous score) to estimate the effect of changes in the probability of having palm crops on FID rates. Nevertheless, we want to test the opposite mechanism, in which palm producers and IAG use violence to displace individuals and acquire additional lands for palm.

Lastly, one could try to estimate the effect of palm prices on places where palm crops are more likely to grow (as Dube & Vargas, 2013; Albertus, 2019). In this case we could rewrite Eq. 1 and replace C_i with D_i which takes the value of 1 if the municipality i has the characteristics to grow African palm.

$$FID_{it} = \pi_1 + \pi_2 D_i \times Ln(P_{t-1}) + X_{it} + T_t + M_i + \eta_{it} \tag{2}$$

In this case an estimate of π_2 represents an intention-to-treat (ITT) estimator while an estimation of α_2 in Eq. 1 represents an average treatment on the treated (ATT). We show estimations of Eq. 2 among our results. However, it is important to point out that only around 30% of municipalities with the characteristics to grow palm do in fact have palm trees. Thus, one can expect that $\pi_2 < \alpha_2$.[16]

[12] Data from the Human Rights Observatory – CEDE.

[13] Some AUC soldiers did not demobilize and created independent armed groups named Bandas Criminales – BACRIM (Hristov, 2014; Hristov, 2021). We will show evidence later in this paper that the BACRIM were not involved in the palm expansion after 2008 in the same way that the AUC was between 2002 and 2007.

[14] Biodiesel is a bio-fuel from a mix of diesel and natural oils, usually African palm oil (UPME, 2009).

[15] Fig. 15 in Appendix A shows how palm oil yields do jump with respect to altitude and temperature, but not at the expected points given the strong correlation between altitude and temperature (Fig. 16 in the same Appendix). In addition, Fig. 17 in Appendix A shows that the probability of having palm trees at municipality level does not behave as a continuous homogeneous function which jeopardizes the estimation using a RDD.

4. Data

This work uses data from different administrative sources. Displacement data at the municipality level comes from *Registro Único de Víctimas (RUV)*.[17] RUV is demand-driven registration of individuals who registered as displaced by the armed conflict to the local or national authorities. After registration, governmental officials must validate each case. Once a registration is accepted, the individual enters the system and can receive certain benefits. Governmental aid may encourage some individuals to enter the RUV, even if they were not forcefully displaced by violent actions. However, according to some estimates, about 30% of IDP never registered because they fear being identified (Ibáñez et al., 2006). Therefore, FID rates may be deflated.

Information about palm crops and production comes from FEDEPALMA's annual reports. We also use GIS information from the *Instituto Geográfico Agustín Codazzi (IGAC)* about geographical characteristics such as altitude. Fig. 4 shows the geographical distribution of municipalities with palm prior to the expansion, from 2002 to 2007 and from 2008 to 2014. One can see how the palm expansion to new municipalities in the Central and East regions took place in neighboring municipalities, while in the North region new municipalities created a new cluster in the southern part of the region.

Finally, we use the palm oil price in Malaysia, which is the reference price in the international market. Our source is indexmundi.com, which uses information from different sources such as the US Department of Agriculture, the World Bank and Oil World. Fig. 5 shows the evolution of the international price of palm oil. Using this figure, one can expect that FID increased more in palm oil producing municipalities from 2002 to 2008 due to a continuous increase in the price, while FID should have increased less in palm- than in non-palm municipalities from 2010 due to the continuous fall in the international price.

Table 1 summarizes the main statistics for palm- and non-palm municipalities for our period of analysis.[18] Firstly, it is important to point out that our treatment group only includes 75 of the 502 municipalities in the analysis. Additionally, only 7% of the municipalities that did not grow palm before 2002 started at some point to have palm crops, with an average area of one third of the average area cultivated by original palm producers. We understand that our analysis cannot explain the extensive margin of the palm expansion, but the descriptive evidence shows that the intensive margin is more important than the extensive margin.[19]

Regarding FID and other violence indicators, on average, there are no sizable differences between municipalities that did have palm before 2002 and municipalities that did not. However, it is worth noting that expulsion rates are above 2,000 cases per 100,000 inhabitants, meaning that, on average, more than 2% of individuals in a given municipality left their hometown at some point. Additionally, paramilitary presence is more prevalent in palm- than non-palm producing towns (52% against 29%). This difference supports the evidence of the involvement of this specific group in the violent process linked to the expansion of palm (Goebertus, 2008; Rettberg et al., 2011).[20]

5. Results

Table 2 shows the resulting estimates for α_2 of Eq. 1. Columns 1 through 4 show the results for the period of 2002 to 2007, and columns 5 to 8 show the results for the period of 2008 to 2014, to take into account the structural changes in 2007 explained before. We also show estimates constraining the sample to different sets of municipalities. In columns 1 and 2 (5 and 6) we use municipalities in FEDEPALMA regions with lands below 500 masl (the groups for which the parallel trend assumption seems plausible). In addition, column 3 (7) shows the results when we use municipalities with temperature above 26 °C, as temperature is another factor that determines palm cultivation. Finally, in column 4 (8) we combine altitude and temperature to define the set of municipalities in the analysis.

Our favorite estimation is in column 2. According to our results, a 1 log point increase in the international price of palm oil increases the FID rate in palm-producing municipalities with respect to the non-palm towns by 0.421 standard deviations. When we do not control for time-variant characteristics at the municipality level, the coefficient increases to 0.6, showing that some of these characteristics also explain certain differences between palm- and non-palm municipalities. When we use other comparison groups, as in columns 3 and 4, the estimates marginally change. Even though the selection of the comparison group does not appear to change our results, we kept the specification in column 2 for the remaining analysis, as for this group the parallel trend assumption fits better.[21] Finally, for the period 2008 to 2014 we do not find any statistically significant estimates irrespective of the comparison group. Summarizing, columns 2 to 4 show that for the period 2002 to 2007 a positive income shock in the palm market increased FID in those municipalities with palm, with respect to FID rates in similar municipalities but that did not have palm before the expansion. Furthermore, from 2008 to 2014 palm prices do not seem to have had any effect on FID rates in palm-producing municipalities.

Additionally, in Fig. 6 we show the estimated difference between treated and non-treated municipalities, annually. We can see that this difference is only significantly positive from 2004 to 2007, which aligns with the positive increase in price from 2001 to 2008 (see Fig. 5).[22] As explained before, 2007 saw a structural change with respect to the market, due to different factors. The figure then shows that after 2008, despite the sharp decrease in the price, FID rates were not smaller in palm municipalities with respect to non-palm producing municipalities. Additionally, we do not find statistically significant differences before 2002 which support the parallel trend assumption, essential for our estimations.

When we divided the sample by palm regions (Table 3), we found that increases in oil prices only significantly increase FID rates of palm municipalities in the Central and Eastern regions.[23] In the Southwest region and the Northern region, the effect is weaker and not significant. Finally, we did not find significant effects in any region from 2008 to 2014. To understand these regional differences, we investigate the way in which the expansion occurred in each region. Fig. 7 shows how the palm area and the municipalities with

[17] We use municipality panel data from *Centro de Estudios sobre Desarrollo Económico – CEDE* at Universidad de los Andes.

[18] Summary statistics of other variables used in the analysis are in Table 12 in Appendix A.

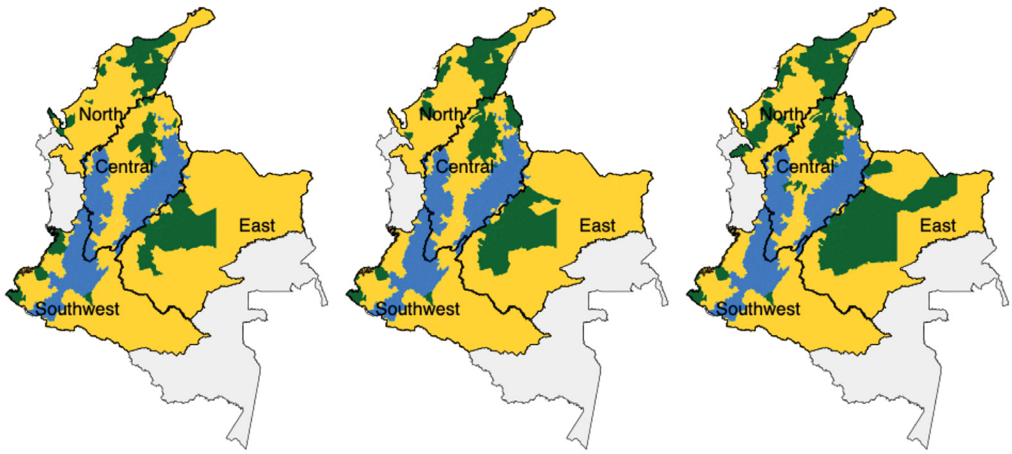
[19] In addition, Fig. 13 in Appendix A shows that the increase in area cultivated with palm was larger from 2007 to 2014 in regions with palm prior to 2002, than in regions without palm prior the expansion.

[20] Palm municipalities also have a more presence of guerrilla groups; however, the difference between palm- and non-palm producing municipalities is smaller.

[21] Fig. 19 in Appendix A show the FID trends for palm- and non-palm municipalities for the sets used for the estimations in columns 3, 4, 7 and 8. Additionally, Table 14 in the same Appendix shows the resulting estimates when using all municipalities in Colombia and all municipalities in FEDEPALMA regions. The results do not change considerably.

[22] There is documented evidence of the use of violence and land accumulation for palm cultivation in specific municipalities before 2002 (Oslender, 2007; Marin-Burgos, 2014). However, the figure shows that such cases do not represent a systematical strategy by palm producers or illegal groups.

[23] Our results in the Eastern region corroborate the findings by Poe and Isacson (2009), Maher (2015), Díaz Moreno (2016).



(A) 1993-2001 (B) 2002-2007 (C) 2008-2014

Legend: With palm crops. Without palm crops but with lands below 500 masl. Without lands below 500 masl. Outside FEDEPALMA regions.
Source: FEDEPALMA and IGAC.

Fig. 4. Geographical distribution of palm crops in Colombia. (Source: FEDEPALMA and IGAC.).

Fig. 5. Palm oil average yearly price. (Notes: Palm oil (Malaysia), 5% bulk, c.i.f. N. W. Europe. Real prices in USD 2015 = 100.) (Source: ISTA Mielke GmbH, Oil World; US Department of Agriculture; World Bank. Downloaded from www.indexmundi.com).

crops increased by region over the expansion period. From Panel A, we can observe that the Southwest region grew in parallel to other regions until 2006 when the area dropped radically over next three years, due to a rot disease epidemic (Martínez, Corredor, & Silva, 2008). This could explain why we do not find significant results for the Southwest.

Regarding the palm expansion in the North, we expected that the effects would be similar to those in the Central region and Eastern region, because they closely follow a trend of increased cultivated area (Panel A). However, the expansion in the North was driven by access to lands in new municipalities instead of expanding on the original municipalities (Panel B). By 2007, 14 new municipalities in the North had palm crops, while only 7 new municipalities in the Central and Eastern regions had palm. We do not claim that violence did not play a part in the expansion in the North; however, our estimations capture the intensive margin (new lands in the same municipality) instead of the extensive margin (new lands in new municipalities).

For this reason, in Table 4, we try to separate the effect of the palm expansion on FID rates in the intensive and extensive margins. Column 1 is exactly as in Table 2 column 2. In column 2,

Table 1
Descriptive statistics for palm- and non-palm municipalities (2002–2014).

Variable	All		Palm municipalities		Non-palm municipalities	
	Mean	S.D	Mean	S.D.	Mean	S.D.
Observations	6526	.	975	.	5551	.
Municipalities	502	.	75	.	427	.
Palm indicators						
Palm oil crops	0.19	0.39	0.91	0.29	0.07	0.25
Palm area (hectares)	4091.07	6617.46	5614.26	7796.06	1749.78	2950.82
Palm area (% of total area)	0.04	0.07	0.06	0.08	0.02	0.03
Armed conflict indicators						
FID rate[1]	2571.62	4835.20	2596.46	4240.72	2567.21	4933.47
FARC presence	0.49	0.50	0.52	0.50	0.48	0.50
ELN presence	0.23	0.42	0.32	0.47	0.22	0.41
AUC presence	0.32	0.47	0.52	0.50	0.29	0.45
Coca crop presence	0.31	0.46	0.25	0.43	0.32	0.47
Other variables						
Population	37848.48	92605.93	61949.02	104932.68	33615.37	89610.88
Rurality index	0.53	0.24	0.41	0.22	0.55	0.24

Notes: Sources describe in Table 13 in Appendix A.
[1] In events per hundred thousand inhabitants (htih).

Table 2
Effects of changes in palm oil prices on FID rates over palm-producing municipalities in FEDEPALMA regions.

	2002–2007				2008–2014			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Ln(P_{t-1}) \times$ Palm producer	0.601**	0.421*	0.367+	0.405+	0.025	0.011	−0.010	−0.020
	(0.209)	(0.190)	(0.221)	(0.229)	(0.149)	(0.150)	(0.165)	(0.159)
Municipality controls	N	Y	Y	Y	N	Y	Y	Y
Palm municipalities (%)	14.94	14.94	18.23	18.23	14.94	14.94	18.23	18.23
Control group mean	3710.20	3710.20	3148.96	19.25	1587.51	1587.51	1332.86	19.25
S.D.	6350.11	6350.11	5742.42	5858.86	2574.51	2574.51	2422.67	2474.36
R^2	0.076	0.113	0.120	0.132	0.113	0.119	0.111	0.115
N	2988	2988	2346	2220	3486	3475	2727	2580

Notes: Standard errors in parentheses. $+\ p < .1, *\ p < 0.05, **\ p < 0.01$. All estimations include municipality and year-region fixed effects. Municipality level controls include one lag of logarithm of population, rurality index, the municipality income and tax income per capita, presence of each IAG (FARC, ELN and AUC), presence of coca crops, IAG demobilization rates and oil and coffee intensity from Dube and Vargas (2013).

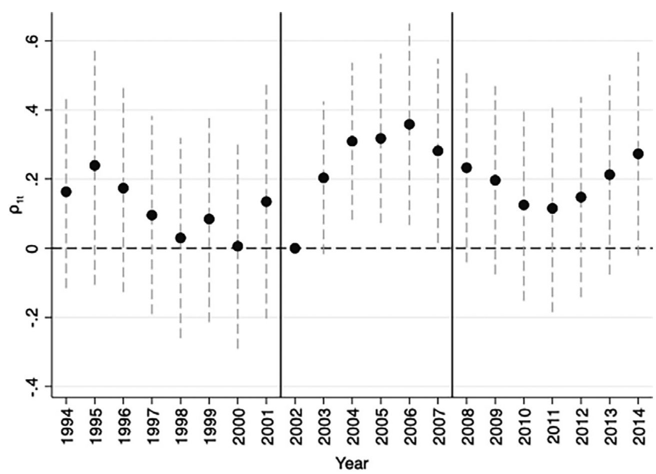


Fig. 6. Estimated FID difference between palm and non-palm municipalities by year (1994–2014). (Notes: We estimate $FID_{it} = \rho_0 + \sum_{t=1994}^{2014} \rho_{0t} \times t + \rho_{1t} C_i \times t + X_{it} + \mu_{it}$. $t = 2002$ used as based year. Confidence interval at 95% in dashed lines. All estimations include the same municipality level control variables as per Table 2).

we use a dummy that takes the value of 1 if the municipality has palm crops in a given year. In this case, even when using municipality and region-year fixed effects, one can expect that the decision to have palm trees or not in a given year is endogenous and depends on unobservable time-variant characteristics that could correlate with the costs and returns of using displacement as a strategy to begin cultivation of African palm. Thus, we do not claim any causality regarding this definition of palm cultivation. Nevertheless, the estimated coefficient is smaller than the one in column 1, telling us that FID may not have been part of the strategy in new municipalities, and maybe improvements in labor market conditions could have reduced FID in comparison with those municipalities that did not grow African palm. From column 3 onwards, we estimate the following equation:

$$FID_{it} = \theta_1 C_{it} + \theta_2 C_{i\ 2002} \times Ln(P_{t-1}) + \theta_3 C_{it} \times Ln(P_{t-1}) + X_{it} + T_t \times R_i + M_i + \eta_{it} \tag{3}$$

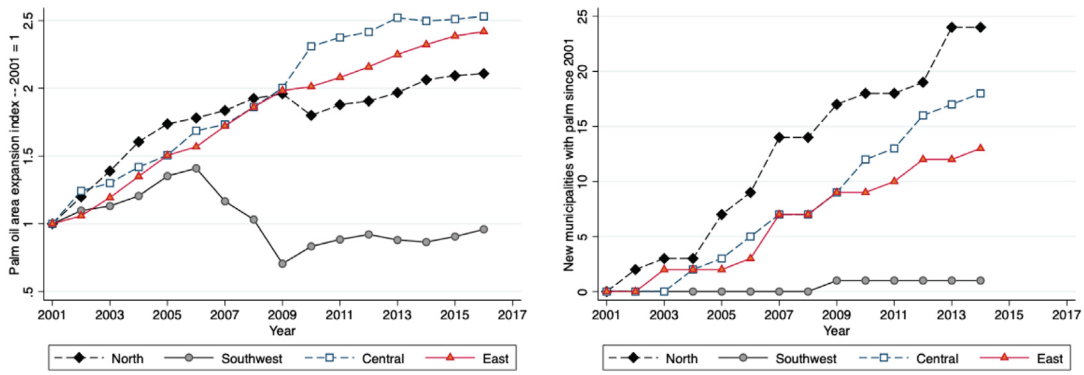
C_{it} takes the value of 1 if the municipality i has palm crops in year t and $C_{i\ 2002}$ equals to 1 if the municipality i had palm crops before 2002. In this case, θ_3 represents the effect of palm prices on FID rates of municipalities where palm crops started after 2002, and as response to better market conditions. The effect of palm prices over original palm producers, if they continue producing, is now the sum $\theta_2 + \theta_3$. For this reason, we also report the p-value of such sum to be able to see if the effect is statistically significant. Once again, it is important to point out that θ_3 does not represent a causal effect but a correlation which is informative for our analysis.

All our results aligned with the idea that the effect of international palm oil prices focuses on the municipalities with palm before 2002 (intensive margin) but not on the new municipalities with palm crops (extensive margin). As described before, the estimated coefficient in column 2 is smaller than the one in column 1,

Table 3
Effects of changes in palm oil prices on FID by palm region and period.

	North	Southwest	Central	East
Panel A: 2002–2007				
$Ln(P_{t-1}) \times$ Palm producer	0.107	0.082	1.113**	1.259**
	(0.360)	(0.436)	(0.352)	(0.407)
Control group mean	2956.14	5100.01	3560.81	4628.65
S.D.	4992.66	9757.22	7421.44	5412.51
R^2	0.169	0.167	0.122	0.080
N	1140	210	912	726
Panel B: 2008–2014				
$Ln(P_{t-1}) \times$ Palm producer	−0.274	0.736	−0.004	0.119
	(0.242)	(0.770)	(0.217)	(0.260)
Control group mean	814.81	~~4590.56~~	1309.37	2215.52
S.D.	1720.04	4329.07	2421.53	2386.09
R^2	0.177	0.167	0.044	0.316
N	1322	245	1064	844

Notes: As per Table 2 column 2.



(A) Area expansion (B) New municipalities

Fig. 7. Palm oil expansion since 2001 by region. Additional area and new municipalities (Source: FEDEPALMA).

Table 4
Effects changes in palm oil prices on FID rates – Intensive vs Extensive margin (2002 – 2007).

	All			By region			
	(1)	(2)	(3)	North	Southwest	Central	East
Palm producer (θ_1)		−2.350+	0.725	1.351	0.000	−2.063	15.249
		(1.245)	(1.511)	(2.439)	(.)	(2.576)	(9.888)
$Ln(P_{t-1}) \times$ Palm producer$_{2002}$ (θ_2)	0.421*		0.519*	0.288	0.425	0.849*	3.664*
	(0.190)		(0.226)	(0.363)	(0.434)	(0.371)	(1.575)
$Ln(P_{t-1}) \times$ Palm producer (θ_3)		0.385+	−0.102	−0.183	−0.653+	0.316	−2.410
		(0.197)	(0.238)	(0.388)	(0.378)	(0.395)	(1.575)
$\theta_2 + \theta_3 = 0$ (p. value)			0.039	0.781	0.610	0.003	0.003
R^2	0.11	0.11	0.11	0.17	0.17	0.12	0.08
N	2988	2988	2988	1140	210	912	726

Notes: As per Table 2 column 2.

showing that increases in palm prices may have reduced FID in new palm municipalities. Despite not being statistically significant, the estimation of θ_3 is negative for all estimations except for the Central region. The effect of prices on original producers remains positive and significant for all regions (column 3) and for the Central and Eastern regions as well (as shown in Table 3).

5.1. Exploring the mechanisms

So far, we have shown that from 2002 to 2007 the rise in international palm prices increased FID rates in palm-producing municipalities. Our results suggest that the palm income shock created a rapacity effect stronger than the positive opportunity-cost effect, due to possible improvements in the labor market. Building on previous works, we claim that the rapacity effect was driven by the desire of palm producers to expand their crops into new lands. As documented in Rettberg et al. (2011), displaced households reported massive land purchases after they left their hometowns due to a rise of violence. In this section we provide evidence that supports this hypothesis. We also show estimations that prove the role of IAG such as paramilitary armies.

5.1.1. The rapacity effect and land conflict

The first piece of evidence is the following. If forced displacement was used to get access to new lands in palm-producing municipalities, one can expect that the violent mechanism was more prevalent in areas where land was owned by many small farmers, because it would be easier to bargain with the owners of smallholdings than with landowners with large farms. Hence, we estimate our main model (as Table 2 column 2) over different levels of land concentration. We divide the sample by quartiles of the estimated Gini coefficient at the municipality level using the land distribution in 2000. Table 5 Panel A shows the resulting estimates by quartile. The estimated effect of palm prices on FID rates is larger for the first quartile (better land distribution), than in the last two quartiles (more land concentration). What is more, the effect is only statistically significant in the first quartile.

In addition, weak land property rights could facilitate the alliance between palm producers and violent organizations. Table 5 Panel B shows the estimated results by land formality quartiles (measured by the proportion of lands with official registry). The results aligned with the ones in Panel A. Palm oil prices only have a significant effect over palm-producing municipalities where institutions were weak and not many lands were legally registered.

Furthermore, if the increase in forced displacement in palm municipalities allowed local landlords to acquire new lands, one could expect that the land distribution worsened in treated municipalities with respect to non-treated ones. Fig. 8 shows the distribution function of the land concentration Gini coefficient in 2000 and 2012. For municipalities without palm before 2002 (upper panel) we do not observe strong changes in Gini distribution; if anything, the density function moved to the right, representing an increase in land concentration (as documented in Ibáñez & Muñoz, 2012). However, the lower panel shows a different story for municipalities with palm crops before 2002. First, Fig. 8.D shows that the shape of the density function turns from normal to bimodal with two humps, one smaller and one larger than the 2000 distribution's hump. When we plot the distribution by region, Fig. 8.F shows that Gini distribution shifted to the right only in the regions where we found that the rise in palm prices increased displacement (Central and East), while this distribution did not change for the regions where the income shock did not increase FID rates significantly (North and Southwest).

Table 5
Effects changes in palm oil prices on FID rates by land concentration and informality quartiles (2002 – 2007).

	Quartile			
	1	2	3	4
Panel A: By land concentration (Gini) quartile				
$Ln(P_{t-1}) \times$ Palm producer	0.935*	0.351	−0.057	0.147
	(0.463)	(0.368)	(0.660)	(0.346)
Gini quartile	0.07	0.16	0.34	1.00
Control group mean	5114.01	3736.00	2560.25	2014.20
S.D.	7253.78	6195.51	4698.81	3145.73
R^2	0.103	0.109	0.127	0.089
N	630	636	636	636
Panel B: By land formality quartile				
$Ln(P_{t-1}) \times$ Palm producer	−0.317	1.120**	0.137	0.613
	(0.414)	(0.307)	(0.456)	(0.428)
Informality quartile	0.07	0.16	0.34	1.00
Control group mean	1989.01	2919.79	3967.50	4437.87
S.D.	3910.20	4905.22	6643.87	6204.72
R^2	0.104	0.116	0.163	0.070
N	546	630	630	624

Notes: As per Table 2 column 2 excluding region fixed effects. Gini and informality quartiles build based on data from the year 2000.

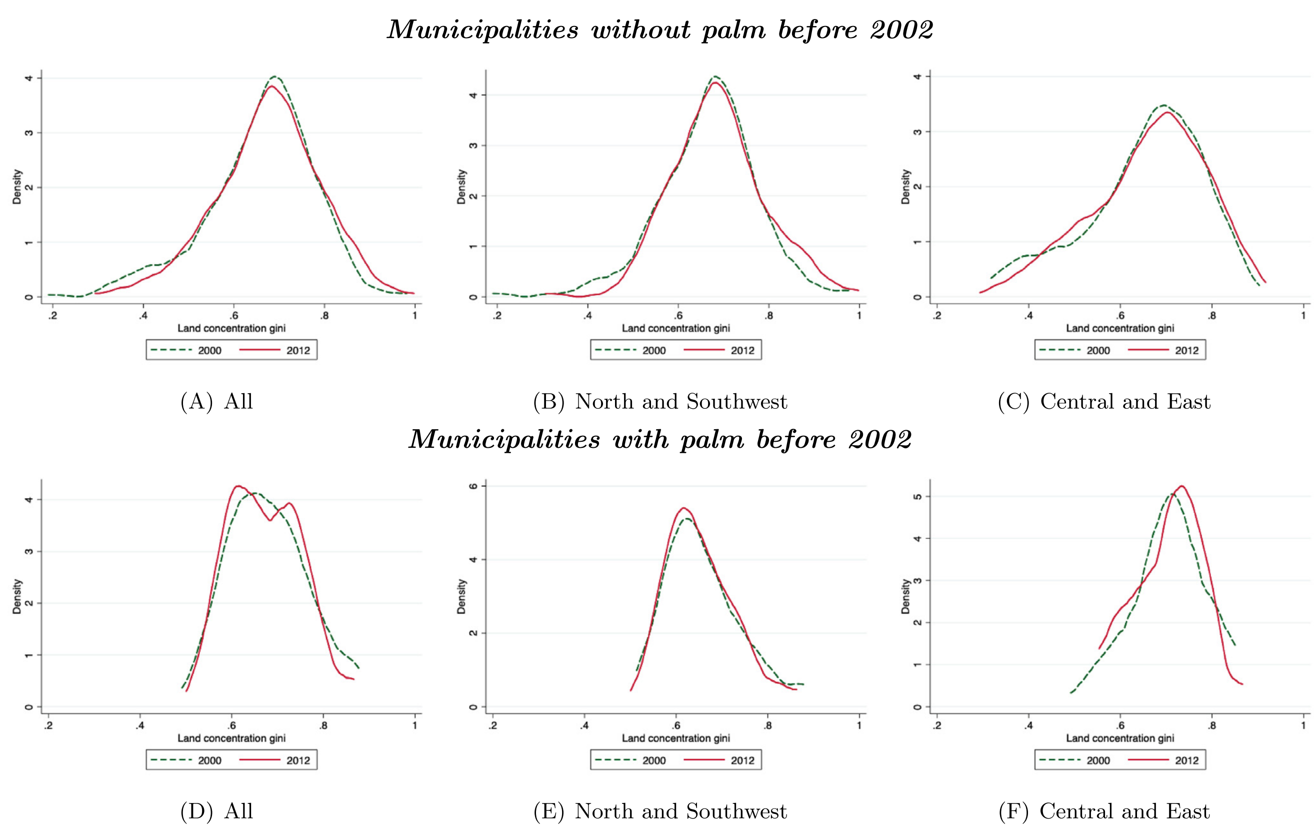


Fig. 8. Land concentration Gini for municipalities in palm regions (2000 and 2012). (Notes: Gini estimates from IGAC-CEDE. Only for municipalities in FEDEPALMA regions and with available Gini data in 2000).

In addition, since 2011 displaced individuals are able to claim their lands via a specific legal process, provided they can prove that they lost them as result of the internal conflict.[24] We do not observe directly how many individuals lost lands by municipality. However, we argue that if land grabbing was part of the strategy in palm municipalities, one should observe a larger proportion of displaced individuals asking for land restitution in palm- than in non-palm municipalities. Fig. 9 shows evidence supporting this last argument. We plot the average number of land restitution claims, applicants and parcels by municipality, from 2011 to 2021, normalized by the total number of displaced individuals before 2011, to take into account that we already showed that palm municipalities have more displaced individuals than municipalities without palm. The results are conclusive; in all cases land restitution is more prevalent in palm- than non-palm municipalities, and these differences are

[24] Ley de Víctimas y Restitución de Tierras No. 1448, 2011 (Presidencia de la República de Colombia, 2011)

statistically significant. This evidence aligned with Bandiera (2021) in the case of banana plantations.

Second, we do not deny the possibility of improvements in the labor market arising from the palm income shock. Total palm employment grew from about 61,000 to 151,000 jobs between 2002 and 2016.[25] However, our results suggest the rapacity over new lands surpassed the benefits from better labor markets. Unfortunately, we do not have data to estimate changes in the labor market associated with changes in the international price of palm; nonetheless, we test how the effect of palm prices on FID varies with the size of the rural population. In a municipality with a large rural population, the labor market effect may be weaker because of an excess of labor supply. In contrast, when labor supply is scarce, the labor market effect may overcome the rapacity effect, and our estimates may diminish or even turn negative.

Table 6 shows the estimated α_2 from Eq. 1 by the size of rural population. As we can see in columns 2 and 3, the estimated coefficient is only positive and significant when the rural population is larger than 5,000. The effect is even bigger when the rural population is greater than 10,000. When we divide the population with respect to the urban population, the effect actually diminishes when municipalities' urban population increases. Changes in urban population do not represent changes in the palm labor market but may capture the relative strength of local institutions, as bigger municipalities often have stronger institutions. Hence, it is not surprising that our estimations of α_2 are smaller where municipalities have a larger urban population.

However, the question must be posed: why is the labor market effect weaker than the rapacity effect for palm crops and not for other agricultural commodities, for example coffee? We approach this question by describing the African palm production function. Fig. 10 shows some features of palm crops in comparison with two other commodities of great importance in Colombia, coffee and bananas. Panel A clearly shows that palm oil plantations are usually larger than coffee and banana fields. As previously explained, palm's long production cycle sets the ideal conditions for obtaining benefits from economics of scale. In addition, Panel B shows that coffee is more labor-intensive than both palm and banana. Thus, income shocks in the palm market increase the need to obtain new lands, but the response of the labor market is not direct with respect to the increase in production. These two features support the fact that our results on palm oil differed from previous literature, especially from the analysis of Dube and Vargas (2013) on coffee in Colombia. Also, as we will discuss later in this document, these features explain why the effect of the income shock on displacement is larger for palm oil than for banana (as in Bandiera, 2021).

5.1.2. Local institutions, paramilitary armies and coca crops substitution

The second claim from previous works describing the violent process that accompanied the palm expansion was the key role played by paramilitary armies.[26] In Table 7, columns 1 to 4, we split the analysis and estimate Eq. 1 by the presence of the main IAG prior the palm expansion (right-wing paramilitaries – AUC, and left-wing guerrillas – FARC and ELN). In all cases the effect is positive and significant, and the coefficients are not different in comparison with each other. These results do not support the idea that paramilitary armies were the only group behind the violence caused by the palm income shock. However, it is important to point out that in Colombia, IAG habitually compete for regional control, which means that in each column we can have a combination of more than one IAG. For example, in column 4, when we constrain the analysis of any given guerrilla group, we can also have many municipalities that have guerrilla groups and paramilitary groups. In order to disentangle the role of paramilitary armies and take into account the effect of IAG regional competition, we estimate the following equation.

$$\begin{aligned} FID_{it} \quad = \quad & \alpha_1 + \alpha_2 C_i \times Ln(P_{t-1}) \\ & + \alpha_{AUC} C_i \times Ln(P_{t-1}) \times AUC_{2000} \\ & + \alpha_{Guerrila} C_i \times Ln(P_{t-1}) \times Guerrilla_{2000} \\ & + \alpha_{Both} C_i \times Ln(P_{t-1}) \times AUC_{2000} \times Guerrilla_{2000} \\ & + X_{it} + T_t \times R_i + M_i + \eta_{it} \end{aligned} \tag{4}$$

The resulting estimates are presented in Table 7 column 5. First, the effect of palm prices in municipalities without previous presence of IAG remains positive and significant. Second, the interaction of our coefficient of interest and the prior presence of paramilitary is also positive and significant, while the interaction with prior presence of guerrilla forces is negative. Third, the interaction between the effect of palm prices with the presence of both types of groups, paramilitary and guerrilla, is also negative, and not statistically significant. For these estimates one can conclude that the stronger effect of palm prices on FID on palm municipalities is in those where the AUC had a monopolistic power before the palm expansion began. What is more, when the AUC had to compete with guerrilla groups, palm prices had no effect on FID rates. Our results align with the evidence collected by works such as Goebertus (2008).

The latest results are conclusive, although one might be concerned that the coefficients only explain that AUC armies are more prevalent in palm- than non-palm municipalities. While this is true, the AUC having been present in 69% of palm municipalities and only in 42% of non-palm municipalities, it can be noted that this is also the case for other IAG. Guerrilla groups were present in 76% and 65% of palm- and non-palm municipalities respectively (see Fig. 20 in Appendix A). Furthermore, even though the presence of different IAG is endogenous, we also include municipality and region-year fixed effects in every estimation to control for time-invariant differences between municipalities and different time trends at a regional level.

Additionally, as we previously explained, the price income shock was accompanied by a series of governmental programs to support palm cultivation, mainly to replace coca cultivation (Grupo Semillas, 2010; Marin-Burgos, 2014). Thus, we test if the effect of palm prices on FID is stronger in municipalities which gave more support to president Álvaro Uribe Velez in the 2002 elections. Our hypothesis is that palm producers were more likely to get benefits from the national government if they supported its election. Fig. 11 shows how the effect of palm prices on FID increases in both, Uribe's vote share and vote share difference, which supports our hypothesis. It is important to point out that Alvaro Uribe did not get more support in palm- than in non-palm municipalities, thus differences in the estimates are not driven by preferences for Uribe's government prior the palm expansion (see Fig. 21 in Appendix A).

Moreover, we explore the relationship between coca cultivation and palm oil expansion. One could expect that if the government strategy was successful, the rise in palm production would be correlated with a decrease in coca cultivation. However, if anything, the reduction in area of coca crops was larger in non-palm than in palm producing municipalities (see Fig. 22 in Appendix A).[27]

[25] Similarly, Kubitza et al. (2019) showed that the palm expansion in Indonesia increased labor market participation within the sector, and created job opportunities outside as a positive externality from the income effect.

[26] We already showed that the effect of palm prices is only significant for the period 2002 to 2007, as Bandiera (2021). However, we do not think this is enough evidence to show the influence of paramilitary armies, as this is also the period of great expansion of guerrilla armies (FARC and ELN).

[27] This result adds to the evidence of the limited scope of different policies to reduce coca cultivation in Colombia (Dion & Russler, 2008; Reyes, 2014) see, for example.

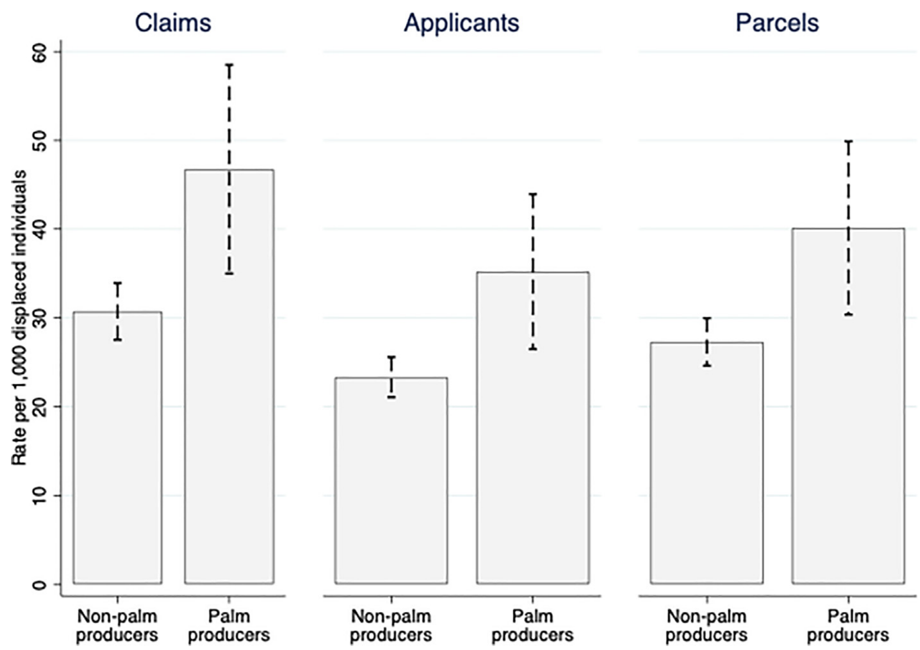
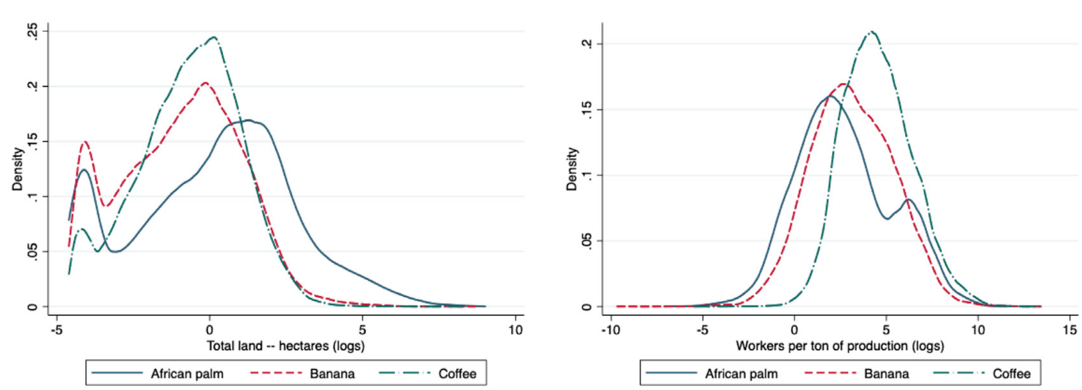


Fig. 9. Land restitution claims, applicants and parcels in palm- and non-palm municipalities. (Notes: 95% confidence interval in dashed lines. Rates in claims/applicants/parcels per 1,000 displaced individuals between 1993 and 2010. Using information of claims from 2011 to 2021 from URT).

Table 6
Effects of changes in palm oil prices on FID rates by size of rural and urban population in 2000.

	Size of rural population			Size of urban population		
	$\leqslant 5,000$ (1)	$5,000 - 10,000$ (2)	$10,000 <$ (3)	$\leqslant 5,000$ (4)	$5,000 - 10,000$ (5)	$10,000 <$ (6)
$Ln(P_{t-1}) \times$ Palm producer	−0.203	0.592*	0.677*	1.370**	0.490	−0.098
	(0.647)	(0.288)	(0.306)	(0.331)	(0.602)	(0.188)
Control group mean	3112.81	3311.88	4375.50	4488.08	3494.07	2532.71
S.D.	7041.96	5187.27	6677.40	7554.20	6440.96	3803.11
R^2	0.098	0.116	0.108	0.119	0.205	0.140
N	744	966	1278	1356	654	978

Notes: As per Table 2 column 2.



(A) Land size (B) Workers per ton of product

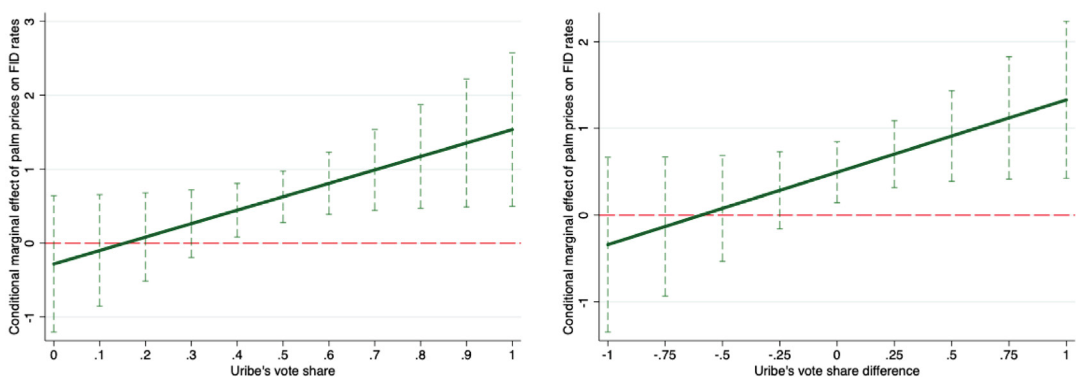
Fig. 10. Distribution of use of factors in palm, coffee and banana crops. (Notes: Using information from DANE (2014)).

We also check if the effect of prices on FID differs from the regions where there had been coca crops before the expansion (Table 8). Our estimations show that the impact of palm oil prices on FID is only significant for areas where coca crops existed before 2002, even after controlling for the presence of IAG. Also, in column 6, we included a dummy for coca crops with a one-year lag as a control variable and found that the resulting coefficient only reduces marginally. The results in Table 8 show that the negative effect of palm prices focused on coca regions; however, we do not see a reduction in coca cultivation in the palm regions. These

Table 7
Effects changes in palm oil prices on FID rates by presence of IAG before the palm expansion (2002 – 2007).

	By presence of IAG				All
	AUC (1)	FARC (2)	ELN (3)	Any guerrilla (4)	5
$Ln(P_{t-1}) \times$ Palm producer	0.578* (0.259)	0.438+ (0.261)	0.752* (0.296)	0.594* (0.232)	0.601* (0.233)
$Ln(P_{t-1}) \times$ Palm producer $\times$ AUC					0.655+ (0.371)
$Ln(P_{t-1}) \times$ Palm producer $\times$ Guerrilla					−0.009 (0.519)
$Ln(P_{t-1}) \times$ Palm producer $\times$ AUC $\times$ Guerrilla					−1.061+ (0.641)
Control group mean	4928.86	5023.92	4850.41	4710.43	3710.20
S.D.	7387.70	7247.09	7167.20	7071.58	6350.11
R^2	0.180	0.151	0.152	0.146	0.114
N	1392	1716	1278	1986	2988

Notes: As per Table 2 column 2, excluding presence of IAG. Presence of IAG before the expansion is defined as having a given IAG in the year 2000.



(A) By vote share (B) By vote share difference

Fig. 11. Effect of palm oil prices on FID from 2002 to 2007, by Álvaro Uribe's vote share and vote difference in the 2002 presidential elections. (Notes: Detail of the estimations in Table 15 in Appendix A. Using information from the Registraduría Nacional about the 2002 presidential elections. Vote difference is the difference between the proportion of votes for Álvaro Uribe Velez and the largest vote share for candidates other than Álvaro Uribe Velez).

results align with the hypothesis that weak institutions, predominant in municipalities with coca crops, are relevant to understanding the increase in FID from a positive income shock in the palm market.[28]

5.1.3. Palm, violence and displacement

Thus far, we have shown how the income effect raised FID rates in palm municipalities with respect to FID rates in municipalities without production. However, there is still an unanswered question. Why did people leave their towns? According to Ibáñez and Vélez (2008), certain violent events are highly correlated with households' decisions to migrate. The most important indicators among these are receiving threats, suffering indirect violence and the presence of paramilitary and/or guerrilla armies. In this section we explore the types of violence which might have been used by IAG to displace households and obtain new lands. We first look for the correlation between multiple violent events with FID rates, and the relationship between palm prices and violent indicators in our region of analysis (see Tables 17 and 18 in Appendix A). Our results align with previous works.[29]

However, based on the results from the previous section we focus our analysis on violence from paramilitary armies. Table 9 shows the results from two different exercises. Column 1 shows the resulting estimates of the correlations of AUC violent actions on FID rates, while column 2 shows estimates of the effect of international palm prices on AUC action in palm-producing municipalities.[30] Combining the results from both columns, one can argue that the resulting income shock from changes in the prices of palm oil increased AUC offensive actions and confrontations with public forces in palm-producing municipalities, increasing FID rates in those locations. As stated in previous literature, prices seem to affect

[28] Additionally, Table 16 in Appendix A shows the estimations by the presence of coca crops from 2008 to 2014, because a reduction in palm cultivation until 2012 was observed. However, we do not find any statistically significant effect of palm prices on FID rates, either in regions with or without coca before the expansion.

[29] We identify a positive correlation between FID rates and multiple violent indicators such as threats, homicides, targeted homicides, accidents with land mines, illegal roadblocks or checks, terrorist attacks, and IAG clashes with public forces. These results remain significant when we only restrict the sample to the Central and Eastern regions and regions with AUC. Our estimates also show that terrorist attacks and specifically IAG clashes with public forces increase in palm-producing municipalities when the price of palm oil increased the year before.

[30] In column 1 we estimate the $FID_{it} = \pi_0 + \pi_1 Vio_{it} + X_{it} + T_t \times R_i + \rho_{it}$. The table reports $\hat{\pi_1}$ for each violent act. In column 2 we estimate Eq. 1, replacing FID_{it} by each VIO_{it}. The table reports $\hat{\alpha_2}$ for each violent act.

Table 8
Effects of changes in palm oil prices on FID rates by presence of coca crops before the expansion (2002–2007).

	Without coca crops			With coca crops		
	(1)	(2)	(3)	(4)	(5)	(6)
$Ln(P_{t-1}) \times$ Palm producer	0.063	0.055	0.072	1.056**	1.037**	1.018**
	(0.243)	(0.241)	(0.242)	(0.375)	(0.380)	(0.380)
IAG presence (1 lag)		Y	Y		Y	Y
Coca crops (1 lag)			Y			Y
R^2	0.105	0.106	0.109	0.156	0.157	0.157
N	1962	1962	1962	1026	1026	1026

Notes: As per Table 2 column 2. Only marked columns include the presence of IAG and coca crops with one year lag as control variables. Presence of coca crops before the expansion is defined as having coca in the year 2000.

rural AUC violence, which could be behind the increase in rural FID rates.

Finally, one can expect that illegal armies do not use a unique specific action but a strategy combining different violent actions. In order to capture this possible combination of violent acts, we compute a violence index using a Principal Components Analysis (PCA). Table 10 summarizes the results. For the violence index in columns 1 to 3, we extract the first component of the PCA using all continuous variables that have a significant correlation with FID rates (see Table 17 in Appendix A). Meanwhile, for column 4 we use the continuous variables of AUC actions that have a significant correlation with FID rates (as Table 9 column 1).[31]

The results are stronger than in our previous analyses. Panel A shows the correlation between different violence indexes and FID rates. For all cases, the violence index is strongly positively correlated with FID rates. In Panel B we show the resulting estimates of the effect of palm prices on the violence index over palm-producing municipalities. In this case, palm prices show a positive significant effect on the violence index. According to these results, an increase in the international price of palm oil increased the violence in those municipalities with palm with respect to the municipalities without palm. Combining this result with the results in Table 2 column 2, we show that violence increased when palm prices increased, which increased FID rates in palm-producing municipalities, allowing palm owners to access more land and get benefits from the rise in the returns of the palm market.

5.2. Additional evidence

5.2.1. Other possible uses of African palm

In this section we analyze the effect of other related prices on the relationship between palm expansion and the displacement process in Colombia. Fig. 23 in Appendix A shows the evolution of palm oil prices, again together with the price of biodiesel (B20 and B90).[32] These prices do have some common trends, but also some important differences among them. It is worth remembering that one of the reasons we divide the analysis into two periods is the change in the use of African palm from palm oil consumption to local biodiesel consumption from 2008. Thus, if the price of palm oil represents the income shock from 2002 to 2007, biodiesel prices should represent the income shock from 2008 to 2014. We have already shown that FID rates only reacted to changes in the price of palm oil from 2002 to 2007.

We estimate Eq. 1 using different prices and do not find any statistically significant effects in any period (see Table 20 in Appendix A). Therefore, one can conclude that an income shock alone did not create a negative externality without the institutional weakness associated with the presence of the AUC in these regions.

[31] PCA coefficients are in Table 19 Appendix A.

[32] Biodiesel is blended using different concentrations. B20 and B90 correspond to 20% and 90% biofuel concentration respectively.

Table 9
AUC violence indicators on FID and palm prices on AUC violence indicators in regions with African palm, lands below 500 masl and AUC's presence in 2000.

Violence outcome variable	Violence on FID (1)	Palm prices on violence (2)
Homicides (rate)	0.039 (0.030) [1160]	−1.401+ (0.775) [1160]
Targeted homicides (at least 1)	0.126 (0.087) [1392]	0.070 (0.155) [1392]
Kidnapping (at least 1)	0.154* (0.068) [1160]	−0.305 (0.437) [1160]
Attacks against civil Population (rate)	0.065* (0.028) [1392]	−0.221 (0.371) [1392]
Terrorist attacks (at least 1)	0.368* (0.166) [1160]	0.123 (0.159) [1160]
Attacks to town (at least 1)	0.097 (0.077) [1392]	0.088+ (0.048) [1392]
Offensive acts against public forces (rate)	0.121** (0.044) [1392]	0.825** (0.309) [1392]
Clashes with public forces (rate)	0.145** (0.049) [1392]	1.073** (0.404) [1392]

Notes: As per Table 2 column 2 excluding the presence of AUC. Observations in squared brackets . Rates in events per 100 thousand inhabitants and standardized to mean 0 and standard deviation 1.

5.2.2. ITT estimates

As previously explained, our estimates of α_2 in Eq. 1 represent the ATT of the palm income shock. We complement our analysis by estimating the effect of the palm income shock on municipalities which could have grown palm. We do not directly use an RDD for the reasons explained in Section 3, but we do estimate changes around 300 masl and 26 °C in a style close to RDD.[33] First, we restrict the analysis to municipalities from 200 to 400 masl (a 100 masl window) and from 25 °C to 27 °C (a 1 degree window). Table 11 summarizes our results.

First, columns 1 and 4 show that the probability of growing palm changes at the respective altitude and temperature cutoffs (panels A and B respectively). Second, when we looked for differences in FID rates (Columns 2 and 5) using a linear model, we only found that in the period 2008 to 2014 the municipalities from 200 to 300 masl had a larger FID rate than the municipalities between

[33] We choose the cutoffs based on Fig. 15 in Appendix A.

Table 10
Violence index on FID rates and palm prices on violence index, in regions with African palm and lands below 500 masl (2002–2007).

	Violence from all violent actors			AUC violence
	All municipalities (1)	Central & East (2)	With AUC in 2000 (3)	With AUC in 2000 (4)
Panel A. Violence index on FID rates				
Violence index (pca)	0.268**	0.318**	0.266**	0.116**
	(0.044)	(0.059)	(0.052)	(0.035)
R^2	0.25	0.34	0.32	0.21
Panel B. Palm prices on violence index				
$Ln(P_{t-1}) \times$ Palm producer	1.052	1.719+	0.431	1.068**
	(0.671)	(1.031)	(0.839)	(0.392)
R^2	0.20	0.24	0.23	0.12
Eigenvalue	2.33	2.40	2.40	1.87
N	1989	1093	1062	1392

Notes: Standard errors clustered at municipality level in parentheses. $+\ p < .1$, $*\ p < 0.05$, $**\ p < 0.01$. All estimations control for department fixed effects, log of population, urban area proportion, we also include the presence of illegal armies (FARC, ELN and AUC), municipality income, and tax income per capita with one year lag. Columns 3 and 4 do not control for the presence of AUC. The violence index for columns 1 to 3 uses threats, homicides, targeted homicides, terrorist attacks and combats with public forces as inputs. For column 4 the violence index uses attacks against the population, offensive acts against public forces and combats with public forces by AUC as inputs.

300 and 400 masl (Panel A column 5). It is important to point out that these differences do not directly take into account changes in the price of palm.

Third, columns 3 and 6 show the resulting estimation of π_2 from Eq. 2. From 2008 to 2014, when the price of palm oil increased, FID rates decreased in municipalities below 300 masl and rose in municipalities with a temperature above 26 °C. Even though these results may seem disappointing, they do not contradict or threaten the validity of the results previously presented. The negative effect of prices on FID aligns with the results in Table 2, columns 5 to 8. As we already explained, from 2008 to 2014, the paramilitary armies were demobilized and the rapacity effect diminished, opening the window to reductions in violence due to better labor market conditions.

Lastly, the fact that for the 2002–2007 period we do not find any significant effect does not compromise our study. These estimates represent an ITT. For this period, coefficients are positive but smaller than our estimates in Table 2 (columns 2 and 4), which capture the ATT. Given that less than 30% of the municipalities that could have been affected by changes in the price of palm had palm crops, π_2 from Eq. 2 should be smaller than α_2 from Eq. 1.

5.3. Robustness checks

Our analysis is based on a comparison of municipalities with palm crops before the expansion began – 2002, with municipalities which could have grown palm because they have lands below 500 masl, but did not. However, as has been shown in recent papers, the estimates of the effect of income shocks on violent conflict and crime may vary strongly depending on the choice of dependent variables, model specification and other features of the estimations. There is also a strong concern about selective publication of findings in empirical studies (Kasy, 2021).

We already showed that our estimates do not change significantly when we use different approaches to define the control group, although one might be still concerned about how stable our findings are. For this reason, we follow the systematic approach proposed by Bazzi and Blattman (2014) and estimate multiple versions of our main specification (Eq. 1), allowing for different definitions of dependent variable, income shock, treatment group, control group, and control variables.

The result of this exercise is forty different estimates of the effect of palm prices on FID rates in Colombia. On the one hand, Fig. 12.B shows the resulting estimates with their correspondent p-value for 2002 to 2007. The evidence is conclusive, as all our estimates fall within a range of 0.36 to 1.2, and in only nine cases is the p-value greater than 0.05.[34] The estimate of our favorite specification is the blue-filled square, which is indeed one of the smaller estimates in the figure. Thus, one can say that the results we have discussed so far may represent the lower bound of the effect of the palm income shock on FID rates. It is worth mentioning again that we chose this specification because it is the one in which the parallel trend assumption fits best.

On the other hand, panels A and C show the resulting estimates for 1993 to 2001 and 2008 to 2014, respectively. These tell a different story because, irrespective of the specification, the resulting estimates are close to zero, and none has a p-value below 0.05. Thus, Fig. 12 shows that prices only impact FID rates in palm-producing municipalities from the moment the expansion began until the AUC was active, reaffirming the importance of its role in the violent process associated with palm expansion in Colombia.

Another concern comes from the effects that palm prices may have had on neighboring municipalities. On the one hand, one may argue that the income shock in palm municipalities could have attracted the attention of IAG in non-palm areas, reducing violence in the former. On the other hand, the income shock in palm municipalities may have strengthened IAG with presence in those areas, allowing them to pursue control in non-palm areas. Both cases violate the stable unit treatment value assumption - SUTVA (Rubin, 1986).

We estimate Eq. 1, this time, taking into account possible effects on municipalities that neighbor a palm municipality, either by excluding them from the analysis or by measuring the direct impact of palm oil prices on palm neighbors (see Table 22 in Appendix A). We found that excluding palm neighbors does not change the estimated coefficient shown in Table 2 column 2. In addition, we do not see any significant direct effect of palm prices on palm neighbors. Hence, we can conclude that the impacts discussed in this paper so far are not significantly affected by possible spillovers on palm-neighbor municipalities.

5.4. Magnitude of the results

First, it is worth pointing out that, on average, FID rates decreased from 2002 to 2007 (see Fig. 3.C). However, FID rates fell more in the non-palm than in palm-producing municipalities. FID rates fell by 1,441 dphtih more in non-palm than in palm municipalities. Second, according to Table 2 column 2, a 1 log point yearly

[34] The few coefficients that are not statistically significant are related to the use of temperature to establish the control group. However, they are not statistically different to most of the other estimates.

Table 11
The effect of discontinuities in altitude and temperature requirements to crop grow palm on the probability of having African palm plantations and FID rates.

	2002 – 2007			2008 – 2014		
	African palm (1)	FID (2)	FID (3)	African palm (4)	FID (5)	FID (6)
Panel A: Altitude						
$1[Altitude < 300]$	0.171**	0.174		0.201**	0.438**	
	(0.042)	(0.110)		(0.046)	(0.110)	
$1[Altitude < 300] \times Ln(P_{t-1})$			0.230			−0.546*
			(0.500)			(0.254)
Control group mean	0.025			0.049		
Municipalities	191			191		
N	1146			1337		
Panel B: Temperature						
$1[Temperature \geqslant 26]$	0.127**	−0.083		0.181**	−0.139	
	(0.040)	(0.143)		(0.048)	(0.125)	
$1[Temperature \geqslant 26] \times Ln(P_{t-1})$			0.010			0.389+
			(0.692)			(0.223)
Control group mean	0.031			0.057		
Municipalities	166			166		
N	996			1160		

Notes: Standard errors in parentheses. $+ \ p < .1, * \ p < 0.05, ** \ p < 0.01$. Panel A includes municipalities from 200 to 400 masl and Panel B includes municipalities from 25 °C to 27 °C in FEDEPALMA regions.

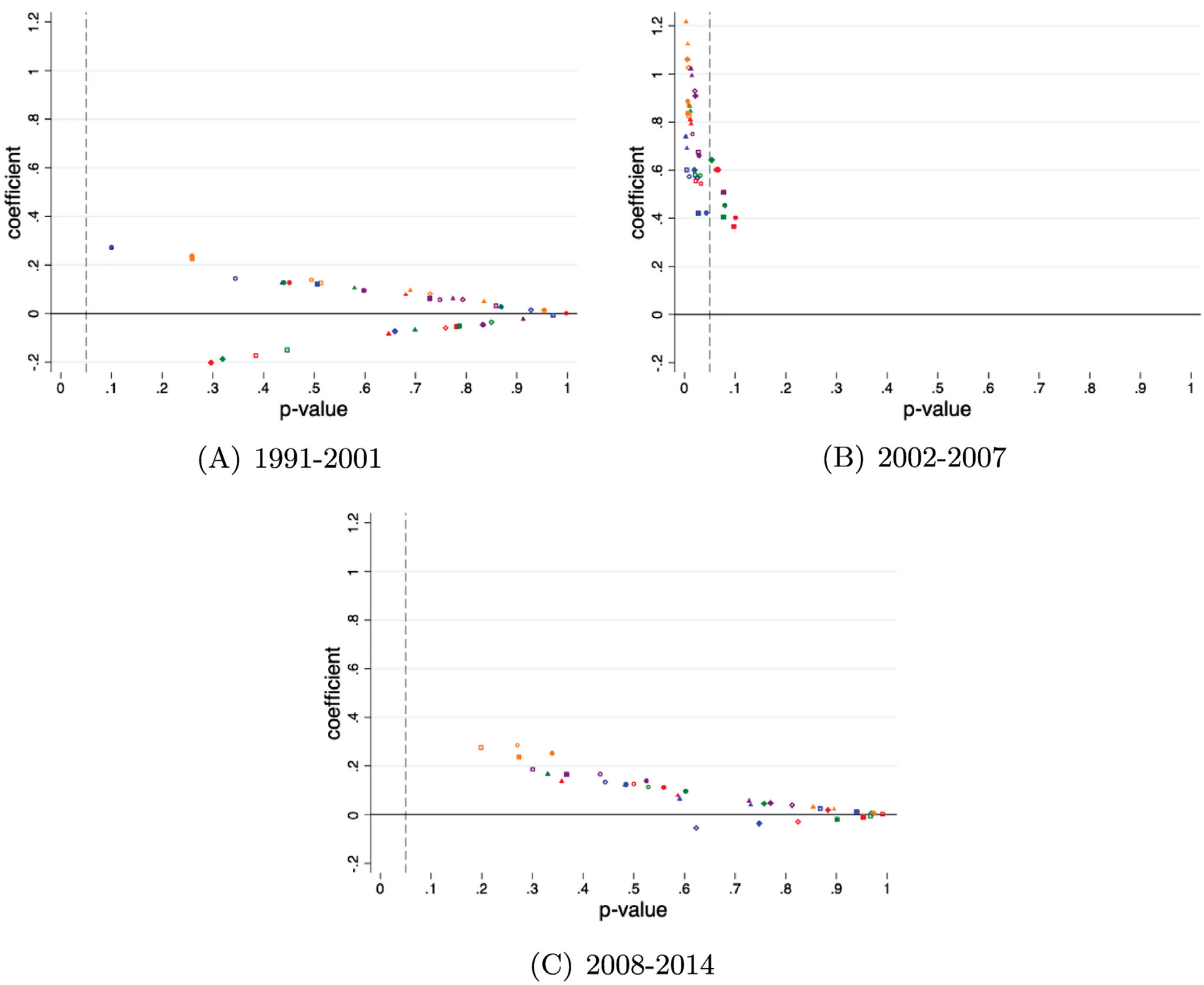


Fig. 12. Effect of palm oil prices on FID rates using multiple specifications. (Legend: Each symbol represents the estimated effect of a given specification following these rules: Definition of treated municipalities: □ = $Ln(P_{t-1}) \times Palm_{2002}$. O = $Ln(P_{t-1}) \times Palm_{1995}$. ◆ = $(Ln(P_{t-1}) - Ln(P_{t-2})) \times Palm_{2002}$. Δ = $(Ln(P_{t-1}) - Ln(P_{t-2})) \times Palm_{1995}$. Definition of outcome variables: □&O = FID_t. ◆&Δ = $(FID_t - FID_{t-1})$. Definition of control municipalities: **Blue** = Municipalities with lands below 500 masl. ***Red*** = Municipalities with temperatures above 26 °C. ***Green*** = Municipalities below 500 masl and temperatures above 26 °C. **Orange** = Match by PSM. **Purple** = Match by PSM within municipalities with lands below 500 masl and temperatures above 26 °C. Control variables: Filled symbols = Controlling for all variables as per Table 2, including municipality and region-year fixed effects. Empty symbols = Controlling only with municipality and region-year. fixed effects).

increase in the price of palm implies an increase in FID rates by 0.421 SD in palm-producing municipalities. Third, the price of palm oil rose by 0.39 log points from 2001 to 2006. Using our estimated coefficient and the FID standard deviation, the rise in price over five years led to an increase in the FID rate by 1,053 dphtih. Therefore, one can argue that the growth in palm oil prices accounted for 73% of the difference in the FID rates between palm- and non-palm producers.

Additionally, the average palm-producing municipality population is 55,501 inhabitants. Then, the palm price increase of 0.39 log points accounts for about 584 displaced individuals in a given municipality over six years. On average, 8,747 people were displaced per palm municipality from 2002 to 2007. Therefore, the price increase could account for 6.6% of the total displacement in these municipalities.

Another way to understand the magnitude of our estimates is by comparing our findings with the findings of Bandiera (2021) on banana crops. According to her work, from 1997 to 2007, the 10% increase in banana prices led to 16 more displacements in an average banana-producing municipality. Using our estimates, for the average palm municipality, a 10% increase in the price of palm would have accounted for about 141 additional displacements, about nine times the effect found by Bandiera.

We consider two factors that explain why our estimated effect is bigger than that of Bandiera. First, as shown in Fig. 10, palm and banana crops are comparable in the ratio of workers per product, but palm crops use significantly larger areas to produce. Thus, one can expect that the land-grabbing incentives were stronger in palm regions than in banana regions.

Second, palm crops were promoted and supported by the Colombian government to replace coca cultivation. We also showed that the effect of palm price on FID was bigger in municipalities that supported the elected president in the 2002 elections. Then, one can argue that palm producers expected an even higher income shock resulting from better prices and governmental subsidies. Hence, the land-grabbing incentive could have been greater in palm municipalities than in banana municipalities.

6. Conclusions

This article provides quantitative evidence about the relationship between the palm oil expansion and violent conflict in Colombia. In conclusion, we have shown that higher palm oil prices increased FID rates in palm municipalities, particularly in regions with paramilitary armies where landowners benefited from acquiring new lands. Even though the palm oil market appeared to be a valuable opportunity for rural development in the midst of the conflict, weak institutions drove a positive income shock to increase violence. Our findings corroborate Palacios (2012) and align with Manotas-Hidalgo et al. (2021) by pointing out the role of local institutions and production technology in determining the direction and size of the impact of the income shock on violent conflict.

Additionally, we add compiling evidence showing that, in this case, FID was a profit-driven strategy of palm producers and IAG, and not only a by-product of the political violence stemming from the long-lasting Colombian conflict. Our results add to the rich literature about the causes of forced migration, both within a country and internationally.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

We are grateful to Agustín Casas, Luigi Minale, Warn Lekfuangfu, Jorge Higinio-Maldonado, Ana María Ibañez, María Alejandra Vélez, Jimena Iguavita, the participants to many seminars, conferences, and workshops, and the anonymous referees whose comments and suggestions improved this paper considerably.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.worlddev.2022.106130.

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