COMMODITY PRICE SHOCKS AND CIVIL CONFLICT: EVIDENCE FROM COLOMBIA*

Oeindrila Dube
Harvard University

Juan Vargas
Universidad del Rosario

November 12, 2008

Abstract

How do income shocks affect armed conflict? Theory suggests two opposite effects. If labor is used to appropriate resources violently, higher wages may lower conflict by reducing labor supplied to appropriation. This is the opportunity cost effect. Alternatively, a rise in contestable income may increase violence by raising gains from appropriation. This is the rapacity effect. Our paper exploits exogenous price shocks in international commodity markets and a rich dataset on civil war in Colombia to assess how different income shocks affect conflict. We examine changes in the price of agricultural goods (which are labor intensive) and natural resources (which are capital intensive). We focus on coffee and oil, the two largest exports. We find that a sharp *fall* in coffee prices in the 1990s increased violence differentially in regions growing more coffee, by lowering wages and the opportunity cost of joining armed groups. In contrast, a *rise* in oil prices increased violence differentially in the oil region, by increasing municipal revenue siphoned through rapacity. This pattern holds in several other agricultural and natural resource sectors, providing robust evidence that price shocks affect conflict in opposite directions depending on the factor intensity of the commodity.

JEL Codes: Q17, F16, J30, O13, D74

*We are especially grateful to Alberto Alesina, Robert Bates, Lawrence Katz, Sendhil Mullainathan, Rohini Pande, and Dani Rodrik for their invaluable guidance, and to Arin Dube, Debraj Ray and Pierre Yared for numerous discussions. We also thank Ernesto Dal Bó, Pedro Dal Bó, Ray Fisman, Jeff Frieden, Ed Glaeser, Lakshmi Iyer, Dale Jorgensen, Ethan Kaplan, Asim Khwaja, Michael Kremer, Ted Miguel, James Robinson, Stergios Skaperdas and Matthias Schündeln, as well as workshop participants at Harvard, LSE, NYU, Manchester, UC Irvine, NEUDC, UN-WIDER, Royal Economic Society and LACEA for valuable comments.

1 Introduction

There is considerable interest in understanding how income shocks affect armed conflict, as civil wars have affected more than one-third of the world's developing nations and claimed over 10.1 million lives between 1946 and 2005 (Lacina and Gleditsch, 2005). However, the relationship between income and conflict is ambiguous from a theoretical perspective. One view suggests that a positive income shock reduces conflict by lowering wages and reducing labor supplied to criminal or conflict activity (Becker, 1968; Grossman,1991). This idea, that wages represent the opportunity cost of fighting, is consistent with cross-country evidence of a negative relationship between growth shocks and risk of civil war (Collier and Hoeffler 1998 and 2004; Fearon and Laitin, 2003; and Miguel, Satyanath and Sergenti, 2004).[1] However, a second view posits that more income means there is more to fight over (Grossman, 1999). This suggests that a rise in income may increase conflict by raising the return to predation and promoting rapacity over these resources. The rapacity effect idea is consistent with the finding that countries exporting oil and other natural resources face a higher probability of experiencing of civil war (Fearon, 2005b). These opposing influences, opportunity cost and rapacity, suggest that some income shocks may mitigate conflict, while other shocks exacerbate it, depending on the relative strength of the two effects.

In this paper, we demonstrate that different types of income shocks affect conflict in different directions, and through distinct channels. We focus on exogenous income shocks induced by movements in world commodity prices, and estimate how these shocks have affected civil war dynamics in Colombia. We employ a unique event-based dataset which records four measures of violence, including guerilla attacks, paramilitary attacks, clashes and war-related casualties, in 900 municipalities over 1988 to 2005. The geographic disaggregation of our data enables us to exploit variation across municipalities and over time in identifying the effect of commodity shocks on conflict. Our empirical strategy interacts the exogenous international commodity price with measures of how intensively the commodity is produced in each municipality. We find that the price of agricultural commodities (which are labor-intensive) are negatively related to conflict: when the price rises, conflict falls differentially in the municipalities that produce more of these agricultural goods. In contrast, the price of natural resources (which are capital intensive) are positively related to conflict:

[1] See Sambanis (2001) for a comprehensive review of this literature.

when the price rises, conflict rises differentially in municipalities that produce more of these natural resources.

The analysis focuses primarily on oil and coffee, the two largest Colombian exports for which high-quality data is available.[2] The negative relationship between agricultural prices and conflict is evident for the coffee shock: a sharp *drop* in the price of coffee during the 1990s increased violence disproportionately in municipalities cultivating more coffee. Our estimates imply a substantial effect: the 68 percent fall in coffee prices over 1997 to 2003 resulted in 4 percent more guerilla attacks, 7 percent more paramilitary attacks, 8 percent more clashes and 6 percent more casualties in the average coffee municipality, relative to non-coffee areas. This price shock also lowered wages, which suggests that violence increased because it was cheaper to recruit workers into armed activity.

In contrast, a *rise* in oil prices led to a differential increase in conflict in the oil region. The 137 percent increase in oil prices over 1998 to 2005 also had a substantial effect on paramilitary attacks, which increased by an additional 13 percent in the average oil producing municipality and by an additional 27 percent in the average oil transporting municipality. The oil shock also increased municipal revenue generated from taxing natural resources in local governments, which suggests that oil prices increased violence by promoting predation over these contestable resources.

Our results are consistent with a simple model developed by Dal Bó and Dal Bó (2006), in which labor intensive appropriation efforts are used to violently siphon resources from the remainder of the economy. In this context, wages represent the opportunity cost of participating in violence. A rise in the price of the labor intensive good is predicted to reduce conflict by raising wages relative to contestable resources, and reducing the size of the appropriation sector. In contrast, a rise in the price of the capital intensive good is predicted to increase conflict by increasing the value of contestable resources relative to wages.

One concern that arises from our focus on the production technology is that there are other ways in which the coffee and oil industries differ from one another. For example, the oil sector is politically visible, and armed groups may strike against oil for strategic reasons. To address this concern, we extend our analysis to six other major exports (covering eight of Colombia's top-ten export

[2] Oil is Colombia's largest export. Coffee was the second largest export in the beginning of the sample period but fell to number three after 2000. Today, coal is Colombia's second largest export. But data on coal production at the municipal level is not available prior to 2005, which is the end of our 1988-2005 sample period.

commodities).[3] We find that the negative relationship between prices and conflict holds in the case of other major agricultural exports, including sugar, banana, palm and tobacco, while that the positive relationship between prices and conflict holds for other natural resources including coal and gold. These results suggest that the pattern of observed effects do not arise for reasons that are idiosyncratic to coffee or oil.

In addition, we consider and present evidence against three alternative accounts. First, because there is anecdotal evidence of collusion between the government and paramilitary groups, this raises the possibility that the state hires armed groups to protect the oil region. However, we show that the oil shock increases paramilitary massacres and infrastructure attacks, which suggests that the increase in violence in the oil region cannot be interpreted as provision of protection services. Second, we show that the increase in attacks cannot be attributed to a decline in government enforcement, since government attacks increase with both the coffee and the oil shocks.

A third alternative account posits that the fall in coffee prices may have led farmers to plant more coca, and substitution toward this drug crop led to more violence in the coffee region. However, we use data on coca cultivation from satellite imagery to demonstrate that the coffee shock did not result in differential coca planting in the coffee region. This is important given a recent study by Angrist and Kugler (2008), which finds that violent deaths escalated differentially in Colombia's coca departments during the late 1990s. In fact, our analysis replicates the finding that coca promoted war-related casualties at the municipal level[4], but shows an independent effect of other commodity shocks on conflict outcomes.

There are two ways in which this paper builds on the previous literature. First, although previous within-country studies have shown a correlation between economic conditions and violence (Deininger, 2003; Barron et al 2004; and Do and Iyer, 2006), the scope of our dataset enables cleaner identification of this effect. For example, by employing municipality fixed effects, we control for time-invariant municipality characteristics that may be correlated with economic conditions and conflict outcomes. We also show that the results are robust to the inclusion of time trends by region and a geography based instru-

[3] We do not cover two of the top-ten (cut flowers and emeralds) since these are differentiated products without a defined international price.

[4] In Colombia, approximately 1,000 muncipalities are grouped into 32 departments. Municipalities are analogous to counties in the US, while departments are analogous to states.

ment for measured coffee intensity.

Second, although there is a rich theoretical literature on the relationship between economic conditions and warfare (including Grossman, 1991; Hirshleifer, 1991; Skarpedas,1992; Grossman and Kim, 1995; Esteban and Ray, 1999; Bates et al 2002; Fearon, 2005a; Chassang and Padró-i-Miquel, 2008a), our paper is the first to present micro-empirical evidence on proposed mechanisms.[5] We use individual-level wage data from rural household surveys to test the importance of the opportunity cost channel, and fiscal data on municipal revenue to highlight the importance of the rapacity effect. Our evidence on the opportunity cost channel is consistent with studies that show a link between economic conditions and illegal activities in non-war contexts, including a study of land invasions in Brazil by Hidalgo et al (2008), as well as the literature on crime, where several empirical analyses have shown that higher wages deter participation in criminal activities (Grogger, 1998 and Gould et al, 2002). Our evidence on the rapacity channel also builds on previous work that has suggested a link between natural resources and conflict (Ross, 2004; Snyder and Bhavnani, 2005; Fearon, 2005b; Humphreys, 2005; and Snyder, 2006).

The remainder of the paper is organized as follows. Section 2 provides background on the institutional context. Section 3 lays out a simple theoretical framework for understanding how commodity price shocks affect conflict. Section 4 describes the data and the methodology. Section 5 presents the results on conflict, mechanisms, and alternative accounts. Section 6 concludes.

2 Institutional Context–the Colombian Conflict

The Colombian civil war involves three actors: left-wing guerillas, the government and right-wing paramilitaries. The conflict started in the 1960s when communist groups launched an insurgency.[6] Today, it is led by the Armed Revolutionary Forces of Colombia (FARC by its Spanish acronym), which is estimated to have 16,000-20,000 combatants, and the National Liberation Army (ELN), which is estimated to have 4,000-6,000 fighters. Both groups fight with the stated aim of overthrowing the government and claim to represent the rural

[5] Other theoretical accounts of warfare that do not focus specifically on economic conditions include Hirshleifer (1995) Powell (2004), Esteban and Ray (2008), Chassang and Padró-i-Miquel (2008b) and Yared (2008).

[6] It differs from other civil wars in that there is no polarization along religious, regional or ethnic divisions, which has been conceptualized as a key predictor of social strife (see Esteban and Ray, 1994; Duclos, Esteban and Ray, 2004 and Esteban and Ray, 2006).

poor by supporting aims such as land redistribution. In spite of the stated ideological motivation, today, these groups are widely regarded as economically motivated, and profit from their involvement in the conflict (Richani, 1997). For example, the FARC is the richest guerilla in the world, and the guerillas together were estimated to have an income of $800 million in 1996 (*ibid*).

The paramilitaries were first organized with military support in the 1970s, but emerged on a widespread scale in the late 1980s, when rural elites and drug barons formed private armies in response to extortion by the guerillas. During the late 1990s, the United Self-Defense Groups of Colombia (AUC), the main coalition of paramilitary organizations, was estimated to have over 15,000 fighters. When the AUC was first formed, some paramilitary factions displayed an ideological motivation in countering the guerilla, although others were effectively armies for hire. After the AUC disbanded in 2003 in the context of a paramilitary demobilization, the groups came to have substantial overlap with criminal networks.[7] Technically, the conflict is three-sided, but there is extensive collusion between the paramilitary groups and the military in countering the guerillas.

The insurgency remained low intensity during the 1980s when it effectively served as a Cold War proxy, but escalated sharply and spread geographically during the 1990s. Our paper attempts to estimate the role of commodity price shocks in this upsurge. Since resource theft and recruitment are important channels for how conflict increases in response to economic shocks, we provide details on these mechanisms in the sub-sections below.

2.1 Resources Siphoned by Armed Groups

A central feature of the Colombian conflict is that the armed groups appropriate resources through several avenues. Both the paramilitaries and guerillas are financed by the drug trade, kidnapping, extortion, and predation on public funds.

Qualitative evidence suggests that predation is particularly high in regions with natural resources. Armed groups target production directly, siphon royalties, and kidnap executives employed in extracting companies. For example, paramilitary predation is documented to be particularly strong in the oil region. Paramilitary groups drill holes in oil pipelines, and sell stolen oil on the black

[7] A paramilitary demobilization took place in 2003, but there is little evidence that this official policy decreased paramilitary activity.

market (USIP, 2004). One journalistic account describing this theft writes that "Colombia's main oil pipeline...has so many holes in it that it is known as the flute (BBC, 2004)." Moreover, these groups also appropriate government revenue, as audits show that oil and gas royalties are often missing from municipal coffers where the paramilitaries exert influence (Human Rights Watch, 2005).

This budgetary predation became especially important after a major decentralization in 1991, which transferred more fiscal resources to local governments (Sanchez and Palau, 2006). Revenue predation takes places as armed groups form ties with corrupt politicians, or extort resources under threat of force. For example, in one case of collusion, mayors of six oil municipalities gave one paramilitary group control of over 50% of the town budgets (*El Tiempo*, 2007). In a case of extortion, paramilitary groups coerced officials to grant public contracts to particular firms, and extracted 30% of these resources from the firms (*Semana*, 2007).

Although there has been less disclosure of collusion between politicians and the guerillas, Richani (1997) discusses that diversion of public funds are also a part of FARC and ELN financing. Since the guerillas and paramilitaries have ties to the political establishment in different regions, this suggests that they successfully pursue predatory activities in different regions as well.

2.2 Wages Paid by Armed Groups

Both the guerillas and the paramilitaries recruit from the ranks of rural workers, as the insurgency today is concentrated largely in rural areas. The paramilitaries are reported to pay regular wages that exceed the official minimum wage (Gutierrez, 2006). Former ELN fighters also report that they were paid salaries and given other compensation (Human Rights Watch, 2003). Some former FARC combatants report that they did not receive salaries, but did receive occasional payments. However, all members are given food and clothing, and interviews with ex-combatants indicate that this can serve as an impetus for joining the guerilla during economic downturns (*ibid).*[8] The recruitment of guerilla and paramilitary combatants in rural areas suggests that rural workers can opt for employment in these armed groups, and economic conditions can influence the decision to become a fighter.

[8] A survey of ex-paramilitary combatants undertaken by the mayor's office in Medellin suggests that the need for employment played an important role in decisions to join paramilitary groups (Human Rights Watch, 2005).

3 Theory–Commodity Prices and Civil War

3.1 Framework

To outline the theoretical channels through which commodity shocks can affect conflict, we adopt the conceptual framework Becker (1968), where workers can choose employment in legal, productive sectors or an illegal appropriation sector associated with violence. To generate predictions about how international prices affect conflict, we lay out a simple model by Dal Bó and Dal Bó (2006), which embeds this worker decision in the canonical 2x2 international trade setting.

In this framework, the economy is composed of two productive sectors. These sectors, 1 and 2, each produce output y_1 and y_2 using constant returns to scale (CRS) technology. The goods are internationally traded at prices p_1 and p_2. We normalize the price of good 2 and use p to denote the relative price of good 1. The two legitimate sectors employ two factors of production, labor L and capital K. Factors are assumed to be mobile across all sectors. $\overline{L}$ and $\overline{K}$ represent the total endowment of these factors, w represents wages (the return to labor), and r denotes the rental rate (which is the return to capital).

There is also a third predation sector which employs labor, but not capital. The predatory sector does not produce output, but rather, siphons a fraction of production from the two legitimate sectors. A larger predation sector is assumed to increase conflict. We let $S(L_S)$ denote the share of output stolen, where L_s units of labor are used for predation purposes. $S(.)$ is a concave function, such that $S\prime(L_s) > 0$ and $S\prime\prime(L_s) < 0$. The size of the predatory sector, which represents the amount of stolen output is

$$S(L_s)\,[py_1 + y_2]$$

Under CRS production, the value of output equals payment to factors, so the amount appropriated is also equivalent to:

$$S(L_s)\left[r\overline{K} + w(\overline{L} - L_s)\right]$$

Thus, appropriation can be conceptualized as stealing output from firms, or targeting owners of factors. As in Becker (1968), workers can choose to enter either the legitimate or illegitimate sector. Individuals employed in the predation sector earn:

$$\frac{S(L_s)}{L_s}\left[r\overline{K}+w(\overline{L}-L_s)\right]$$

Three sets of equations characterize the equilibrium. First, factor market clearing in the two legitimate sectors requires that:

$$\begin{aligned} a_{1K}y_1 + a_{2K}y_2 &= \overline{K} \\ a_{1L}y_1 + a_{2L}y_2 &= \overline{L} - L_s \end{aligned}$$

where a_{ik} is the unit factor requirement of factor k in sector i.

Second, the zero profit conditions in sectors 1 and 2 are given by:

$$ra_{1K} + wa_{1L} = p \quad (1)$$

$$ra_{2K} + wa_{2L} = 1 \quad (2)$$

Finally, in equilibrium, the return from employment in the predation sector has to equal the opportunity cost of employment in the predation sector, which is the wage offered in the legitimate sectors (net of appropriation). This no arbitrage condition can be represented as:

$$\frac{S(L_s)}{L_s}\left[r\overline{K}+w(\overline{L}-L_s)\right] = \left[1-S(L_s)\right]w \quad (3)$$

The framework outlined above generates two predictions. The first result is the well-known Stolper-Samuelson theorem, and establishes how prices affect factor returns. The second establishes and how prices affect conflict.

Result 1 (Stolper-Samuelson Theorem). A rise in the price of the labor intensive good increases w, the return to labor, and decreases r, the return to capital. Conversely, a rise in the price of the capital-intensive good increases r and reduces w.

This result arises from differentiating zero profit conditions (1) and (2) which yields:

$$\frac{dw}{dp} = \frac{-a_{2K}}{a_{1K}a_{2L} - a_{1L}a_{2K}} \quad (4)$$

$$\frac{dr}{dp} = \frac{a_{2L}}{a_{1K}a_{2L} - a_{1L}a_{2K}} \quad (5)$$

When sector 1 is relatively more capital intensive, $\frac{a_{1k}}{a_{1L}} > \frac{a_{2K}}{a_{2L}}$. According to (4) and (5) $\frac{dw}{dp} < 0$ while $\frac{dr}{dp} > 0$. Conversely, when sector 1 is relatively more labor intensive, $\frac{a_{1k}}{a_{1L}} < \frac{a_{2K}}{a_{2L}}$. Then, (4) and (5) indicate that $\frac{dw}{dp} > 0$ while $\frac{dr}{dp} < 0$.

Result 2 A rise in the price of the labor-intensive good reduces the size of the appropriations sector, lessening conflict. In contrast, a rise in the price of the capital-intensive good expands the size of the predatory sector, increasing conflict.

This can be seen by differentiating the no arbitrage condition(3) which yields:

$$\frac{dL_s}{dp} = -\frac{\frac{\overline{K}L_s}{\left(\frac{r}{w}\overline{K}+\overline{L}\right)^2}\frac{d\left(\frac{r}{w}\right)}{dp}}{\left[S\prime - \frac{1}{\frac{r}{w}\overline{K}+\overline{L}}\right]} \quad (6)$$

The denominator is negative since S is a concave function. When good 1 is capital intensive, $\frac{d\left(\frac{r}{w}\right)}{dp} > 0$ by result 1 above, which establishes that $\frac{dL_s}{dp} > 0$. In contrast, when good 1 is labor intensive, $\frac{d\left(\frac{r}{w}\right)}{dp} < 0$ and $\frac{dL_s}{dp} < 0$.

To see which forces give rise to this effect, consider an increase in the price of the labor intensive good. This price increase bids wages up and the rental rate down as the labor intensive sector expands and the capital intensive sector contracts, making labor relatively more scarce. The net effect is that wages rise relative to contestable income in the economy, which reduces conflict by reducing the size of the appropriations sector. In this case, the opportunity cost effect arising from the wage increase trumps the potential rise in predation.

In contrast, when the price of the capital intensive good rises, the rental rate rises while wages fall, as the capital intensive sector expands and the labor intensive sector shrinks. This increases disputable wealth in the economy relative to wages, and leads to an expansion of the appropriative conflict sector. In contrast to the labor intensive case, there is no offsetting effect from wage increases. In this case, the rapacity effect dominates.

3.2 Testable Predictions

To test the predictions of the model, we make the additional assumption that each municipality in Colombia is economically distinct: factor endowments vary, and factor mobility is imperfect across municipalities. This implies that factor returns and the production structure also vary across municipalities (e.g., some places produce coffee more intensively, while other places produce oil more intensively).

It is straightforward to test the opportunity mechanism since we have a measure of wages. However, we cannot observe the rental rate or the amount of contestable income in each municipality. To test the rapacity effect, we instead use the fact that in this institutional context, armed groups appropriate both production and municipal revenue generated by taxing production (see discussion in Section 2). Since revenue is observable, we use this as a measure of potentially contestable resources. In the case of natural resources (such as oil), a national law establishes a uniform national royalty rate and specifies that the amount of revenue received by each municipality is based on the value of production in that municipality.[9] This revenue sharing arrangement suggests that resource revenue is in fact a good proxy for contestable production (or associated factor income).

This framework generates two sets of testable predictions. First, a rise in the price of agricultural goods such as coffee should increase wages relative to contestable municipal revenue, and reduce conflict differentially in regions that produce this good more intensively.

Second, an increase in the price of oil should increase municipal revenue relative to wages, and increase conflict differentially in regions that produce oil more intensively. To test these predictions, we estimate the effect of the coffee and oil shocks on wages, resource revenue and conflict outcomes.

4 Data and Methodology

4.1 Data

[9] In the case of coffee, there is an export tax charged by the National Federation of Coffee Growers (NFCG), a quasi-governmental institution which distributes revenue to coffee producing regions.

Our data on the Colombian civil war comes from the *Conflict Analysis Resource Center* (CERAC). This dataset is event-based, and includes over 21,000 war-related episodes in over 950 municipalities from 1988 to 2005. It is collected on the basis of 25 major newspapers, and supplemented by oral reports from Catholic priests residing in remote regions, which leads to the inclusion of municipalities that would otherwise receive little media coverage. The priests are regarded as neutral actors in the conflict, and often used as negotiators between the two sides. This minimizes potential over-reporting of violent events perpetuated by one side over another. The data is also cross-checked against other official sources, including a dataset by the National Police and reports by Human Rights Watch and Amnesty International. The procedure used to collect the data is described more extensively in Restrepo et al. (2004), and further details can be found in the data appendix.

The conflict data distinguishes between a unilateral *attack,* carried out by an identified politically-motivated armed group against a military or civilian target, and a *clash*, which involves an exchange of fire between two or more groups. Clash events include fighting between the guerilla and the paramilitary, and fighting between the armed groups and the government. Our analysis therefore focuses on four main dependent variables: the number of guerilla attacks, number of paramilitary attacks, number of clashes and number of war-related casualties.

We combine data on commodity intensities from a variety of sources, which are also detailed in the data appendix. For all agricultural commodities, we use a measure of the hectares of land used for cultivating that crop during one particular year. For example, a coffee census records the amount of land used for growing coffee in each municipality in 1997. This is prior to the major fall in coffee prices in 1998, which helps alleviate potential concerns that the measured coffee area changed in response to the price shock. Moreover, we interpret the 1997 coffee intensity as a time invariant indicator for how much coffee can be grown in the region, since geographic conditions determine which regions are most suited for cultivating coffee. We present direct evidence favoring this interpretation by developing a rainfall and temperature based coffee intensity measure and showing that this instrumented intensity yields similar results to the measured intensity.

Figure 1 maps our coffee measure and shows that Colombia is a good case for comparing conflict dynamics in regions of varying coffee intensity, since cultivation is not isolated to any particular region. In fact, 514 municipalities or approximately 58 percent of the municipal sample is classified as coffee producing. In 1997, the coffee sector accounted for 30 percent of rural employment (Ministry of Agriculture, 2007) Although coffee is not a plantation crop, and is grown largely by smallholders in Colombia, labor is demanded for harvesting purposes (Ortiz, 1999).[10]

Municipal level data for the other agricultural commodities (including sugar, banana, tobacco and African palm), is not available prior to 2005. We again interpret the 2005 measures as proxies for time-invariant cultivation intensity. Nonetheless, the availability of higher quality coffee data from an earlier time period is a key reason why we focus our analysis primarily on coffee.

For the natural resources, we have municipal-level production measures from a given year. The oil production measure is the average barrels of crude oil produced per day in each municipality in 1988, and the transport measure is the length of pipelines used to transport oil through each municipality in 2000. [11] It is important to consider transport in this analysis, since pipelines are a target of frequent attack by armed groups, and because municipalities receive revenue from taxing oil transport. According to our measures, there were 37 municipalities producing oil and 136 municipalities transporting oil in the sample. Figure 2 maps these oil-related regions of Colombia. The production measures for municipal-level coal and gold production are from later years, in 2004 and 2005, respectively.

In addition, we obtain data on coca cultivation from two sources. *Dirección Nacional de Estupefacientes* (DNE) has a measure of land used for coca cultivation in each municipality from 1994. An equivalent measure for 1999 to 2004 comes from the *United Nations Office of Drug Control* (UNODC), which collects this data based on satellite imagery.

In terms of prices, data on the international price of crude oil comes from the *International Financial Statistics* (IFS). Figure 3 shows the time series of the international price of oil, which rises sharply starting 1998. Data on coffee prices comes from the National Federation of Coffee Growers (NFCG), the quasi-governmental institution which oversees the taxation of coffee exports and sets the internal price of coffee paid to growers. This internal price does

[10] Colombian coffee has to be hand-picked because it tends to be grown on terraced slopes which makes it difficult to difficult to mechanize the harvest. Farmers hire casual agricltural workers for up to five months during two harvesting seasons. Larger farms also employ landless workers for non-harvest labor throughout the year (Ortiz, 1999).

[11] These pipelines are designated specifically for shipping petrol from oil fields to refineries and ports.

not vary across regions and is lower than the international price which includes transportation and marketing costs incurred by exporters, as well as the 'contribución cafetera', the coffee export tax. Revenue generated from taxing coffee accumulates in the National Coffee Fund (NCF), and these resources are used by the NFCG to stabilize coffee prices against external shocks.[12] Figure 4 compares the internal and international price of coffee. The sources for other international prices are described in the data appendix.

In exploring the mechanisms through which price shocks affect conflict, we analyze fiscal revenue data from the National Planning Department (NPD). Specifically, we analyze a capital revenue line-item, which includes tax revenue obtained by each municipality from production and transport of various natural resources. We also analyze a land pirating theft variable that comes from the Center of Studies on Economic Development (CEDE).

Finally, we use a nationally representative rural household survey called *Encuesta Nacional de Hogares* (ENH). This gives us labor market outcomes such as the hourly wage and other demographic variables. The Data Appendix table summarizes the sample size and data sources of key variables. Table I presents the summary statistics.

4.2 Methodology

Our empirical strategy compares violence dynamics in different regions of Colombia. Specifically, we assess if changes in commodity prices affect violence disproportionately in regions that produce these commodities more intensively. In the case of oil we estimate:

$$y_{jt} = \alpha_j + \beta_t + (Oilprod_j \times OP_t)\lambda + (Oilpipe_j \times OP_t)\theta + \mathbf{X}_{jt}\phi + \omega_{jt} \tag{7}$$

where α_j are municipality fixed effects, β_t are year fixed effects and y_{jt} are conflict outcomes in municipality j and year t, as measured by the number of

[12] Prior to 2001, the NFCG was able to enact a price floor and maintain a minimum price for coffee growers by guaranteeing the purchase of all coffee that met quality requirements at this price (Giovannucci et al., 2002). A 'fair price' was calculated on the basis of the sales price and anticipated marketing costs to exporters. However, in January of that year, the price floor had to be abandoned because plummeting international prices bankrupted the NCF. Subsequently, the Colombian government began offering a direct subsidy to growers instead. The AGC subsidy, which is still in operation, becomes activated when the price of parchment coffee is below US$.80/lb and is proportional to the gap between this floor and the actual price.

guerilla attacks, paramilitary attacks, clashes or casualties. $\mathbf{X}_{jt}$ is a vector of control variables. This vector varies across specifications but always includes the natural log of population, which controls for the scale effect since the dependent variable is the number of attacks. $Oilprod_j$ is the oil production level of municipality j in 1988, $Oilpipe_j$ is the length of oil pipelines in municipality j in 2000, and OP_t is the natural log of the international price of oil. The coefficients λ and θ capture the extent to which the oil price induces a differential change in violence in municipalities that produce or transport oil more intensively, respectively. Since we employ the international price directly, equation (7) is estimated using OLS.

In the case of coffee, we use the internal coffee price instrumented by the international price in the baseline specifications. We take this approach because the internal price reflects the actual exposure of producers to prices, but movements in the international price are more plausibly exogenous to Colombia's production. Although the internal price does not vary by region, it is possible to develop accounts of potential endogeneity, such as the NFCG rewarding lower violence in the coffee region by raising the internal price of coffee. We exploit variation in the international price to avoid concerns of this nature.

The estimating equation for coffee can thus be represented in two stages, though the estimate is always undertaken through a one-step procedure. In the first stage, the interaction of coffee intensity and internal price is instrumented with the interaction of coffee intensity and international price. We estimate:

$$Cof_j \times CP_t = \alpha_j + \beta_t + (Cof_j \times ICP_t)\gamma + \mathbf{X}_{jt}\rho + \upsilon_{jt} \tag{8}$$

where Cof_j is the hectares of land devoted to coffee production in 1997;[13] CP_t is the natural log of the internal coffee price in year t; ICP_t is the natural log of the international coffee price.

The second stage estimates the effect of the instrumented coffee interaction on the violence outcomes. This is given by:

$$y_{jt} = \alpha_j + \beta_t + (\widehat{Cof_j \times CP_t})\delta + \mathbf{X}_{jt}\phi + \varepsilon_{jt} \tag{9}$$

where δ measures the differential effect of coffee prices on violence in regions

[13] Hectares of land is the appropriate measure of coffee intensity since our outcome variable is the number of violent events, rather than the number normalized by total land area or population. To account for the fact that larger municipalities may experience more attacks, we control for the log of population.

with greater exposure to price changes.[14]

To what extent can international coffee and oil prices be considered exogenous to Colombia's production? The answer is straightforward for oil. Colombia holds less than 1 percent of the world oil market and is therefore considered a price-taker. In contrast, the country is a major player in the world coffee market, and its coffee exports may have influenced the international price during certain periods.[15] However, in considering the relationship between agricultural prices and violence, the most plausible form of endogeneity is one that would exert an upward bias against the hypothesized negative effect. In particular, reverse causality may arise if an intensification of violence in the coffee region lowers coffee production levels, causing the international price to increase. Although this supply effect would bias us against finding an effect, we take two steps to address other potential endogeneity concerns.

As a first step, we restrict the sample to 1994-2005, when prices were arguably exogenous to Colombia's production. Coffee prices rose exogenously in 1994 due to an intense frost episode in Brazil which decimated Brazilian coffee exports. As shown in Figure 5, prices remained high from 1994 to 1997, but then plummeted sharply as supply increases from Vietnam and Brazil drove the real international price to a new historic low.[16] The Brazilian expansion occurred because the government promoted planting in frost-free areas after the 1994 crop failure. The harvest of additional output also coincided with a 66 percent devaluation of the Brazilian currency in 1999 which further boosted exports (Evangelist and Sathe, 2006). The Vietnamese expansion was caused by several factors including World Bank development assistance programs that promoted coffee exports during the mid 1990s (Oxfam, 2002), normalization of trade relations with the US in 1995, and a government led export promotion strategy, including subsidies, which was initiated in 1999 (Nguyen and Grote, 2004). As shown in Figure 5, Colombia's exports did not rise during this 11-year interval, while the price dropped dramatically. This suggests that the changes in Colombia's exports did not drive changes in the international price during this sub-period.

As a second step, we also instrument the internal price of coffee in Colom-

[14] Miller and Urdinola (2006) independently developed a similar measure of coffee price shocks in Colombia.

[15] In particular, the system of export quotas negotiated under the World Coffee Organization came to and end in the late 1980s, and all major coffee producing countries subsequently expanded their exports causing the international price of coffee to fall until 1994.

[16] Figures 4 and 5 plot the price of Arabica, the Colombia-relevant coffee variety.

bia with the quantity of exports from the other major coffee producers, which ensures that we capture movements in the international price driven by other countries. This strategy allows us to use the entire time series of violence data, from 1988 to 2005. It is possible that a more subtle endogeneity problem could arise if governments in Vietnam and Brazil based their policy decisions on violence levels in Colombia, encouraging coffee production when the conflict intensifies in the Colombian coffee region. However, this is unlikely since the Brazilian government's decision to promote expansion into frost-free areas was related to technological advances such as new hybrid plants and mechanization that allowed coffee to be harvested from these regions (Oxfam, 2002), while the 1999 devaluation was a major policy change that followed on the heals of the East Asian financial crisis and massive speculative pressure in capital markets. Similarly, World Bank aid programs and the US decision to end sanctions against Vietnam were unlikely to be motivated by developments in Colombia's civil war.

When we instrument the international price of coffee with the exports of the other major coffee producing nations, the first stage is given by:

$$Cof_j \times CP_t = \alpha_j + \beta_t + (Cof_j \times FE_t)\gamma + \mathbf{X}_{jt}\rho + \nu_{jt} \tag{10}$$

where FE_t is the log of foreign coffee exports from the three largest coffee producers besides Colombia: Vietnam, Brazil and Indonesia.

We begin by presenting a simple graph that captures the essence of our identification strategy. In Figure 6, we plot the mean of four violence measures over time, distinguishing between coffee and non-coffee areas. The figure shows that all four measures follow common trends in the two types of regions prior to the price shock, but diverge in the late 1990s, when the price of coffee falls in the international market. The graph in the top left corner shows that the average number of guerilla attacks diverges in 1998, with mean conflict levels rising more in the coffee areas. Moreover, the gap starts closing in 2003, when the price of coffee begins its slow recovery (see Figure 5). The same pattern applies to the other three measures of political violence, although the divergence starts one year later, in 1999, for paramilitary attacks and clashes, and two years later, in 2000 for casualties.

In Figure 7, we present the equivalent figure for mean violence levels in oil and non-oil areas. In contrast to coffee, these graphs show that guerilla attacks, clashes and casualties tend to be higher in oil areas relative to non-oil areas for most years of the sample period, and do not diverge systematically across regions during years when oil prices are high. However, a distinct pattern emerges in the case of mean paramilitary attacks, which rise differentially in the oil regions after 1998, when the price of oil rose sharply in the world market (see Figure 3). This visual evidence suggests that the coffee shock affected all forms of violence, while the oil shock specifically affected paramilitary attacks. In the results that follow, we generalize the representation in Figures 6 and 7 into a regression framework.

5 Results

5.1 The Coffee Shock and Conflict: Baseline Results

In this sub-section, we use regression analysis to assess the effect of coffee prices on civil war outcomes in Colombia. Since this analysis is restricted to the 1994-2005 period, we simply instrument the internal price with the international price. The equations for the first and second stages are (8) and (9), although the estimate is undertaken in one step. The results are presented in Table II. For all specifications, the standard errors are clustered at the department level to control for potential serial correlation over time and across municipalities within a department. This is a fairly stringent test since over 900 Colombian municipalities in our sample are grouped into 32 departments.

Panel A displays the results from our baseline sample, which includes every municipality for which we have conflict, coffee and population data. Columns (1) - (4) indicate that coffee prices have a *negative* relationship to conflict: when the price of coffee *increases*, violence *falls* differentially in municipalities that produce coffee more intensively. The estimates are of statistical and economic significance. To gauge the magnitude, we consider the rise in violence associated with the fall in coffee prices from the peak in 1997 to the trough in 2003, when internal price fell by .68 log points. For the mean coffee municipality, where the coffee intensity is 1.54 thousand hectares, the coefficients imply that the price fall resulted in .02 more guerilla attacks, .01 more paramilitary attacks, .04 more clashes and .14 more casualties each year.

It is useful to compare these increases to mean violence levels. Over 1994-2005, municipalities experienced an average of .58 guerilla attacks, .12 paramilitary attacks, .54 clashes and 2.36 casualties. This suggests that in the mean coffee region, the price shock induced these outcomes to increase by an additional 4 percent, 6 percent, 7 percent and 6 percent, respectively. The effects are larger for regions that are more coffee dependent. For a municipality at the 75th percentile of the coffee intensity distribution, the equivalent figures are 5 percent, 8 percent, 9 percent and 7 percent. A final way of gauging the magnitude of this effect is by recognizing that .14 casualties translates into approximately 495 additional deaths in the coffee region during the interval when coffee prices were falling.

Panels B shows that these results are robust to two variations in the sample: one eliminates 27 municipalities affected by a major earthquake in the coffee region in 1999, and the second eliminates 5 regions in the Demilitarized Zone (DMZ), which were turned over to the guerilla between 1998-2002.

5.2 The Coffee Shock and Conflict: IV Results

In this sub-section, we address potential endogeneity and measurement error in our coffee intensity measure. The intensity measure (defined as the hectares of land used for coffee cultivation) comes from a census undertaken in 1997. The analysis thus far has treated municipal coffee cultivation as a time-invariant characteristic, but in actuality, it is a time varying feature that may reflect past periods of high or low coffee prices. In particular, coffee prices were at their peak in 1997, and these high prices may have induced some municipalities to substitute toward coffee temporarily. This presents a challenge for the analysis since it introduces measurement error into the coffee intensity measure, which will bias the estimates.[17] Moreover, if the elasticity of substitution into coffee cultivation is correlated with unobserved factors that reduce violence, this may lead to an underestimate of the true effect. For example, substitution toward coffee may be highest in areas where municipal governments invest in rural infrastructure and security. In this case, these high investment regions will be measured to have high coffee intensity in 1997 and experience a smaller rise in violence during subsequent years.

To address this problem, we instrument the coffee intensity variable with climactic conditions that capture the latent coffee production capability of a municipality. In a country like Colombia, coffee is most favored to grow where the temperature ranges between 16 to 26 degrees Celsius, and where annual rainfall ranges from 1800 to 2800 mm per year (De Graaf, 1986). Thus, we

[17] If production responds to price so that municipalities with lower coffee intensity respond more to high price years, then the measurement error is not of the classical form, and would not necessarily bias the coefficients toward zero.

instrument coffee intensity using a fully flexible cubic specification of rainfall, temperature and the interaction of these two variables. In this IV specification, the first stage is given by:

$$Cof_j \times CP_t = \alpha_j + \beta_t + \sum_{m=0}^{3}\sum_{n=0}^{3}\left(R_j^m \times T_j^n \times ICP_t\right)\theta_{mn} + \mathbf{X}_{jt}\rho + \mu_{jt} \quad (11)$$

where R_j^m is the average annual rainfall of municipality j raised to the power m, T_j^n is the average annual temperature of municipality j raised to the power n,and $\theta_{00} = 0$. The F-stat from the first stage is 7.5, and the R-sqr is .19, which suggests that rainfall and temperature are good predictors of the coffee intensity variable.

In the second stage, we again estimate (9). These results are displayed in Table III. The standard errors are larger relative to the estimates in Table II, and Column (4) indicates that the coffee shock no longer has a significant effect on casualties. However, the effect remains significant for the other outcome measures at either the 1% or 5% level. Columns (1)-(4) also indicate that the IV coefficient estimates are larger in absolute value, compared to the estimates in Table II. This suggests that either measurement error exerts a downward bias, or the elasticity of substitution into coffee cultivation is negatively correlated with factors such as investment in security.

Next, we use non-parametric estimates to examine whether municipalities with a higher predicted coffee intensity also experienced a larger increase in conflict over this period. We continue defining predicted coffee intensity on the basis of the cubic interaction in rainfall and temperature, and compare violence outcomes during the period when coffee prices were high (1994-1997) with the period when they were low (1998-2005). To do this, we first create residual measures of the four outcome variables, controlling for municipality and year fixed effects. We then employ locally weighted regressions to generate non-parametric plots which graph the difference in residual violence between the two price regimes against the predicted coffee intensity. Figure 8 presents these plots. It shows that the increase in residual guerilla attacks, paramilitary attacks and casualties across the two periods generally rises in the level of predicted coffee intensity. For clashes, the difference decreases initially, but rises steadily beyond a threshold fitted value of .5. These non-parametric estimates further establish that when prices fell in 1998, the extent to which conflict increased was closely linked to the latent coffee production capability of the municipality, as determined by its geographic attributes.

5.3 The Oil Shock, the Coffee Shock and Conflict

In this sub-section, we explore the simultaneous effect of oil prices and coffee prices on political violence in Colombia. Here, we use the data from the full sample of available years, from 1988 to 2005. We begin by estimating the effect of the oil shock on our four measures of civil conflict, and then re-estimate the effect of the coffee shock for this longer time period. Finally, we include both shocks simultaneously in one specification. The results from all three estimates show that oil prices and coffee prices affect conflict in opposite directions: a rise in the price of oil increases the number of attacks differentially in the oil region, while a rise in the price of coffee reduces violence more in coffee-intensive areas.

To assess the effect of the oil shock, we estimate (7). The results in Panel A of Table IV indicate that both oil shock measures exert a positive and significant effect on one of the four conflict outcomes: the number of paramilitary attacks in the municipality. To measure the magnitude of the coefficients in column (2), we consider the rise in attacks over 1998 to 2005, when the oil price rose by 1.37 log points. Since mean oil production in 1988 was .086 hundreds of thousands of barrels per day, the coefficient on the production interaction implies that paramilitary attacks increased by .012 more in the average oil producing region, which represents a 13 percent increase above the mean attacks in the full sample period. Moreover, since mean pipeline length is .506 hundreds of kilometers, the coefficient on the pipeline interaction implies a 27 percent increase above the mean for the average oil transporting municipality.

To estimate the effect of the coffee shock for the 1988-2005 period, we instrument the internal price with the coffee export volume of the other major coffee producing nations. We take this approach since Colombia's production may have influenced the international price during the early 1990s, as detailed in Section 4.2.[18] The first and second stages are given by (10) and (9). The results in Panel B of Table IV show that the coffee shock continues to exert a significant effect on all four conflict outcomes in this longer period. The co-

[18] In Section 5.1, we analyzed the 1994 to 2005 period, and chose to instrument the internal price with the international price since the international price is a less noisy predictor of the internal price relative to the exports of other major coffee producers. However, our results for the longer 1988 to 2005 period are not sensitive to using either the international price or the export volume as the instrument for internal price.

efficients in columns (1) and (2) imply a somewhat larger effect on the attack variables relative to the results in Table II. According to these estimates, the fall in coffee prices between 1997 and 2003 resulted in 6 percent more guerilla attacks, 9 percent more paramilitary attacks and clashes, and 6 percent more casualties in the mean coffee area.

In Panel C, we assess the simultaneous effects of the coffee and oil shocks, which limits the sample to the set of municipalities for which data on violence and coffee intensity are available. The results are the same as when the two shocks are analyzed separately in Panels A and B. We can compare the size of the coffee and oil effects by looking at the coefficients in column (2). These numbers suggest that the coffee and oil effects are similar in magnitude: a 10 percent fall in the price of coffee results in 2 percent more paramilitary attacks in the mean coffee region, while a 10 percent rise in the price of oil results in 2 percent more attacks in the average transporting area, and 1 percent more attacks in the average oil producing area.

If violence follows different trends over time due to unobserved region-specific factors, then these omitted variables may also exert a bias on the estimates. For example, it is possible that either the oil or coffee municipalities happen to be located in regions where violence escalated faster during the 1990s, due to factors that are unrelated to commodity prices. To account for this possibility, in Panel D, we introduce linear time trends by department as an additional control. Relative to the baseline specification in Panel C, the effect of the coffee shock on guerilla attacks is somewhat weaker, but still significant at the 10 percent level. Overall, the results indicate that differential trends by region cannot explain the effect of commodity shocks on violence outcomes.[19]

In summary, these results suggest that coffee prices have a significant negative effect on civil war outcomes: attacks, clashes and casualties *decrease* disproportionately in the coffee areas when the price of coffee rises in the international market. In contrast, oil prices are positively related to incidence of violence: when the price of oil rises in international markets, paramilitary attacks *increase* more in the municipalities that house oil reserves and pipelines. We address the asymmetry of why the coffee shock appears to affect all measures of violence, while the oil shock specifically affects paramilitary attacks in section 5.6.

[19] We also find that the results are robust to the inclusion of other variables such as land inequality and an indicator for whether the region was urban, interacted with the price of coffee and oil.

5.4 Wages and the Opportunity Cost Channel

As predicted by the framework in Section 3, commodity prices can either affect conflict by lowering wages, which alters the opportunity cost of armed recruitment, or by increasing municipal revenue, which raises the incentive to predate on these resources. In this sub-section, we assess the importance of the opportunity cost channel by estimating the effect of the coffee and the oil shocks on wages. We estimate:

$$q_{ijt} = \alpha_j + \beta_t + (\widehat{\text{Cof}_j \times \text{CP}_t})\delta + (\mathit{Oilprod}_j \times \text{OP}_t)\lambda + (\mathit{Oilpipe}_j \times \text{OP}_t)\theta + \mathbf{X}_{ijt}\rho + \omega_{ijt} \quad (12)$$

where q_{ijt} is the (log) real wages of individual i in municipality j and year t; and $\mathbf{X}_{ijt}$ is a vector of individual-level controls including education, experience and its square, the number of individuals residing in the household, and indicator variables for gender and marital status. Table V presents these results for 1996-2004, the subset of years for which the wage data is available.[20] Column (1) shows the effect on all workers in the sample, while Columns (2) and (3) disaggregate the sample according to whether the workers are employed in the agricultural sector.

The results indicate that the coffee shock had a substantial effect on the wages of workers in the coffee region, and that this effect arises from the impact on wages in the agricultural sector. The coefficient in Column (2) implies that a 1 percent increase in the real price of coffee increases real agricultural wages by .18 percent more in the mean coffee municipality, relative to a non-coffee area. The 68 percent fall in coffee prices from 1997 to 2003 would therefore have reduced wages by an additional 12 percent in the mean coffee region, and by an additional 2 percent and 16 percent in municipalities at the 25th and 75th percentile of the coffee intensity distribution.

The results from Table V also demonstrate that the oil shock did not have a significant effect on wages, which establishes that the opportunity cost effect does not arise in the case of the capital-intensive resource commodity.

[20] We also re-estimate our baseline violence specification for the 1996-2004 period and confirm that our main results hold for this sub-sample to ensure that sample selection does not affect the results.

5.5 Revenue and the Rapacity Channel

In this sub-section, we test the importance of the rapacity channel by examining whether the coffee and oil shocks had a significant effect on budgetary resources in local governments. The theory predicts that price shocks affect government resources through their effect on tax revenue. In the Colombian context, there are two ways in which oil prices can affect municipal tax revenue. On the production side, foreign oil companies are required to pay the government royalties amounting to 50 percent of the value of their oil exports. An explicit revenue sharing agreements (codified in Law 141) requires that each level of government – central, departmental and municipal – receives a share of these resources, which are called oil regalias. [21] The amount received by each municipality is proportional to municipal production. This legislation also specifies that companies pay a transport tax to municipalities with oil pipelines. The amount each municipality receives is contingent on the length of the pipeline, the volume of oil transported, and a tariff based on the profitability of the oil sector which is contingent on the value of oil. In the fiscal data, both the transport tax and regalias are codified under a line-item called "capital revenue," which also includes other transfers from the central government, such as cofinancing for joint investment projects with the municipal government. Therefore, we assess the effect of the commodity shocks on this capital revenue line-item.

These results are shown in column (1) of Table VI, and indicate that both measures of the oil shock have a significant effect on capital revenue at the disposal of the municipal government. The coefficient on the oil production interaction indicates that a 1 percent rise in the price of oil increases revenue by .04 percent more in the mean producing municipality, while the coefficient on the pipeline interaction implies a revenue increase of .17 percent in the mean transporting municipality. This suggests that the 137 percent increase in oil prices from 1998 to 2005 resulted in 5 and 23 percent more revenue in the average producing and transporting municipality, respectively. Table VI also indicates that the coffee shock does not have a significant effect on capital revenue, which confirms that the rapacity effect does not arise in the case of the labor intensive agricultural commodity.

Finally, we present some suggestive evidence indicating that the oil shock re-

[21] The government puts 80 percent of the oil royalties into a Oil Stabilization Fund. The remaining 20 percent of the royalties are distributed among various levels of government. Specifically, 32 percent of the remaining revenue is allocated to the central government, 47.5 percent is allocated to the department, and 12.5 percent to the municipal government.

sults in greater predation. In columns (2)-(3) of Table VI, we look at a "land pirating" variable, which effectively measures armed robbery of commercial goods that are transported on land. These results must be taken as suggestive since the variable is only available for a third of the municipal sample, for the years from 2001-2005. The results indicate that paramilitary pirating (but not guerilla pirating) increase in response to the oil shock. In other words, the paramilitaries are found to escalate both attacks and theft in the oil region. To the extent that greater oil wealth result increases demand for consumer goods, a rise in commercial theft is consistent with the idea that the rise in oil prices generates more stealable wealth. No equivalent effect is found in the case of the coffee shock.

5.6 Interpretation

Our evidence indicates that the coffee shock lowers wages but does not affect contestable municipal revenue. This is consistent with the idea that violence increases as the opportunity cost effect predominates in the case of a price shock to a labor intensive goods. In contrast, the rise in oil prices increases contestable revenue and pirating in the oil region, but does not affect wages. This is consistent with the prediction that violence increases as the rapacity effect predominates in the case of price shocks to capital intensive goods.

Our interpretation of this evidence is that when agricultural laborers in the coffee region face lower wages, this raises their incentive to join armed groups. The availability of cheaper recruits also leads armed groups to scale up recruitment activities in these areas. Because recruitment is a decentralized activity, it is possible for both the paramilitary and guerilla groups to escalate in the same municipality, with the guerillas recruiting in some parts of the municipality and the paramilitary recruiting in others. This is consistent with the symmetric result that both guerilla and paramilitary attacks increase in the coffee region when the price of coffee falls in the international market.

In addition, we posit that a rise in petrol prices motivates armed groups to escalate appropriation activities in oil-rich areas to seize contestable resources. One form of predation targets government revenue, which can be siphoned through extortion or through links with corrupt politicians.

Unlike recruitment, predation of this nature requires a clear winner: for example, a single mayor is unlikely to strike deals with both the paramilitaries and the guerillas in the same municipality, at the same time. Thus, when violence escalates through predation, we should observe one dominant group escalating conflict activity. This is consistent with the asymmetric result that the paramilitaries, but not the guerillas, escalate attacks in the oil region. Determining which side wins in the case of a particular commodity shock is beyond the scope of this paper. However, we posit that the armed groups have commodity specific military and political capital which determines their predation capacity under different circumstances. For example, the paramilitary may be able to dominate in the oil region because of their ties to the government military, which has a strong presence in the oil region. However, the guerillas may be more skilled predators in the case other commodity shocks, an issue we examine in the next section, where we examine the generalizability of our results to other commodities.

5.7 Other Commodity Price Shocks and Conflict

In this section, we examine the extent to which our findings are generalizable to other agricultural and natural resource commodities. We choose other goods according to three criteria. The commodity should be a major export, have a defined international price, and there should be a reasonable number of treatment municipalities producing the good. (Further details are available in the data appendix). These criteria yield two additional natural resources: coal and gold; and four other agricultural goods: bananas, sugar, African palm, and tobacco.

We begin by presenting the results on other agricultural commodities in Table VII. First, the coefficients in columns (1)-(2) demonstrate that a fall in the price of these goods result in a differential increase in attacks in regions that grow these crops more intensively. Second, the price shock generally has symmetric effects, increasing attacks by both the paramilitaries and the guerillas. This is consistent with the idea that both types of groups can increase their presence in a municipality when they are pursuing recruitment activities. Consequently, the agricultural price shocks also have an effect on overall measures of conflict, resulting in greater clashes and casualties in Columns (3) and (4). The exception is the palm shock, where the coefficient is insignificant in the case of guerilla attacks. However, even in this case there is an increase in both measures of aggregate violence.

These estimated coefficients imply a substantial effect on violence outcomes. For example, considering the mean municipality in the crop intensity distribution, a 10 percent fall in the price implies a differential clashes increase of 8 percent for coffee, 17 percent for sugar, 14 percent for bananas, 14 percent for palm, and 17 percent for tobacco. As discussed in the data appendix, the data on other crops are less ideal for this analysis relative to the data on coffee. Thus, for the results in Table VII, we place more weight on the direction of the effect rather than the implied magnitude of the coefficients.

In Table VIII, we present the results on other natural resource commodities. First, the coefficients in Columns (1)-(2) demonstrate that the positive relationship between the price of capital intensive resource commodities and attack outcomes generalize beyond oil, and hold in the case of both coal and gold. Second, the results confirm that price shocks to these commodities have asymmetric effects on attacks by group: while the oil shock escalates paramilitary attacks and has no significant effect on guerilla attacks, the coal and gold shocks increase guerilla attacks, but have no significant effect on paramilitary attacks. The implied effect of the price shock is smaller in the case of gold and coal, relative to oil. A 10 percent rise in the price of coal and gold both imply a 2 percent increase in guerilla attacks in the average gold and coal producing municipality (compared to a 5 and 16 percent increase in the average oil producing and transporting municipalities, respectively).

The asymmetric effect on attacks is consistent with the idea that when the motivation is rapacity, it is generally one side that succeeds in extorting or colluding with politicians to predate on budgetary resources. Thus, the effect on more aggregate measures of conflict is ambiguous. Indeed columns (3)-(4) show that in the case of the oil and coal shocks, there is no significant increase in either clashes between sides or casualties. On the other hand, the gold shock results in significant increases in both these aggregate violence outcomes.

5.8 Alternative Account: Paramilitary Protection

In this section we consider an alternative account of why the oil shocks results in more attacks in the oil region. Since oil generates considerable foreign exchange earnings in Colombia, this suggests that local governments may invite paramilitaries into the oil region to protect this valuable asset, and effectively outsource security provision to these groups. By this alternative account, the rise in paramilitary attacks reflects protection, rather than predation.

We present evidence against this hypothesis by looking at two disaggregated versions of the attack variable. First, we divide the attacks into infrastructure attacks (which includes destruction of roads, bridges and pipelines) versus non-infrastructure attacks. Second, we focus specifically on a particular type of attack: a massacre, where at least four civilians are killed in a single event.

Table IX shows these results. The first three columns confirm that the oil shock does not have a significant effect on guerilla attacks of any type. Column (4) indicates that both oil shock measures have a substantial effect on non-infrastructure attacks undertaken by the paramilitary. This result is consistent with both the predation and protection hypothesis and does not help us distinguish between these two potential explanations. However, Column (5) indicates that a rise in oil prices also results in more infrastructure attacks undertaken by paramilitary groups in the pipeline regions, which appears inconsistent with the protection account [22] In fact, this result appears more consistent with several anecdotal accounts of how the paramilitary groups target pipelines to steal petrol, which is then sold on the black market (see Forero, 2004 and McDermott, 2004).

Finally, Column (6) of Table IX shows that there was an increase in the number of massacres undertaken by paramilitary groups in oil producing regions. These results suggest that the paramilitary presence does not safeguard the pipelines or the population in the oil region.

5.9 Alternative Account: Enforcement

A second alternative account suggests that the price shocks may have affected violence by reducing enforcement in the coffee or oil regions. For example, when the price of coffee fell, there may have been reduced military presence in the coffee region, which could have facilitated attacks by armed groups. To explore this hypothesis, we look at a measure of government attacks, which proxies for how actively the military is fighting in a particular area. The results in Table X indicate that government military attacks *increased* differentially in the coffee region when coffee prices fell, which suggests that military enforcement increased over this period. The results also indicate that when the oil price increased, government attacks increased more in the oil producing region, and were not affected in the oil transporting regions, which confirms that reductions

[22] It is possible that paramilitary protection against the guerilla could result in collateral damage against pipelines. However, it is unlikely that an event of this nature would be mis-coded as an infrastructure attack in our data, since events involving two or more groups are classified as a clash in our dataset.

in enforcement can't account for the rise of attacks in the oil region.

5.10 Alternative Account: Coca

A third alternative account focuses on coffee, and suggests that the coffee shock results in greater violence due to changes in illicit cultivation of coca. There are two ways in which the presence of coca may confound the findings. First, because the paramilitaries and guerillas are financed by the drug trade, policy changes that increase coca in a municipality will also increase the amount of conflict in that municipality. This may bias our estimates of how commodity shocks affect conflict if there is a correlation between coca and coffee intensity, or between the presence of oil and coca across regions.

There are two important policy changes that had an impact on coca cultivation during the sample period. In 1999, a US-backed military aid initiative called *Plan Colombia* began an aggressive military campaign, including aerial spraying aimed at eradicating drug crops. If eradication was successful, then it may have lowered coca cultivation in the traditional coca region, and thus lowered violence in less coffee-intensive regions. This would upward bias our estimates on the effect of the coffee shock, since it would effectively have lowered violence in the control regions. On the other hand, if *Plan Colombia* resulted in greater military clashes in coca areas, then this may downward bias our estimate by intensifying violence in the less coffee-intensive (or control) areas. We account for this potential contamination by interacting the 1994 coca intensity with the price of coffee and the price of oil, which controls for any changes (such as *Plan Colombia)* that were contemporaneous with changes in the commodity prices, and may have caused violence to change differentially in coca areas. The results, presented in Panel A of Table XI, show that our main results do not change substantially. With the exception of the guerilla attack outcome in the case of the coffee shock, the estimated coefficients are larger relative to the baseline specification in Panel C of Table IV, which suggests that, for the most part, this policy change exerted a downward bias in the original specifications.

The second policy change we consider is increased air interdiction to curb the transport of coca out of Peru and Bolivia, which shifted coca cultivation from the other Andean nations into Colombia in 1994. Angrist and Kugler (2008) argue that the subsequent increase in coca production was concentrated in Colombian municipalities that were already growing coca prior to 1994. Thus, we take their approach and control for this policy change by interacting the 1994 coca intensity measure with a post-1994 indicator variable. This specification also allows us to assess whether political violence rose disproportionately in the coca stronghold in the post-1994 period.

The results in Panel B of Table XI once again show that the core results do not change substantially when we include this additional control. Moreover, the coca shock is found to significantly raise the amount of clashes and casualties, though it does not appear to affect the number of guerilla and paramilitary attacks. The coefficients in columns (3) and (4) indicate that after 1994, clashes and casualties increased by 28 and 57 percent respectively in the mean coca municipality. This is consistent with the Angrist and Kugler finding that violent deaths increased more in coca departments after 1994, though we replicate this finding at the municipal level and show the link to political violence, by using data on civil war-related casualties instead of mortality statistics as the measure of violence.

Besides other contemporaneous policy changes, there is a second way in which coca may affect our findings. The fall in coffee prices may have led farmers to substitute away from coffee production and into coca production. Since armed groups fight to control proceeds from the drug trade, the rise in coca cultivation could serve as an alternative mechanism through which the price shocks affect violence, beyond the opportunity cost and rapacity channels. In fact, there has been extensive media coverage claiming that the sharp fall in international coffee prices in the late 1990s led farmers to cultivate more coca in Colombia and other neighboring countries (see Krauss 2001, Wilson, 2001a; Wilson 2001b and Fritsch, 2002). To test this hypothesis, we re-estimate equation (9), using time-varying coca intensity as the outcome variable.[23] These results are summarized in Panel A of Table XII. The coefficients in Column (1) indicate that the coffee shock did not have a significant effect on coca cultivation. Because this sample is restricted to the subset of years and municipalities for which we have coca data, we re-estimate our violence outcomes for this subsample in columns (2) - (5), and find that the basic results do not change.

In Panel B, we undertake a second falsification test to present evidence against this alternative mechanism. If the coffee shock affects conflict through the coca channel, then it should no longer exert a significant effect once we remove every municipality ever recorded as producing coca from the estimation

[23] We define coca intensity as the hectares of land used for cultivating coca.

(which represents one-quarter of the municipalities in our sample). Moreover, we are only able to observe whether municipalities grow coca after 1994, which suggests that we should restrict this analysis to the post-94 period. Together, these two restrictions reduce the number of municipality-year observations by nearly 50 percent relative to the full sample in the baseline specification (shown in Table IV). However, rows (i) and (ii) of Panel B show that the main results continue to hold even within this reduced sample. As shown in Column (2), the effect of the coffee shock on guerilla attacks is no longer significant at the 10 percent level, but the coefficient becomes marginally insignificant (with a p-value of .108). These results establish that coca cannot be the driving force through which coffee areas experienced an increase in conflict outcomes.

6 Conclusion

This paper has examined how different types of commodity shocks affect civil war outcomes, using a detailed within-country analysis. We present evidence showing that price shocks to labor intensive agricultural commodities and capital intensive resource commodities have opposite effects on political violence in Colombia. A *fall* in the price of coffee, a labor-intensive good, increases violence disproportionately in municipalities growing more coffee. In contrast, a *rise* in the price of oil intensifies attacks disproportionately in areas transporting and producing more oil. These results are robust to using a geography based instrument for coffee production and controlling for differential trends by region.

We also present evidence on specific mechanisms through which these commodity prices affect civil conflict, and find that different channels are relevant in the two cases. The opportunity cost effect is found to be important in the case of the labor intensive commodity: the fall in coffee prices reduces workers' wages and lowers the cost of recruiting workers into armed groups. On the other hand, rapacity is found to play a key role in the case of the capital intensive resource commodity: the oil shock substantially increases local government revenue, encouraging paramilitary groups to move into oil areas to control these resources. We are also able to rule out several alternative accounts including changes in enforcement and coca cultivation.

In addition, we show that the negative relationship between prices and conflict holds in the case of several other agricultural goods, including sugar, bananas, palm and tobacco, and that the positive relationship between prices and conflict holds in the case of other extractive sectors, including gold and coal. This suggests that our findings generalize to the broader class of labor intensive agricultural commodities and capital intensive natural resources.

Several important policy implications emerge from this analysis. First, the findings suggest that stabilizing prices of labor intensive commodities can play a role in mitigating civil war violence. Second, they indicate that social programs designed to reduce poverty and unemployment may moderate conflict in the wake of price shocks to this class of goods. Third, they suggest that monitoring revenue generated from natural resources may be essential to prevent these funds from financing conflict activity. Finally, they suggest that the structure of local government can interact with price shocks in affecting conflict outcomes. For example, price shocks to commodities such as oil are more likely to invite predation when fiscal decentralization transfers resources to lower levels of government. In this paper, we have focused on the critical role of the factor intensity in determining how price shocks affect civil war. However, how the production technology interacts with political institutions in mediating the value-to-violence relationship is an important avenue for future study.

References

Angrist, Joshua D. and Adriana Kugler. 2008. "Rural Windfall or a New Resource Curse? Coca, Income and Civil Conflict in Colombia." *The Review of Economics and Statistics,* forthcoming.

Barron, Patrick, Kai Kaiser and Menno Pradhan. 2004. "Local Conflict in Indonesia: Measuring Incidence and Identifying Patterns." mimeo, The World Bank.

Bates, Robert, Avner Greif and Smita Singh. 2002. "Organizing Violence." *Journal of Conflict Resolution 46(5): 599-628.*

Becker, Gary S. 1968. "Crime and Punishment: An Economic Approach." *Journal of Political Economy* 76(2): 169-217.

Chassang, Sylvain and Gerard Padró i Miquel. 2008a. "Mutual Fear and Civil War." BREAD Working Paper No. 165.

Chassang, Sylvain and Gerard Padró i Miquel. 2008b. "Conflict and Deterrence under Strategic Risk." NBER Working Paper No. 13964.

Collier, Paul and Anke Hoeffler. 1998. "On Economic Causes of Civil War." *Oxford Economic Papers* 50: 563-573.

Collier, Paul and Anke Hoeffler. 2004. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56: 563-595.

De Graaf, J. 1986. *The Economics of Coffee.* Wageningen, the Netherlands: Centre for Agricultural Publishing and Documentation.

Dal Bó, Ernesto and Pedro Dal Bó. 2006. "Workers, Warriors and Criminals: Social Conflict in General Equilibrium." Brown University.

Deininger, Klaus. 2003. "Causes and Consequences of Civil Strife: Micro-Level Evidence from Uganda." *Oxford Economic Papers* 55: 579-606.

Do, Quy-Toan and Lakshmi Iyer. 2006. "Poverty, Social Divisions and Conflict in Nepal." mimeo, The World Bank.

Duclos Jean-Yves, Joan Esteban and Debraj Ray. 2004. "Polarization: Concepts, Measurement, Estimation." *Econometrica* 72: 1737–177.

El Tiempo (2007). *Seis Alcaldes del Casanare Sellaron Pacto con Paramilitaries al Estilo Ralito.* February 20, Bogota.

Esteban, Joan and Debraj Ray. 1994. "On the Measurement of Polarization." *Econometrica* 62(4): 819–851.

Esteban, Joan and Debraj Ray. 1999. "Conflict and Distribution." *Journal of Economic Theory 87(2): 379-415.*

Esteban, Joan and Debraj Ray. 2006. "Polarization, Fractionalization and Conflict." *Journal of Peace Research 45(2): 163-182.*

Esteban, Joan and Debraj Ray. 2008. "On the Salience of Ethnic Conflict."*American Economic Review*, forthcoming.

Evangeliste, Mike and Valerie Sathe. 2006. "Brazil's 1998-1999 Currency Crisis," manuscript.

Fearon, James D. 2005a. "Civil War Since 1945: Some Facts and a Theory," mimeo, Stanford University.

Fearon, James D. 2005b. "Primary Commodities Exports and Civil War." *Journal of Conflict Resolution* 49(4): 483-507

Fearon, James D., and David Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97(1): 75-90.

Forero, Juan. 2004. *Safeguarding Colombia's Oil.* The New York Times, October 22.

Fritsch, Peter. 2002. *Bitter Brew: An Oversupply of Coffee Beans Deepens Latin America's Woes — Meanwhile, Corporate Profits Rise, as Retail Prices Fall Far Less Than Wholesale — Growers Try Heroin Poppies.* The Wall Street Journal, July 8.

Giovannucci, Daniele, Jose Leibovich, Diego Pizano, Gonzalo Paredes, Santiago Montenegro, Hector Arevalo and Panos Varangis. 2002. "Colombia: Coffee Sector Study." CEDE Report No. 2002-15.

Gould, Eric D., Bruce Weinberg and David Mustard. "Crime Rates and Local Labor Market Opportunities in the United States: 1979-1997." *Review of Economics and Statistics 16(4): 756-791.*

Grogger, Jeffrey. "Market Wages and Youth Crime." *Journal of Labor Economics* 16(4): 756-791.

Grossman, Herschel. 1991. "A General Equilibrium Model of Insurrections." *American Economic Review* 81(4): 912-921.

Grossman, Herschel and Minseong Kim. 1995. "Swords or Plowshares? A Theory of the Security of Claims to Property." *Journal of Political Economy 103(6): 1275-88.*

Gutiérrez, Francisco. 2006. "Recruitment into a civil war: a preliminary discussion of the Colombian case." mimeo, Santa Fe Institute.

Hidalgo, Daniel F., Suresh Naidu, Simeon Nichter and Neal Richardson. 2008. "Occupational Choices: Economic Determinants of Land Invasions," mimeo, UC Berkeley.

Hirshleifer, Jack. 1991. "The Technology of Conflict." *American Economic Review Papers and Proceedings 81(2): 130-134.*

Hirshleifer, Jack. 1995. "Anarchy and its Breakdown." *Journal of Political Economy* 103(1): 26-52.

Human Rights Watch. 2003. *You'll Learn Not to Cry: Child Combatants in Colombia* New York, NY: Human Rights Watch.

Human Rights Watch. 2005. "Smoke and Mirrors: Colombia's Demobilization of Paramilitary Groups." Report Vol. 17, No. 3.

Humphreys, Macartan. 2005. "Natural Resources, Conflict, and Conflict Resolution: Uncovering the Mechanisms." *Journal of Conflict Resolution* 49(4): 508-537.

ICO, 2006. "Historical Data" http://www.ico.org/asp/select2.asp (last accessed August 9, 2006).

Krauss, Clifford. 2001. *Desperate Farmers Imperil Peru's Fight on Coca.* The New York Times, February 23.

Lacina, Bethany Ann & Nils Petter Gleditsch, 2005. "Monitoring Trends in Global Combat: A New Dataset of Battle Deaths." *European Journal of Population* 21(23): 145165.

Marin, Carlos M. 2006. "Why People Join Illegal Armed Groups: Unveiling Some Hidden Causes of the Protraction of the Colombian Conflict." manuscript.

McDermott, Jeremy. 2004. *Colombia Cracks Down on Oil Theft.* BBC, February 15. http://news.bbc.co.uk/2/hi/americas/3489829.stm

Miguel, Edward, Shanker Satyanath and Ernest Sergenti. 2004. "Economic Shocks and Civil Conflict: An Instrumental Variables Approach." *Journal of Political Economy* 112(4): 725-753.

Miller, Grant and Piedad Urdinola. 2006. "Is Mortality in Developing Countries Procyclical? Health Production and the Value of Time in Colombia's Coffee-Growing Municipalities." NBER Working Paper # 11704.

Ministry of Agriculture. 2007. *Evolucion del Empleo Agricola Directo Generado por Cultivo.* In http://www.agrocadenas.gov.co/ indicadores/ind_sec_empleo2.htm, (last access 12/20/2007).

Nguyen, Hoa and Ulroke Grote. 2004. "Agricultural Policies in Vietnam: Producer Support Estimates, 1986-2002." International Food and Policy Research Institute Discussion Paper No. 79.

Ortiz, Sutti. 1999. *Harvesting Coffee, Bargaining Wages.* Ann Arbor, MI: University of Michigan Press.

Oxfam. 2002. *Mugged: Poverty in Your Coffee Cup.* Boston, MA: Oxfam America.

Powell, Robert. 2004. "The Inefficient Use of Power: Costly Conflict with Incomplete Information." *American Political Science Review* 98(2): 231-41.

Restrepo, Jorge, Spagat, Michael and Juan F. Vargas. 2004. "The Dynamics of the Colombian Civil Conflict: A New Data Set." *Homo Oeconomicus* 21(2): 396-428.

Richani, Nazih. 1997. "The Political Economy of Violence: The War-System in Colombia." *Journal of Interamerican Studies and World Affairs*, 39(2): p. 37-81.

Ross, Michael L. 2004. "How Do Natural Resources Influence Civil War? Evidence from Thirteen Cases." *International Organization* 58: 35-67.

Sambanis, Nicholas. 2001. "A Review of Recent Advances and Future Directions in the Quantitative Literature on Civil War." manuscript.

Sanchez, Fabio and María del Mar Palau. 2006. "Conflict, Decentralization and Local Governance in Colombia, 1974-2004." CEDE Working Paper No. 2006-20.

Semana. 2007. *Memorias de un Para.* Edition 1298, March 19 to 26, Bogota.

Skarpedas, Stergios. 1992. "Cooperation, Conflict, and Power in the Absence of Property Rights." *American Economic Review* 82: 720-739.

Snyder, Richard. 2006. "Does Lootable Wealth Breed Disorder?" *Comparative Political Studies 39(8): 943-968.*

Snyder, Richard and Ravi Bhavnani. 2005. "Diamonds, Blood, and Taxes: A Revenue-Centered Framework for Explaining Political Order." *Journal of Conflict Resolution* 49(4): 563-597.

United States Institute for Peace. 2004. "Civil Society Under Siege in Colombia." Special Report No. 114.

Wilson, James. 2001a. *Coffee or Poppies? Colombia's Growers Under the Spotlight.* Financial Times, October 25.

Wilson, Scott. 2001b. *Coca Invades Colombia's Coffee Fields Falling Prices Push Farmers to Plant Illegal Crops, Threatening U.S. Drug War.* Washington Post, October 30.

Yared, Pierre. 2008. "A Dynamic Theory of Concessions and War." mimeo, Columbia Business School.

A Data Appendix

A.1 CERAC Conflict Data

The CERAC dataset is constructed on the basis of events listed in the annexes of periodicals published by two Colombian NGOs, *CINEP* and *Justicia y Paz*. Most of the event information in these annexes comes from one of two primary sources, a network of priests from the Catholic Church, with representation in almost all of Colombia's municipalities, and over 25 newspapers with national and local coverage. CERAC follows a stringent regime to guarantee the quality and representativeness of the data. As a first step it randomly samples a large number of events and compares these against the original source, to check for correct coding from the annexes into the dataset. Second, it looks up a different random sample in press archives to confirm whether incidents should have been included in the annexes. This step checks the quality of the raw information provided by the two NGOs, which turns out to be quite high. Third, the largest events associated with the highest number of casualties are carefully investigated in press records. Finally, without double-coding, CERAC ensures that major events recorded in reports by Human Rights Watch, Amnesty International and Colombian Government agencies are incorporated into the dataset.

A.2 Sample Size at the Municipal Level

The CERAC dataset includes 966 municipalities that experienced any civil war event between 1988 to 2005. Because the insurgency is concentrated in rural areas, and conflict dynamics vary substantially in the metropolitan areas, we eliminate the 22 largest municipalities from the analysis, defined as those whose population exceeded 250,000 in 1997, the middle of our sample period. This leaves us with a sample of 944 municipalities for analyzing guerilla and paramilitary attacks, clashes and casualties. Because our dependent variables are the *number* of civil war events, we also control for (log of) population, and the availability of time varying population data further reduces the municipal sample to 916 cases. Since the oil production variable from 1988 and oil transport variable from 2000 are available for each of these municipalities, this is our sample size when we analyze the effect of the oil shock on violence.

To define the coffee shock, we use a coffee intensity measure from the 1997 Coffee Census, which is a nation-wide enumeration of all coffee growers conducted by the *National Federation of Coffee Growers,* over the 1993-1997 period.

The availability of the 1997 coffee intensity measure reduces the number of municipalities to 894 cases when we analyze the coffee shock. (This is also our final sample for specifications that include the coffee and oil shocks simultaneously).

The availability of municipal level control variables also affects the number of municipalities included in the analysis. When we assess the effect of the coca shock, or control for coca-related policy changes, the availability of the 1994 coca intensity further reduces the sample to a set of 876 municipalities.

A.3 Data Sources for Commodities and International Prices

Data on hectares of land used for coffee cultivation comes from the National Federation of Coffee Growers. It is based on a survey of agricultural units undertaken in the 1997 Coffee Census. Data on hectares of land used for the cultivation of sugar, banana, tobacco and African palm in 2005 comes from the Agricultural Ministry. These are based on estimates undertaken by technical assistance experts employed in the municipal government.

Data on oil production in 1988 and pipeline in 2000 comes from the Ministry of Mines and Energy (MME). Municipal-level data on coal production in 2004 and gold production in 2005 come from another government ministry, Ingeominas. The international prices of gold, coal and tobacco are from the Global Financial Data. The international prices of sugar, bananas, and African palm are from the IMF. See the Data Appendix Table for a summary of the sample size and sources of key variables.

A.4 ENH Household Survey Data

We use the rural component of household surveys called the *Encuesta Nacional de Hogares* to analyze the effect of the coffee and oil shocks on the wages of agricultural and non-agricultural workers across municipalities. This is a nationally representative survey carried out by Departamento Administrativo Nacional de Estadistica (DANE), the Colombian statistical agency. Consistent measures of income are available for the years 1996 to 2004.

When analyzing wages, we also make the following restrictions on our sample. For consistency with the analysis of violence outcomes, we include only those municipalities that have experienced civil war events as defined in the CERAC dataset, and exclude the large municipalities as defined by the 1997 population.

In addition, we include only working age individuals (between 18 and 65), and those who are employed, as indicated by non-zero income levels. Moreover, we clean the data by excluding those who report hours per week exceeding120 hours, and a monthly income exceeding 100 million pesos. We multiply the hours per week by four to obtain a measure of monthly hours, and divide this into monthly income to obtain a measure of hourly wages.

A.5 Selecting Agricultural and Natural Resource Sectors

In addition to coffee and oil, we chose other sectors according to three criteria. The first criteria is that the commodity must be one of Colombia's five largest agricultural exports after coffee. Alternatively, it must be one of the five largest natural resource exports after oil. For agriculture, this yields cut flowers, sugar, bananas, palm oil, and tobacco. For natural resources, this includes coal, iron ore, nickel, emeralds and gold.

Second, the commodity must have a defined international price. This eliminates cut flowers and emeralds, since different varieties of flowers and emeralds have different international prices. Moreover, Colombia is one of the world's only major emerald producers, which means that the price could not be taken as plausibly exogenous to Colombia's production.

Third, there must be sufficient variation in the spatial distribution of production to enable a reasonable set of control and treatment municipalities. This eliminates iron ore and nickel, since in both cases, there is 1 mine in Colombia that produces each of the goods, which would mean 1 treatment municipality against over 900 control municipalities.

These three criteria together yield two additional natural resources: coal and gold, and four additional agricultural goods: bananas, sugar, African palm, and tobacco.

Table I
Summary Statistics

Variable	Obs.	Mean	Std. Dev	Min	Max
Number annual guerilla attacks	15999	0.53	1.52	0.00	41.00
Number annual paramilitary attacks	15999	0.09	0.46	0.00	15.00
Number annual clashes	15999	0.50	1.31	0.00	24.00
Number annual casualties	15999	2.11	7.12	0.00	292.00
Number annual government attacks	15999	0.10	0.52	0.00	31.00
Number annual guerilla infrastructure attacks	15999	0.17	0.78	0.00	32.00
Number annual guerilla non-infrastructure attacks	15999	0.33	0.97	0.00	22.00
Number annual paramilitary non-infrastructure attacks	15999	0.00	0.05	0.00	2.00
Number annual paramilitary infrastructure attacks	15999	0.09	0.44	0.00	15.00
Number annual guerilla massacres	15999	0.01	0.12	0.00	4.00
Number annual paramilitary massacres	15999	0.05	0.30	0.00	7.00
Coffee intensity, thousands of hectares, 1997	15999	0.89	1.59	0.00	10.59
Sugar intensity, hundreds of hectares, 2005	15999	0.19	0.97	0.00	9.69
Banana intensity, hundreds of hectares, 2005	15999	0.02	0.22	0.00	5.17
African palm intensity, hundreds of hectares, 2005	15999	0.08	0.70	0.00	9.25
Tobacco intensity, hundreds of hectares, 2005	15999	0.04	0.36	0.00	8.43
Coca intensity, thousands of hectares, 1994	15709	0.08	0.58	0.00	9.08
Coca intensity, thousands of hectares, 1994 & 1999-2005	7127	0.12	0.77	0.00	16.52
Oil production, hundreds of thousands barrels/day, 1988	15999	0.00	0.06	0.00	1.63
Length of oil pipelines, hundreds of km, 2000	15999	0.08	0.26	0.00	2.68
Coal production, tens of thousands of tons, 2004	15999	0.13	1.05	0.00	15.55
Gold production, hundreds of thousands of grams, 2005	15891	0.17	1.49	0.00	26.58
Population, millions	15999	0.02	0.03	0.00	0.29
Real municipal capital revenue, billions 2006 pesos	10732	3.93	6.12	0.00	94.46

Notes . Summary statistics of key variables are presented in this table. Infrastructure attacks include attacks on bridges, roads and pipelines. Non-infrastructure attacks include all other attacks. Massacres are events that result in the death of four or more individuals. Coffee, sugar, banana, african palm, tobacco and coca intensity are measured as the hectares of land used for growing these crops in each municipality. Oil, gold and coal production are measured as the quantity produced at the municipal level. The data appendix includes further details on sample size and data sources.

Table II
The Effect of the Coffee Shock on Violence, 1994-2005

Dependent variables:	(1) Guerilla attacks	(2) Paramilitary attacks	(3) Clashes	(4) Casualties
Panel A: Basic results				
Coffee int x log coffee price	-0.141	-0.048	-0.261	-0.918
	(0.077)*	(0.021)**	(0.070)***	(0.309)***
Observations	10,701	10,701	10,701	10,701
Panel B: Robustness checks varying sample				
(i) Remove earthquake mun				
Coffee int x log coffee price	-0.17	-0.065	-0.336	-1.213
	(0.094)*	(0.023)***	(0.066)***	(0.322)***
Observations	10,437	10,437	10,437	10,437
(ii) Remove DMZ mun				
Coffee int x log coffee price	-0.142	-0.048	-0.264	-0.938
	(0.077)*	(0.021)**	(0.070)***	(0.310)***
Observations	10665	10665	10665	10665

Notes. In Panels A-B, variables not shown include municipality and year fixed effects and log of population. Robust standard errors clustered at the department level are shown in parentheses. In both panels, the interaction of coffee intensity with the internal price of coffee is instrumented by the interaction of coffee intensity with the international price of coffee. In specification (i) of panel B, we exclude 27 municipalities affected by an earthquake in the coffee region. In specification (ii), we remove the 5 municipalities in the DMZ from the sample. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table III
The Coffee Shock and Violence: IV Results, 1994-2005

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
IV coffee int x log coffee price	-0.257	-0.097	-0.377	-0.957
	(0.131)**	(0.043)**	(0.126)***	(0.741)
Observations	9,799	9,799	9,799	9,799

Notes. Variables not shown include municipality and year fixed effects and log of population. Robust standard errors clustered at the department level are shown in parentheses. The interaction of coffee intensity and the internal coffee price is instrumented by a cubic interaction of rainfall and temperature conditions with the international coffee price. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table IV

The Effect of the Oil and Coffee Shocks on Violence, 1988-2005

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
Panel A: The oil shock				
Oil production x log oil price	0.454	0.805	0.042	0.876
	(1.110)	(0.139)***	(0.656)	(1.761)
Oil pipe length x log oil price	-0.341	0.281	-0.083	0.336
	(0.540)	(0.113)**	(0.338)	(1.653)
Observations	15709	15709	15709	15709
Panel B: The coffee shock				
Coffee int x log coffee price	-0.198	-0.057	-0.285	-0.868
	(0.073)***	(0.022)***	(0.086)***	(0.364)**
Observations	15999	15999	15999	15999
Panel C: The coffee and oil shocks				
Coffee int x log coffee price	-0.192	-0.064	-0.285	-0.881
	(0.071)***	(0.022)***	(0.087)***	(0.359)**
Oil production x log oil price	0.493	0.810	0.107	1.038
	(1.112)	(0.139)***	(0.661)	(1.791)
Oil pipe length x log oil price	-0.295	0.292	-0.003	0.554
	(0.543)	(0.113)***	(0.334)	(1.633)
Observations	15999	15999	15999	15999
Panel D: Control for department trends				
Coffee int x log coffee price	-0.143	-0.077	-0.266	-1.055
	(0.082)*	(0.026)***	(0.135)**	(0.490)**
Oil production x log oil price	0.079	0.614	0.164	0.177
	(1.101)	(0.144)***	(0.645)	(1.736)
Oil pipe length x log oil price	-0.278	0.28	0.002	0.557
	(0.534)	(0.112)**	(0.321)	(1.586)
Observations	15999	15999	15999	15999

Notes. Variables not shown include municipality and year fixed effects and log of population. Robust standard errors clustered at the department level are shown in parentheses. In Panels A-D, the interaction of coffee intensity and the internal price of coffee is instrumented by the interaction of coffee intensity and the export volume of Brazil Vietnam and Indonesia. Panel D also includes linear time trends for each of the 32 departments in Colombia.*** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table V

The Effect of the Coffee and Oil Shocks on Wages, 1996-2004

	(1)	(2)	(3)
Subsample:	All workers	Agricultural workers	Non-agricultural workers
Coffee int x log coffee price	0.097	0.118	0.073
	(0.027)***	(0.025)***	(0.065)
Oil production x log oil price	1.038	0.571	0.318
	(1.099)	(1.451)	(1.245)
Oil pipe length x log oil price	-0.129	-0.164	-0.012
	(0.088)	(0.126)	(0.132)
Observations	52773	34768	18005

Notes. The dependent variable in Columns (1)-(3) is the log of hourly wage, defined as income earned per month divided by hours worked per month. Variables not shown include municipality and year fixed effects, linear time trends by department, dummies for gender and marital status, number of household members, experience and experience squared and years of education. Robust standard errors clustered at the department level are shown in parentheses. The interaction of the coffee intensity and the internal price of coffee is instrumented by the interaction of the coffee intensity and the export volume of Brazil Vietnam and Indonesia. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table VI
The Effect of the Coffee and Oil Shocks on Predation

	(1)	(2)	(3)
Sample years	1988-2005	2001-2005	2001-2005
Dependent variables:	Log capital revenue	Paramilitary land pirating	Guerilla land pirating
Coffee int x log coffee price	-0.121	0.049	-0.267
	(0.096)	(0.114)	(0.104)
Oil production x log oil price	0.417	31.163	9.64
	(0.159)***	(0.000)***	(0.347)
Oil pipe length x log oil price	0.333	0.75	-0.005
	(0.168)**	(0.060)*	(0.988)
Observations	10564	1580	1580

Notes . Land pirating refers to the theft of commercial goods that are being transporting over land. Robust standard errors clustered at the department level are shown in parentheses. Variables not shown include municipality and year fixed effects, log of population, and an urban indicator interacted with the price of oil and the internal price of coffee. The interaction of the urban variable with the internal coffee price is instrumented by the interaction of the urban variable with the export volume of Brazil Vietnam and Indonesia. The interaction of the coffee intensity and the internal price of coffee is also instrumented by the interaction of the coffee intensity and the export volume of Brazil Vietnam and Indonesia. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table VII

The Effect of Other Agricultural Price Shocks on Conflict, 1988-2005

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
Coffee int. x log coffee price	-0.102	-0.061	-0.241	-0.853
	(0.079)	(0.026)**	(0.133)*	(0.421)**
Sugar int. x log sugar price	-0.473	-0.108	-0.315	-2.185
	(0.007)***	(0.003)***	(0.009)***	(0.030)***
Banana int. x log banana price	-0.047	-0.185	-0.655	-2.264
	(0.016)***	(0.006)***	(0.020)***	(0.064)***
Palm int. x log palm price	-0.012	-0.082	-0.166	-0.973
	(0.153)	(0.011)***	(0.059)***	(0.309)***
Tobacco int. x log tobacco price	-0.742	-0.068	-0.804	-2.692
	(0.269)***	(0.028)**	(0.060)***	(0.896)***
Observations	15709	15709	15709	15709

Notes. Variables not shown include municipality and year fixed effects, log of population and the interaction of coca production in 1994 interacted with year dummies. Robust standard errors clustered at the department level are shown in parentheses. The interaction of coffee intensity with internal coffee price is instrumented by the interaction of coffee intensity and the coffee exports of Vietnam, Brazil and Indonesia. ** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table VIII
The Effect of Other Natural Resource Price Shocks on Conflict, 1988-2005

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
Oil production x log oil price	0.000	0.613	0.086	-0.191
	(1.154)	(0.138)***	(0.665)	(1.761)
Oil pipe length x log oil price	-0.286	0.306	-0.133	0.289
	(0.557)	(0.112)***	(0.338)	(1.675)
Coal production x log coal price	0.047	-0.012	0.006	0.025
	(0.023)**	(0.009)	(0.017)	(0.087)
Gold production x log gold price	0.110	0.007	0.076	0.386
	(0.023)***	(0.005)	(0.022)***	(0.095)***
Observations	15997	15997	15997	15997

Notes. Variables not shown include municipality and year fixed effects, log of population and the interaction of coca production in 1994 interacted with year dummies. Robust standard errors clustered at the department level are shown in parentheses. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table IX
The Effect of the Oil Shock on Attacks by Type, 1988-2005

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables:	Non-infrastructure guerilla attacks	Infrastructure guerilla attacks	Massacres by guerilla	Non-infrastructure paramilitary attacks	Infrastructure paramilitary attacks	Massacres by paramilitary
Oil production x log oil price	-0.153	0.529	0.002	0.819	-0.001	0.094
	(0.525)	(0.514)	(0.015)	(0.139)***	(0.010)	(0.049)*
Oil pipe length x log oil price	-0.183	-0.144	0.042	0.268	0.006	0.009
	(0.260)	(0.255)	(0.043)	(0.114)**	(0.004)*	(0.043)
Observations	16395	16395	16395	16395	16395	16395

Notes. Variables not shown include municipality and year fixed effects and log population. Robust standard errors clustered at the department level are in parentheses. Infrastructure attacks include attacks on bridges, roads and pipelines. Non-infrastructure attacks include all other attacks. Massacres are events that result in the death of four or more individuals. *** is significant at 1% level, ** is significant at 5%, * is significant at 10% level.

Table X
The Effect on Enforcement, 1988-2005

	Govt. attacks
Coffee int x log coffee price	-0.046
	(0.016)***
Oil production x log oil price	0.585
	(0.192)***
Oil pipe length x log oil price	0.016
	(0.137)
Observations	15999

Notes . Variables not shown include municipality and year fixed effects and the log of population. Robust standard errors clutered at the department level are shown in parentheses. The interaction of coffee intensity and the internal price of coffee is instrumented by the interaction of coffee intensity and the export volume of Brazil Vietnam and Indonesia. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table XI
The Effect of the Coffee and Oil Shocks, 1988-2005: Controlling for Coca

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
Panel A: Control for coca intensity interacted with prices				
Coffee int x log coffee price	-0.187	-0.066	-0.293	-0.891
	(0.071)***	(0.022)***	(0.087)***	(0.360)**
Oil production x log oil price	0.473	0.796	0.116	1.014
	(1.127)	(0.125)***	(0.659)	(1.799)
Oil pipe length x log oil price	-0.228	0.321	-0.026	0.737
	(0.557)	(0.110)***	(0.343)	(1.645)
Observations	15691	15709	15709	15709
Panel B: Control for coca intensity interacted with post-1994				
Coffee int x log coffee price	-0.189	-0.065	-0.288	-0.897
	(0.071)***	(0.022)***	(0.087)***	(0.357)**
Oil production x log oil price	0.475	0.796	0.114	1.001
	(1.127)	(0.126)***	(0.655)	(1.806)
Oil pipe length x log oil price	-0.227	0.322	-0.022	0.695
	(0.557)	(0.109)***	(0.344)	(1.649)
Coca int x post1994 dummy	0.038	0.016	0.101	0.881
	(0.033)	(0.022)	(0.051)**	(0.237)***
Observations	15709	15709	15709	15709

Notes. Variables not shown include municipality and year fixed effects and log of population. Panel A also includes the interaction of the 1994 coca intensity interacted with the price of oil and the price of coffee. Panel B also includes the interaction of the 1994 coca intensity with the post-1994 indicator variable. Robust standard errors clustered at the department level are shown in parentheses. The interaction of coffee intensity and internal coffee price is instrumented by the interaction of coffee intensity and the export volume of Brazil Vietnam and Indonesia. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table XII
Testing the Coca Substitution Account, 1994-2005

	(1)	(2)	(3)	(4)	(5)
Dependent variables:	Coca	Guerilla attacks	Paramilitary attacks	Clashes	Casualties
	Panel A: Effect on coca				
(i) The coffee shock					
Coffee int. x log coffee price	0.004	-0.172	-0.053	-0.949	-0.297
	(0.018)	(0.088)*	(0.030)*	(0.407)**	(0.101)***
Observations	7127	7127	7127	7127	7127
(ii) The oil shock					
Oil production x log oil price	-0.148	-0.739	1.315	-0.598	-0.229
	(0.233)	(1.583)	(0.228)***	(1.103)	(3.099)
Oil pipe length x log oil price	-0.206	-0.853	0.407	-0.427	-1.142
	(0.226)	(0.619)	(0.274)	(0.420)	(1.349)
Observations	7303	7303	7303	7303	7303
	Panel B: Effect on violence removing every coca municipality				
(i) The coffee shock					
Coffee int. x log coffee price	-	-0.137	-0.03	-0.147	-0.494
	-	(0.090)	(0.015)**	(0.050)***	(0.151)***
Observations		7813	7813	7813	7813
(ii) The oil shock					
Oil production x log oil price	-	0.875	0.953	-0.169	1.240
	-	(1.090)	(0.119)***	(0.678)	(1.611)
Oil pipe length x log oil price	-	-1.463	0.676	-1.083	-1.469
	-	(1.205)	(0.300)**	(0.750)	(1.783)
		7969	7969	7969	7969

Notes. Variables not shown include municipality and year fixed effects and log of population. Robust standard errors clustered at the department level are shown in parentheses. In Panels A and B, the interaction of coffee intensity with internal coffee price is instrumented by the interaction of coffee intensity and the international coffee price. In Panel B, we remove every municipality that is reported to produce coca in the sample period. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Data Appendix Table
Data Sources and Sample Size

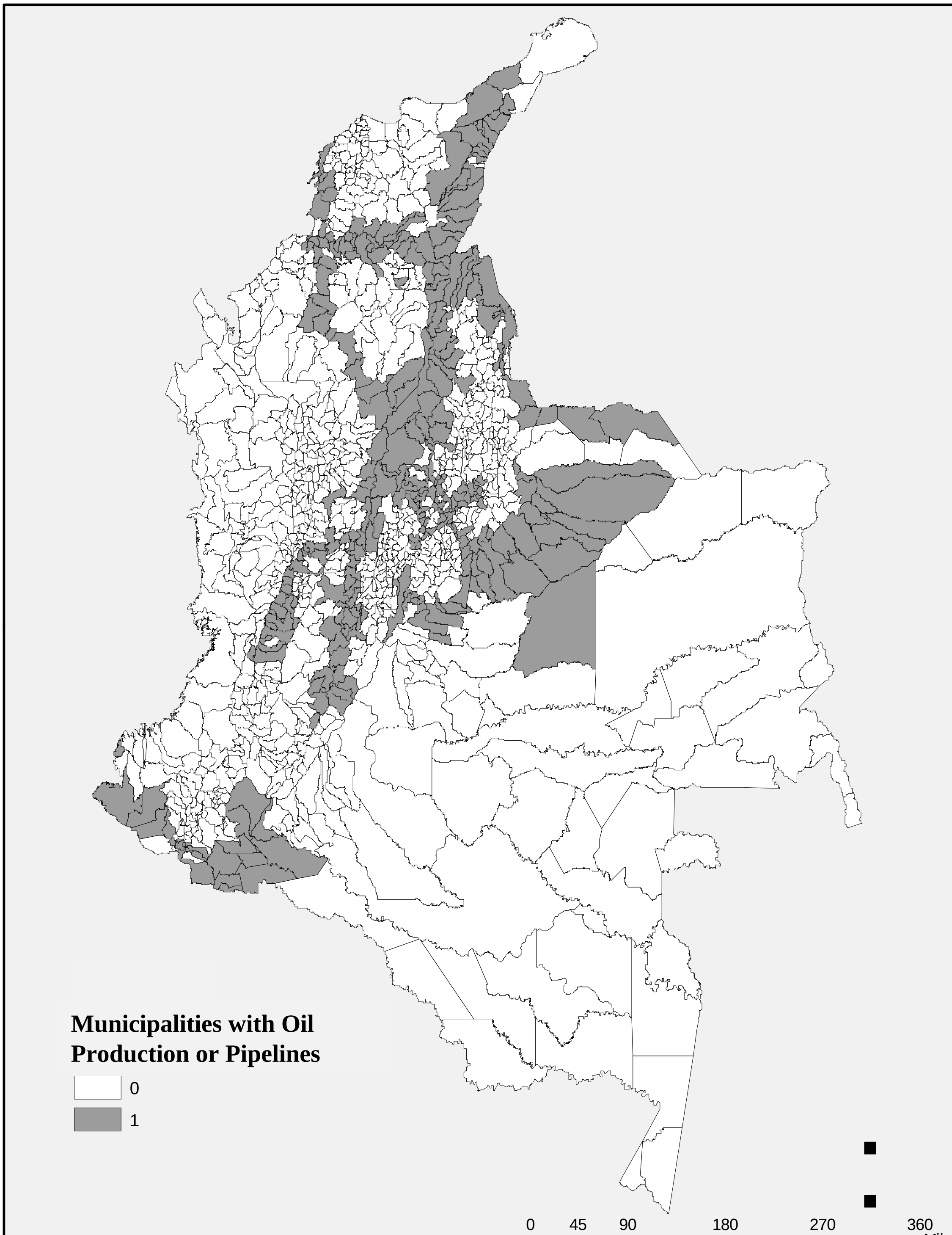
Municipal level variables:	Sample Size: *Years*	*Municipalities*	From: *Source*
Number annual paramilitary attacks	1988-2005	944	CERAC
Number annual clashes	1988-2005	944	CERAC
Number annual casualties	1988-2005	944	CERAC
Number annual guerilla attacks	1988-2005	944	CERAC
Number annual government attacks	1988-2005	944	CERAC
Number annual guerilla infrastructure attacks	1988-2005	944	CERAC
Number annual guerilla non-infrastructure attacks	1988-2005	944	CERAC
Number annual paramilitary non-infrastructure attacks	1988-2005	944	CERAC
Number annual paramilitary infrastructure attacks	1988-2005	944	CERAC
Number annual guerilla massacres	1988-2005	944	CERAC
Number annual paramilitary massacres	1988-2005	944	CERAC
Coffee intensity, in thousands of hectares, 1997	1997	894	NFCG
Sugar intensity, hundreds of hectares, 2005	2005	894	Agricultural Min
Banana intensity, hundreds of hectares, 2005	2005	894	Agricultural Min
African palm intensity, hundreds of hectares, 2005	2005	894	Agricultural Min
Tobacco intensity, hundreds of hectares, 2005	2005	894	Agricultural Min
Coca intensity, in thousands of hectares	1994, 1999-2005	894	DNE, UNODC
Coca intensity, in thousands of hectares, 1994	1994	876	DNE
Oil production, hundreds of thousands barrels/day, 1988	1988	916	MME
Length of oil pipelines, hundreds of km, 2000	2000	916	MME
Coal production, tens of thousands of tons, 2004	2004	916	Inegominas
Gold production, hundreds of thousands of grams, 2005	2005	916	Inegominas
Population, in millions	1988-2005	916	CEDE
Real municipal capital revenue, billions 2006 pesos	1988-2005	880	NDP
Individual level variables:	*Years*	*Individuals*	*Source*
Hourly wage, thousands of Colombian pesos	1996-2004	6500 per year, on average	DANE (ENH Survey)
Prices:	*Years*		*Source*
Internal coffee price, thousands of 2006 pesos/lb	1988-2005	n/a	NFCG
International coffee price, thousands of 2006 pesos/lb	1988-2005	n/a	NFCG
Int'l price of crude oil, thousands of 2006 pesos/barrel	1988-2005	n/a	IFS
International sugar price, thousands of 2006 pesos/lb	1988-2005	n/a	IMF
International banana price, thousands of 2006 pesos/lb	1988-2005	n/a	IMF
International palm price, thousands of 2006 pesos/lb	1988-2005	n/a	IMF
International tobacco price, thousands of 2006 pesos/lb	1988-2005	n/a	GFD
International coal price, thousands of 2006 pesos/ton	1988-2005	n/a	GFD
Int'l gold price, thousands of 2006 pesos/ounce	1988-2005	n/a	GFD

Notes. This table lists the sample size and data source of key variables. The DANE ENH survey is not a panel of households; thus the number of individuals in the sample varies from year to year and the average number of individuals sampled across years is listed above. CERAC is the Conflict Analysis Resource Center. Agricultural Min refers to the Ministry of Agriculture. DNE is the National Department of Drugs. UNODC is the United Nations Office of Drug Control. MME is the Ministry of Mines and Energy. Ingeominas is a government agency in charge of mining and precious metals. CEDE is the Center for Studies on Economic Development. DANE is the Colombian statistical agency. NFCG is the National Federation of Coffee Growers. GFD refers to Global Financial Data.

Figure 1. Coffee Intensity of Colombian Municipalities

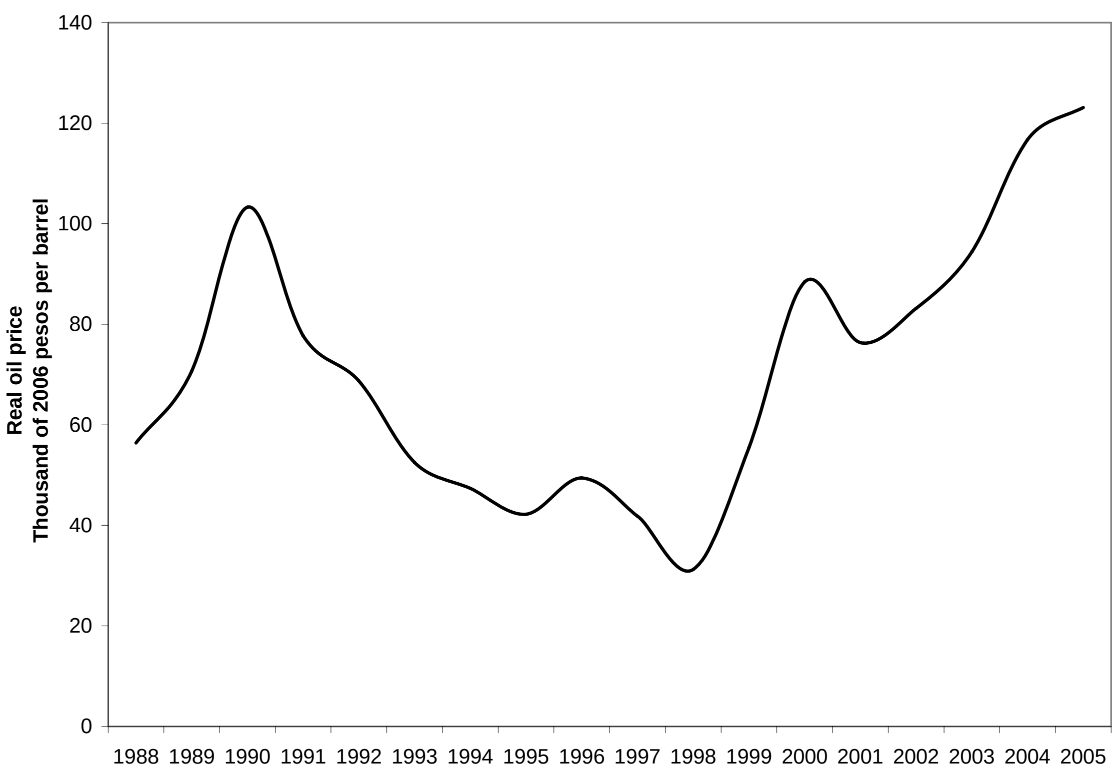
Source: National Federation of Coffee Growers

Figure 2. Municipalities with Oil Reserves or Oil Pipelines



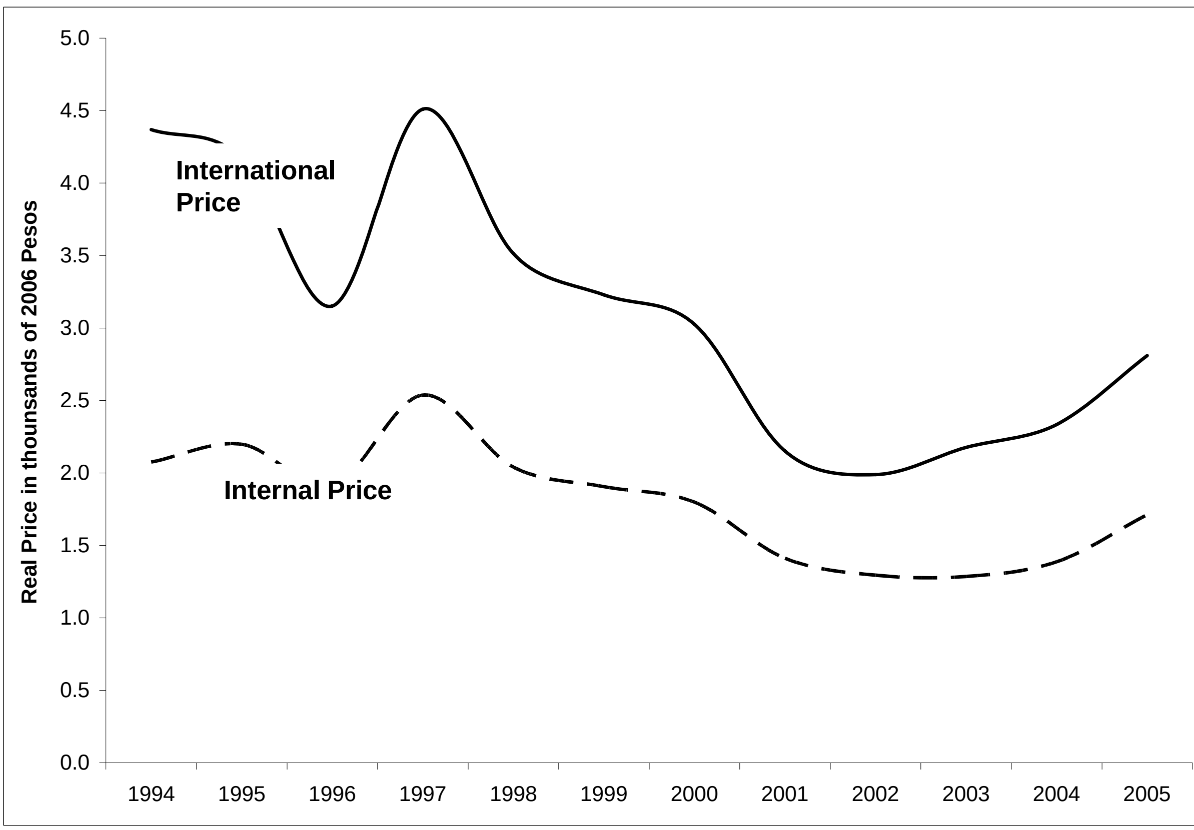
Sources. Shape: IGAC, Data: National Planning Department and Ministry of Mines

Figure 3. Real Price of Oil



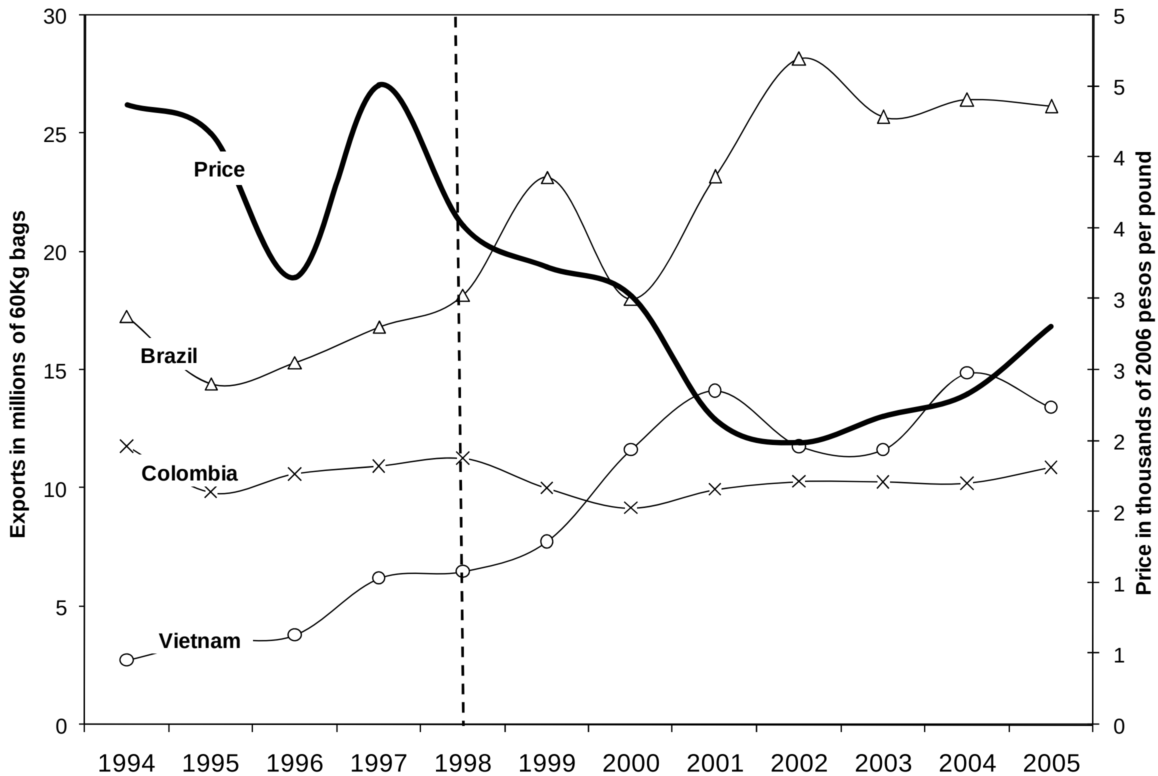
Source: International Financial Statistics

Figure 4. Real Internal and International Price of Coffee



Source: National Federation of Coffee Growers

Figure 5. Coffee Exports of Main Producers and Real International Price



Source: International Coffee Organization and National Federation of Coffee Growers

Figure 6. Mean Violence in Coffee and Non-coffee Municipalities

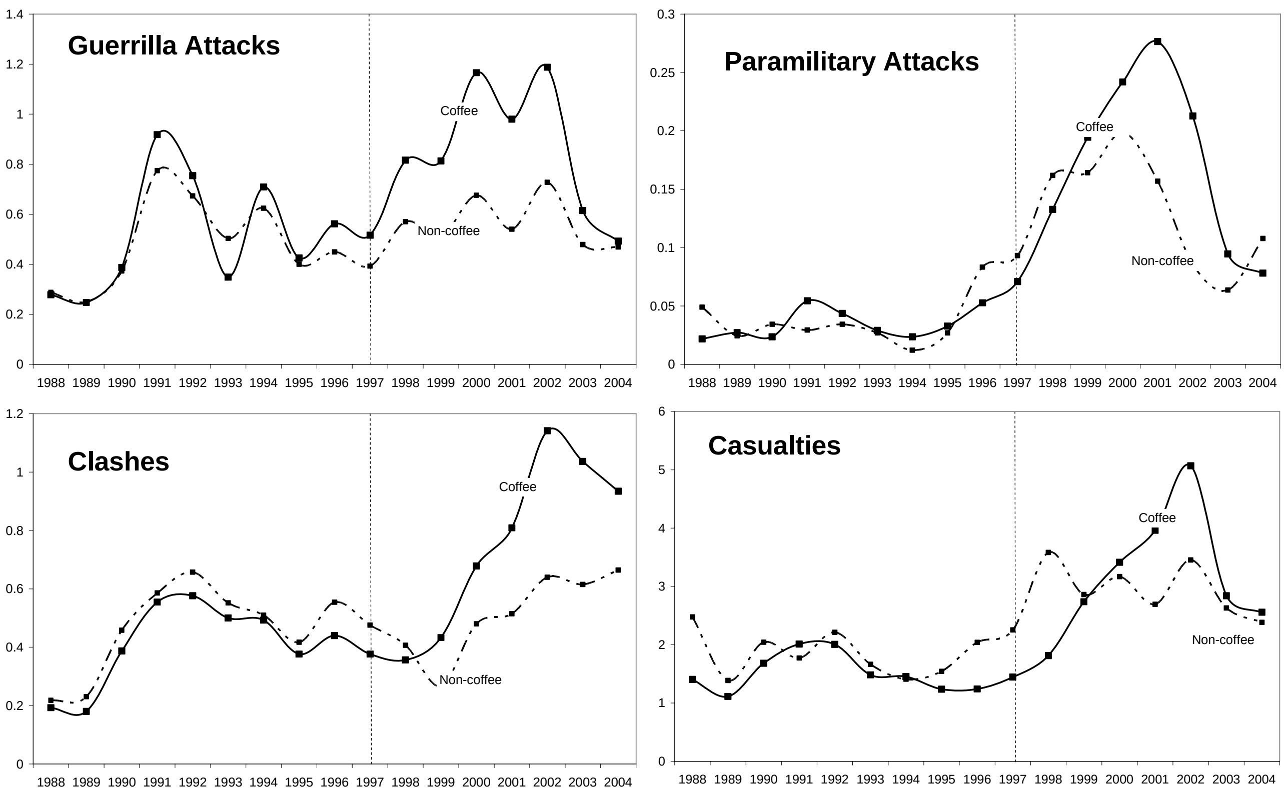


Figure 7. Mean Violence in Oil and Non-Oil Municipalities

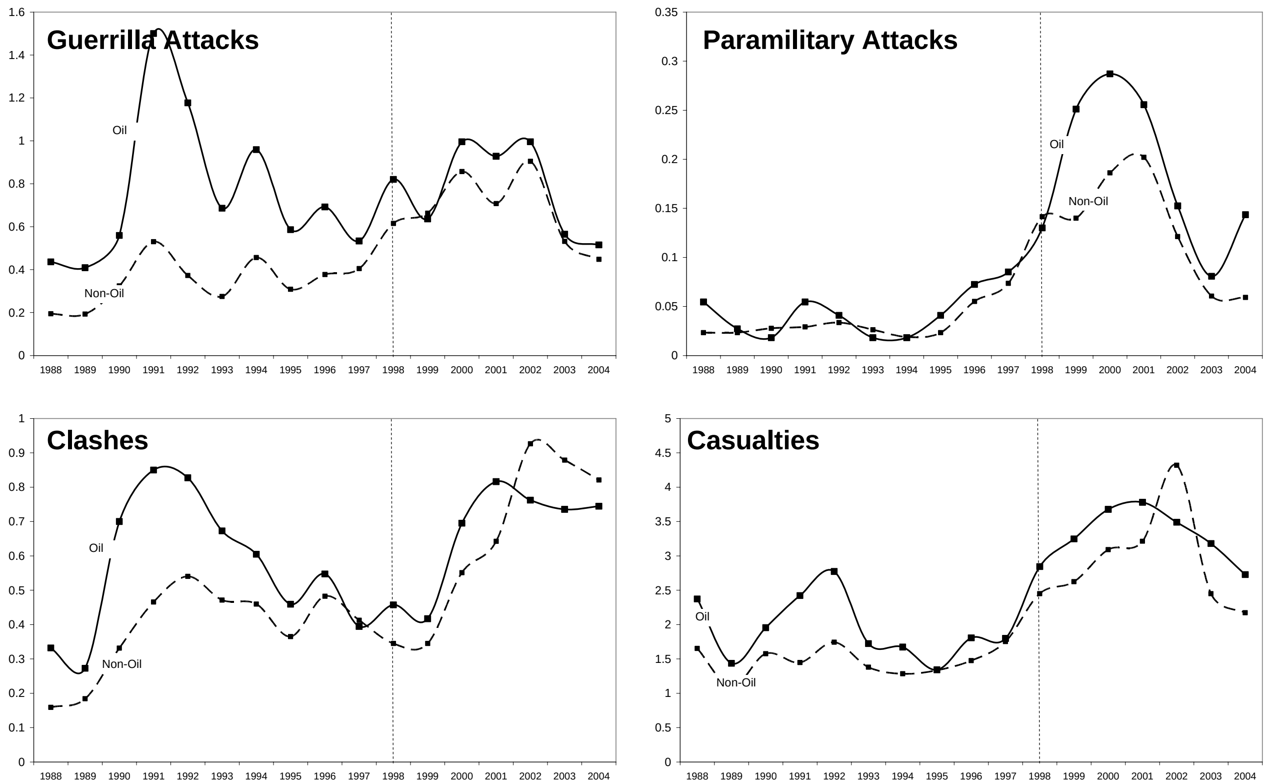
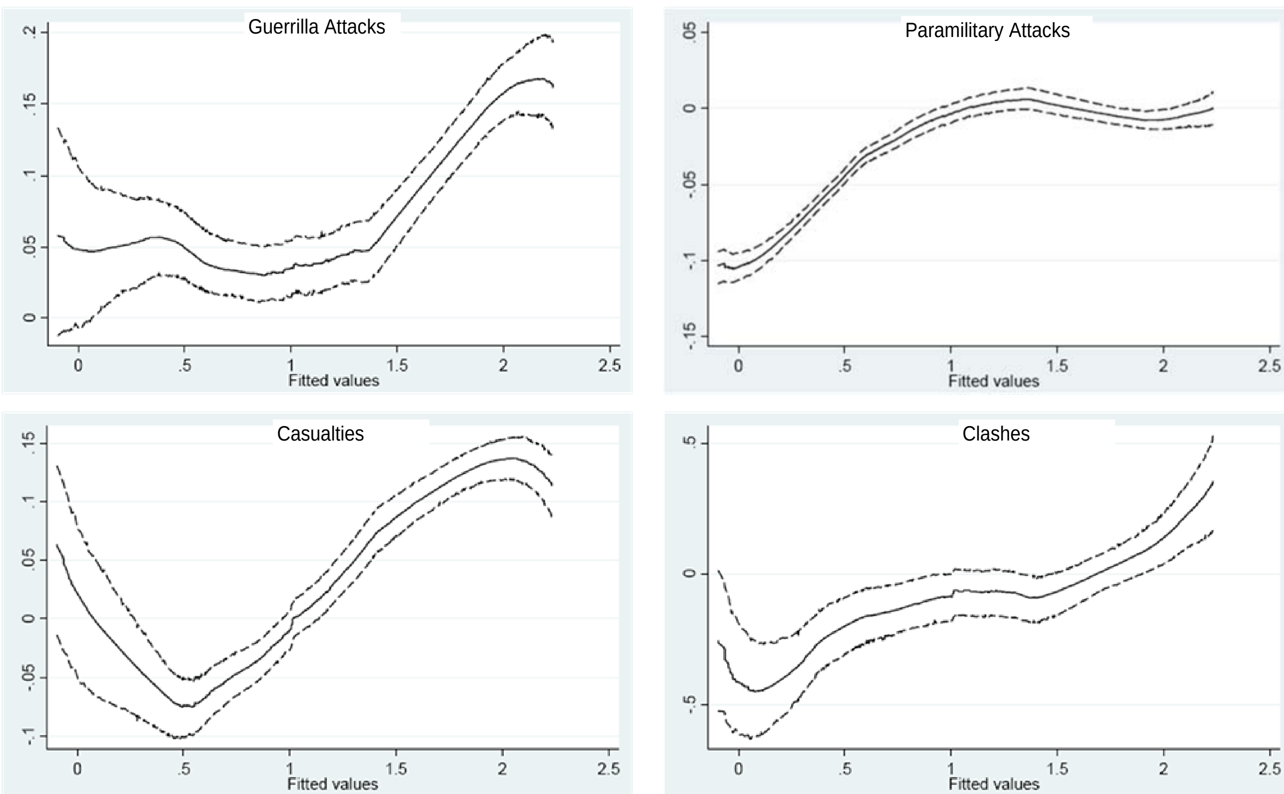


Figure 8. Non-parametric Plots: Predicted Coffee Intensity and the Rise in Conflict



Notes: Plots are based on locally weighted regressions of bandwidth 1.5. We plot the difference in residual violence over 1994-1997 (when coffee prices are high) and 1998-2005 (when coffee prices were low), against predicted coffee intensity based on temperature and rainfall. The sample has been trimmed by eliminating 5 percent of the extreme observations based on values of temperature and rainfall. Bootstrapped standard errors are based on 300 repetitions and have been used to generate a 95 percent confidence interval. Controls include municipality and year fixed effects.