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COMMODITY PRICE SHOCKS AND CIVIL CONFLICT: EVIDENCE FROM COLOMBIA*

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Abstract

This paper explores how commodity price shocks in the international market affect armed conflict. Using a new dataset on civil war in Colombia, we find that exogenous price shocks in the coffee and oil markets affect conflict in opposite directions, and through separate channels. A sharp fall in coffee prices during the late 1990s increased violence disproportionately in coffee-intensive municipalities, by lowering wages and the opportunity cost of recruitment into armed groups. In contrast, a rise in oil prices increased conflict in the oil region, by expanding local government budgets and raising potential gains from rapacity and predation on these resources. Our analysis suggests that the price of labor intensive goods affect conflict primarily through the opportunity cost effect, while the price of capital intensive goods affect conflict through the rapacity channel.

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1 Introduction

The role of economic shocks in perpetuating armed conflict has received considerable attention from academics and policymakers during recent years. 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). Recent evidence suggests that income plays a prominent role in promoting political stability: countries experiencing positive growth shocks appear to face a lower risk of civil war (Collier and Hoeffler 1998 and 2004; Fearon and Laitin, 2003; and Miguel et al, 2004). But beyond the effect of aggregate GDP, little is known about which types of economic shocks are most likely to perpetuate conflict, and the precise mechanisms through which these shocks translate into civil war. For example, they may affect conflict through the labor market by changing individuals' wages and their incentives to join insurgency. Alternatively, they can affect potential financing available to armed groups, or alter the state's ability to invest in defense.

This paper shows that different types of economic shocks affect conflict through different mechanisms. We use a unique municipal-level dataset on civil war in Colombia to demonstrate that price shocks to labor and capital intensive commodities affect armed conflict in opposite directions, and through distinct channels. We look at coffee as an example of a labor intensive commodity and oil as an example of a capital intensive commodity. These sectors form a substantial part of the Colombian economy, representing the first and third largest exports, respectively. Exploiting exogenous price shocks in international markets, we find that a *drop* in the price of coffee during the late 1990s increased civil war violence in municipalities that cultivate coffee more intensively. In contrast, a *rise* in oil prices during the same period induced greater conflict in the oil municipalities relative to the non-oil region. Lower coffee prices exacerbated conflict by reducing wages and the opportunity cost of recruiting fighters into armed groups, while higher oil prices fuelled conflict by increasing contestable revenue in local governments, which invited predation by groups that steal these resources.

Our paper adds to the current literature in three ways. First, we take advantage of a detailed dataset on political violence to conduct a within-country analysis of civil war, which enables us to identify the impact of economic shocks in a convincing manner. Although other studies have shown a relationship between economic conditions and violence within-country (Deininger, 2003; Barron, Kaiser and Pradhan, 2004; and Do and Iyer, 2006), the depth and scope of our data on the Colombian conflict enables cleaner identification of this effect. Our event-based data tracks violence at a geographically disaggregated level in approximately 900 municipalities, over 1988 to 2005. This allows us to exploit variation over time within a municipality, which controls for time-invariant municipal characteristics that are potentially correlated with conflict outcomes. We are also able to examine several different measures of violence, including guerilla, paramilitary and government attacks, clashes among armed groups, and war-related casualties.

Our estimates imply a substantial effect of commodity prices on civil war: the sharp 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 a non-coffee area. The oil shock had a robust and substantial effect on paramilitary attacks, which increased by 18 percent more in the oil region over 1998 to 2005.

Second, we propose a simple framework for understanding these results. We modify a model developed by Dal Bó and Dal Bó (2006), which essentially embeds the Becker (1968) crime theory in the international trade setting, and predicts that higher commodity prices can either raise or lower conflict, depending on the factor intensity of the production technology. In our framework, changes in international commodity prices can affect conflict through two channels: they can alter wages, which changes the opportunity cost of recruiting workers, and they can affect revenue from taxing capital, which changes rapacity, or the incentive to steal resources from local governments. The opportunity cost effect is a direct prediction of the Becker model, where a rise in the return to the legal sector decreases the extent of criminal activities. Our innovation is to introduce the rapacity channel, where a rise in the price of the legal commodity can *increase* predatory activity by generating more contestable wealth in the economy. Thus, the theory predicts that a rise in the price of a labor intensive good reduces conflict either by increasing wages or reducing government revenue, while a rise in the price of the capital intensive good increases conflict by reducing wages or increasing government revenue.

Third, in contrast to previous papers, we test for these channels by empirically assessing the relative importance of the opportunity cost and rapacity mechanisms in the case of coffee and oil. Using individual-level data from rural household surveys, we show that the fall in coffee prices during the late 1990s caused wages to fall substantially more in coffee-intensive municipalities. On the other hand, oil prices did not alter labor market outcomes differentially in the oil region, which suggests that the opportunity cost effect is more important in the case of the labor-intensive good. In contrast, the oil shock appears to affect conflict through changes in local government resources. Using fiscal data, we show that tax revenue and public spending increased substantially more in oil areas, relative to the non-oil region. We argue that this gave rise to predation as armed groups moved in to extort resources from municipal governments. However, coffee prices did not affect tax revenue or expenditures in the coffee municipalities, which suggests that the rapacity channel is more important in the case of the capital-intensive good.

In addition, we consider and present evidence against two alternative channels. We show that the rise in violence in the coffee and oil regions cannot be attributed to the presence of coca, an illegal crop used to manufacture cocaine. We do so by controlling for policy changes that may have caused violence to rise in the traditional coca stronghold, and by showing that changes in coffee and oil prices did not lead to greater coca cultivation in these regions. This is important given a recent study by Angrist and Kugler (2008), which finds that violent deaths escalated more in Colombia's coca departments during the late 1990s. In fact, our analysis replicates the finding that coca promotes war-related casualties at the municipal level [1]. However, we draw a distinction between analyzing the effect of legal versus illegal commodity shocks on conflict outcomes, since violence is required for contract enforcement in illicit markets such as coca.

Finally, we show that the rise in oil prices did not alter government attacks or police allocation, which establishes that conflict escalation in the oil region did not was not stem from increased state efforts to pursue rebel groups. This is important given the hypothesis articulated by Fearon and Laitin (2003), that state revenue may affect civil war by altering the state's coercive capacity. In addition, we show that the fall in coffee prices resulted in *more* government attacks and *greater* police allocation in the coffee region, which rules out the possibility that deterioration in local law enforcement efforts invited greater attacks by armed groups in the coffee region.

The remainder of the paper is organized as follows. Section 2 lays out the theoretical framework of commodity price shocks and conflict. Section 3 gives the background on the Colombian civil war. Section 4 describes the data and

[1] 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.

the methodology. Sections 5 and 6 present the results. Section 7 considers alternative explanations, and Section 8 concludes.

2 Theory– Commodity Price Shocks and Civil War

2.1 Framework

In this section, we outline the theoretical channels through which commodity price shocks can affect civil conflict. To do so, we adapt and build on the model in Dal Bó and Dal Bó (2006), where the economy is composed of two productive sectors, as in the canonical 2x2 international economics model. These two sectors, 1 and 2, each produce output y_1 and y_2 using constant returns to scale technology. The goods are internationally trade 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. w represents wages, the return to labor, and r denotes the rental rate, or return to capital. The government taxes owners of capital at rate τ which generates revenue:

$$R = \tau r \overline{K} \tag{1}$$

As in Dal Bó and Dal Bó (2006), there is also a third appropriations sector which employs labor, but not capital. However, instead of defining appropriation as theft of production, we define appropriation as theft of revenue generated by taxing production, and assume that armed groups target local government for predation purposes. An increase in the size of this appropriations sector is also assumed to increase conflict. We let $s(L_s)$ denote the share of revenue 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 (or total revenue stolen) is therefore given by:

$$s(L_s)\left[\tau r \overline{K}\right]$$

As in Becker (1968), workers can choose to enter either the legitimate or illegitimate sector. Profits siphoned from the legitimate sectors are divided among the L_s individuals employed in the predatory sector, where each worker earns:

$$\frac{s(L_s)}{L_s}\left[\tau r\overline{K}\right]$$

In this framework, 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:

$$ra_{1K} + wa_{1L} = p \tag{2}$$

$$ra_{2K} + wa_{2L} = 1 \tag{3}$$

In the appropriations sector, wages are allocated in a way that exhausts stolen output. In equilibrium, wages in the appropriation sector have to equal wages offered in the productive sectors. This no arbitrage condition requires that:

$$\frac{s(L_s)}{L_s}\left[\tau r\overline{K}\right] = w \tag{4}$$

This framework generates two basic results.

Result 1. 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 is the well known Stolper-Samuelson theorem.

This result arises from differentiating zero profit conditions (2) and (3) which yields:

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

$$\frac{dr}{dp} = \frac{a_{2L}}{a_{1K}a_{2L} - a_{1L}a_{2K}} \quad (6)$$

When sector 1 is relatively more capital intensive, $\frac{a_{1k}}{a_{1L}} > \frac{a_{2K}}{a_{2L}}$, then, according to (5) and (6) $\frac{dw}{dp} < 0$ 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, (5) and (6) indicate that $\frac{dw}{dp} > 0$ while $\frac{dr}{dp} < 0$.

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

This can be seen by differentiating the no arbitrage condition(4) which yields:

$$\frac{dL_s}{dp} = \frac{L_s \frac{dw}{dp} - \left[s(L_s)\tau\overline{K}\right] \frac{dr}{dp}}{\tau\overline{r}\overline{K}s\prime(L_s) - w} \quad (7)$$

When good 1 is capital intensive, $\frac{dr}{dp} > 0$ and $\frac{dw}{dp} < 0$ by result 1 above. This establishes that the numerator is negative. Since the denominator is also negative, $\frac{dL_s}{dp} > 0$. In contrast, when good 1 is labor intensive, $\frac{dr}{dp} < 0$ and $\frac{dw}{dp} > 0$. In that case, $\frac{dL_s}{dp} < 0$.

Two reinforcing effects give rise to the second result. Lets consider an increase in the price of the capital intensive good. First, this lowers wages, reducing the opportunity cost of predatory activity. Wages fall because when p increases, sector 1 expands and sector 2 contracts, releasing more labor into the economy than can be employed by sector 1 at the original factor prices. When wages fall, this reduces the cost of hiring workers into the appropriations sector. This is analogous to the *opportunity cost channel* as conceptualized by the Becker crime model. In addition, there is a second channel which reinforces how the commodity price affects conflict: an increase in p raises the return to capital, which also increases lootable resources, since capital is taxed to generate government revenue. This increases conflict by raising potential gains from predation, a mechanism we label the *rapacity channel*.

Lets now consider an increase in the price of the labor intensive good. This price increase bids wages up as labor becomes relatively more scarce, which reduces the size of the appropriations sector through the opportunity cost channel. Moreover, the rental rate falls, which reduces government revenue and lower predation, which serves as a second channel through which conflict is reduced.

2.2 Testable Predictions

Since there are two reinforcing channels through which price shocks can affect conflict, we use an empirical test to see which channel is more important in the case of coffee, a labor intensive commodity, versus oil, a capital intensive commodity. To conduct this empirical test, we assume that each municipality in Colombia is economically distinct: factor endowments vary across municipalities, and factor mobility is imperfect, which means that some regions produce coffee more intensively, while others produce oil more intensively. Factor prices also vary across these geographic units. Under these assumptions, the framework outlined above generates two sets of testable predictions. First, an increase in the price of coffee should lower conflict differentially in regions that produce coffee more intensively. If the effect occurs through the opportunity cost channel, then we should observe that the coffee shock reduces wages disproportionately in the coffee regions, but does not affect tax revenue. If the effect occurs through the rapacity channel, then we should observe that the coffee shock lowers tax revenue, but does not affect wages.

Second, an increase in the price of oil should increase conflict, either by lowering wages or by raising government revenue. If the opportunity cost channel is more relevant, then we should observe that the oil shock lowers wages disproportionately in the oil region, but does not affect revenue. If the rapacity channel is relevant, then we should observe that the oil shock results in more expenditures in the oil areas, but does not affect wages.

3 Background–Colombia's Civil War

This section provides background on the Colombian conflict, focusing on the two issues that are critical for understanding the channels through which price shocks affect civil war: the recruitment of fighters, which is relevant for the opportunity cost mechanism, and the financing of armed groups, which is relevant for the rapacity channel.

The Colombian civil war started in the 1960s. 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 in other contexts (Esteban and Ray, 1994 and Duclos, Esteban and Ray, 2004). Instead, the war involves three actors: communist guerillas, the government and right-wing paramilitaries. Technically, the conflict is three-sided, but in actuality, there is extensive collusion between the paramilitary and military in countering the guerilla, who fight with the stated aim of overthrowing the state. The insurgency is concentrated in rural areas. 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 claim to represent the rural poor by supporting aims such as land redistribution.

The paramilitaries were first organized with military support in the 1970s, but emerged on a widespread scale during the 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 13,000 fighters. The paramilitary are financed by large landowners and therefore seen to be affiliated with the political and economic elite.

The conflict remained low intensity during the 1980s when it effectively served as a Cold War proxy, but escalated sharply during the 1990s. Both the guerillas and the paramilitary expanded their operations during this decade, which increased the number of municipalities affected by the conflict. Between 1987 and 2000, FARC expanded operations from 26 to 48 fronts, while ELN expanded from 4 fronts to 41 fronts (Sanchez and Palau, 2006). Fighting also intensified in municipalities already affected by the conflict. We take advantage of this escalation across regions and over time to identify the effect of commodity shocks on conflict. We posit that armed groups consider both the cost of recruiting fighters and potential financing gains when they choose their strategy for scaling up conflict activity: municipalities with more revenue are attractive targets from a financing perspective, while municipalities with lower wages are attractive from a recruitment perspective. We therefore discuss the institutional aspects of recruitment and financing in the subsections below.

3.1 Recruitment by Armed Groups

Both the guerillas and the paramilitary recruit from the ranks of rural workers. Although there is variation across groups in the level and nature of payment, recruits are generally compensated, which indicates that relative wages in the legal and illegal sectors serve as an important factor in the decision to become a fighter.

The paramilitaries are reported to pay regular wages that exceed the official minimum wage (Gutierrez, 2006). In addition, some recruits receive land in exchange for fighting, which suggests that joining the paramilitary can be perceived as a means of achieving upward mobility. Former ELN fighters also report that they were paid salaries and given other compensation to help support their families (Human Rights Watch, 2003). However, there is mixed evidence about the extent to which the FARC pays regular wages. Some former FARC combatants report that they did not receive salaries, but did receive occasional payments, which increased when there was strong recruitment competition among groups (*ibid).* However, all FARC 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. This is consistent with evidence that these fighters come largely from impoverished backgrounds (Marin, 2006).

The recruitment of guerilla and paramilitary combatants in rural areas suggests that landless laborers, whose employment opportunities are affected by economic shocks, are also targeted for enlistment by these armed actors. This is particularly relevant in the case of the coffee price shock. In 1998, more than one-third of total agricultural employment was generated by the coffee sector (Ministry of Agriculture, 2007). A major fraction of coffee-related employment stems from casual agricultural workers, who are hired for up to five months during the harvesting season.[2] This suggests that if fluctuations in coffee prices affect the wages of casual laborers, they will also alter the cost of recruiting workers into the guerilla and the paramilitary.

[2] 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. Larger farms also employ landless workers for non-harvest labor throughout the year (Ortiz, 1999).

3.2 Financing of Armed Groups

Besides cost of recruitment, potential financing gains may also motivate guerilla and paramilitary decisions to scale up activities in particular regions. The paramilitaries are financed by the drug trade, contributions from landowners, as well as public resources extorted from local governments. These groups are affiliated with agricultural activity undertaken by large landowners, especially cattle ranching. In contrast, crops such as coffee, which are dominated by smallholder producers, are not known to be a major source of voluntary finance, though it is possible that involuntary payment extorted in the form of "war taxes" may end up financing part of the conflict.

As the paramilitaries expanded their activities during the early 1990s, narcotrafficking and predation on public resources became important sources of finance. As argued by Sanchez and Palau (2006), predation on municipal budgets became especially important after a major fiscal decentralization in 1991, which resulted in the transfer of more resources to lower levels of government, and also introduced greater budgetary autonomy at the local level. We posit that the theft of public resources can occur through two mechanisms: collusion with corrupt local politicians, or coercion under the threat of harm.

Judicial hearings from a nation-wide paramilitary demobilization in 2003 offers considerable anecdotal evidence on this point. For example, in one case, paramilitary members coerced local authorities to allocate public contracts to firms that would give their group 30% of the profits earned from these projects (*Semana*, 2007). The testimony from ex-paramilitary members suggests that predation was particularly prevalent in the oil region. For example, a written agreement between the Martin Llanos paramilitary group and mayors of six oil municipalities shows that the paramilitaries were given control over 50% of the town budgets and a share of public sector jobs in exchange for ensuring that the mayors' preferred candidates won during the 2003 elections. Oil revenue comprised over 90% of the total budget in these municipalities (*El Tiempo*, 2007). These accounts suggest that if oil prices have a substantial effect on fiscal resources, they will alter the potential financing gains from extortion in the oil region.

The financial links between the political elite and the paramilitary groups are reflected in the fact that 40 Congressmen are currently in prison or under investigation for corruption charges involving the paramilitary.[3] However, there

[3] For a complete list of politicians accused of having links with the paramilitaries see Center

is an asymmetry between the paramilitary and the guerilla in this regard, with the latter having fewer ties to politicians. There are two reasons for this asymmetry. First, the guerillas disengaged from the formal political process after their legal political wing was exterminated during the late 1980s. In particular, the FARC had launched a legal political party called the Patriotic Union (UP) in 1985. However, by 1991, they had withdrawn from the political process and returned to full-scale warfare, when over 1,000 UP politicians, including a presidential candidate, had been assassinated by the paramilitary groups.

Second, to the extent that FARC does have ties to local politicians, they are likely to be concentrated in a collection of five municipalities called the Demilitarized Zone (DMZ). The FARC were given control of this region in 1998 as a part of a failed peace negotiation, and they served as the unofficial government in the DMZ until the military re-captured the territory in 2002. Because the guerillas receive financial support from local governments outside the DMZ, predation on public funding is a less important source of finance for the guerillas, relative to the paramilitaries. This is corroborated by data from the *Colombian Presidential Council for National Defense and Security*, which suggests that diversion of public funds constitute less than 3 and 4 percent of ELN and FARC financing, respectively (Richani, 1997). In contrast, these groups rely on kidnappings, the drug trade, and 'war taxes' on farmers and businesses as their largest sources of finance (*ibid*).

4 Data and Methodology

4.1 Data

Our data on the Colombian civil war comes from the *Conflict Analysis Resource Center* (CERAC). The CERAC dataset is event-based, and includes over 21,000 war-related episodes in nearly 950 municipalities over 1988-2005. The data 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 procedure used to collect this data is described extensively in Restrepo et al. (2004), and details on this dataset can be found in the data appendix.

for International Policy (2007).

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. When we consider alternative explanations such as changes in state capacity, we also analyze government attacks from the CERAC data and a measure of police allocation at the department level from the *National Planning Department* (NPD).

In terms of commodities, we use data on coffee, coca and oil. A coffee census from 1997 records the hectares of land used for coffee cultivation in each municipality, which gives us a measure of coffee intensity at one point in time. Figure 1 maps this variable, and shows that Colombia is a good case for comparing conflict dynamics in regions of varying coffee intensity, since coffee production is not isolated to any particular region of the country. In fact, in our final sample, 514 municipalities or approximately 58 percent of the sample is classified as coffee producing. Data for coca cultivation comes from two sources. For 1994, *Dirección Nacional de Estupefacientes* (DNE) has a measure of the hectares of land used for coca cultivation in each municipality. For 1999 to 2004, we obtain an equivalent measure from the *United Nations Office of Drug Control* (UNODC), which collects this data on the basis of satellite imagery.

Data from the NPD is used to determine whether municipalities contain oil reserves, and data from the Ministry of Mines is used to determine whether they contain petrol related pipelines. These data are used to construct an indicator variable of whether municipalities either contain reserves or pipelines. It is important to include pipelines in the definition of what constitutes an oil municipality because pipelines are a target of frequent attack by the guerilla, and because municipalities with pipes receive revenue from taxing oil transport. Our final sample contains 223 oil-related municipalities and 693 non-oil municipalities. In Figure 2, we map the oil-related regions in Colombia.

In terms of commodity prices, data on the international price of crude oil comes from the *International Financial Statistics* (IFS). Figure 3 shows the time series of this oil price, which rises sharply starting 1998. Data on coffee prices comes from the *National Federation of Coffee Growers* (NFCG), which is a quasi-governmental institution that oversees the taxation of coffee exports and sets the internal price of coffee paid to growers. This internal price does not vary across regions and is generally lower than the international price which includes transportation and marketing costs incurred by exporters, and the 'contribución cafetera', which is effectively a coffee export tax. Figure 4 compares the internal and international price of coffee.

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. 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).[4] 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. [5]

In exploring the mechanisms through which price shocks affect conflict, we analyze data on fiscal revenue and public expenditures. Our data on municipal tax revenue comes from *Contraloria General de la Nación* (CGN) while data from the NPD is used to construct department-level measures of government spending. Because the NFCG also spends coffee revenue on public goods such as health and education in the coffee region, we use department level data on the Federation's expenditures to construct a second measure of public spending in these regions. Both the revenue and the expenditure data are reported annually.

We also use a nationally representative rural household survey called *Encuesta Nacional de Hogares* (ENH) from the Departamento Administrativo Nacional de Estadistica (DANE) to obtain labor market outcomes such as the hourly wage and other demographic variables summarized in the data appendix. Data on other municipal characteristics, including population, rainfall and temperature are obtained from the Center of Studies on Economic Development (CEDE). The Data Appendix table summarizes the sample size and the data sources for key variables used in the analysis.

[4] A 'fair price' was calculated on the basis of the sales price and anticipated marketing costs to exporters. If this fair price fell below the price floor which was considered the minimum necessary for coffee farmers given average nation-wide production costs, the price floor would be offered instead. Because this daily NFGC price was posted publicly, private exporters and other purchasing agents used it as a benchmark for calculating their own prices.

[5] 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.

Table I presents the summary statistics for key variables, including the difference in means for areas that have coffee intensity above and below the average (of 1.54 thousand hectares), and the difference in means for oil versus non-oil areas. The table shows that coffee-intensive areas are larger in terms of population, had higher primary enrollment rates in the beginning of the sample period, higher land inequality as measured by the land gini, and lower levels of coca cultivation in 1994 and in the sample period as a whole. Oil areas also tend to be larger in terms of population but have higher levels of coca cultivation throughout the sample period. Given these differences, the results in sections 5 and 6 include specifications where we control for these characteristics.

4.2 Methodology

In this paper, we employ a *Difference-in-differences* type strategy to compare violence dynamics in different regions of Colombia. Specifically, we assess if changes in coffee prices affect violence disproportionately in regions that produce coffee more intensively, and whether changes in oil prices affect violence more in the oil region relative to the non-oil region.

In the case of coffee, we use the internal price instrumented by the international price in our 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. Since internal prices do not vary by region, and we find that higher prices *reduce* violence more in the coffee-intensive regions, this rules out some obvious forms of reverse causality (such as violence lowering production and raising price through a supply effect). However, it is possible to provide more complicated 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 α_i are municipality fixed effects and β_t are year fixed effects; Cof_j is the coffee intensity of municipality j in 1997 as measured by hectares of land devoted to coffee production;[6] 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; and $\mathbf{X}_{jt}$ 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.

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 y_{jt} are conflict outcomes in municipality j and year t, as measured

by the number of guerilla attacks, paramilitary attacks, clashes or casualties. $(Cof_j \times CP_t)$ is the interaction of the coffee price with coffee intensity, and represents the coffee treatment, or coffee shock.[7] δ is the coefficient of interest, and measures the differential effect of coffee prices on violence in regions with greater exposure to price changes.

In the case of oil, we use the international price directly since there is no separate internal price. The estimating equation is given by:

$$y_{jt} = \alpha_j + \beta_t + (Oil_j \times OP_t)\lambda + \mathbf{X}_{jt}\phi + \omega_{jt} \tag{10}$$

where Oil is a categorical variable which equals 1 if the municipality contains oil reserves or pipelines, and OP_t is the natural log of the international price of oil. The coefficient on the interaction term, λ, captures the extent to which oil prices induce a differential change in violence in the oil municipalities, relative to the non-oil areas.

To what extent can international coffee and oil prices be considered exogenous to Colombia's production? The answer is straightforward for oil. Colombia holds a tiny fraction 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 have influenced the international price during

[6] 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.

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

certain periods. In particular, during the late 1980s and early1990s, international coffee prices fell steadily due to rising exports from all major coffee producing nations (including Colombia), when the system of export quotas negotiated under the International Coffee Organization came to an end. This raises concerns about potential reverse causality if a rise in coffee exports from Colombia's coffee-intensive regions drove down world prices and coincided with a disproportionate intensification of conflict in these municipalities. Coffee cultivation might be associated with more violence if for example, the guerilla and paramilitary tax coffee production to finance violence in these areas.

We address this potential concern in two ways. 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.[8] 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 remained relatively stable 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 Colombia 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

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

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:

$$Cof_j \times CP_t = \alpha_j + \beta_t + (Cof_j \times FE_t)\gamma + \mathbf{X}_{jt}\rho + \nu_{jt} \tag{11}$$

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 – the Effect of Price Shocks on Conflict

5.1 The Coffee Shock and Conflict: Baseline Results

In this section, we use regression analysis to assess the effect of coffee prices on civil war outcomes in Colombia. We find that municipalities cultivating more coffee experienced a larger increase in violence when prices fell in the 1990s, and this effect is robust to several alterations in our sample. Since we restrict the analysis in this sub-section 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 nearly 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.

In Panel B, we vary the sample size in two ways to ensure that other changes during this period do not drive the baseline results. In specification (i), we account for the fact that a major earthquake struck the heart of the coffee region in 1999. This may lead to an overestimate of the effect if armed groups took advantage of the resultant chaos and inflow of relief aid to target these areas. To test this hypothesis, we re-estimate (9), eliminating the 27 coffee municipalities affected by the natural disaster. Compared to Panel A, the coefficients in Panel B are larger (in absolute value) for all four measures of violence. This establishes that response to the earthquake does not account for the impact of coffee prices on conflict. In specification (ii), we address the fact that the FARC was granted control over the DMZ municipalities 1998. This could affect our result since coffee is grown in the DMZ, and violence escalated there during the period of low coffee prices, since the government fought to recapture this area in 2002. The results presented in the last row of Panel B and show that the significance of the coffee interaction is robust to eliminating the five DMZ municipalities from the sample.

5.2 The Coffee Shock and Conflict: IV Results

In this sub-section, we address potential endogeneity and measurement error in the coffee intensity variable. The coffee 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.[9] Moreover, if the elasticity of substitution into coffee cultivation is correlated with unobserved factors that reduce violence, this

[9] 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.

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 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:

$$Cof_j \times CP_t = \alpha_j + \beta_t + \sum_{m=0}^{3} \sum_{n=0}^{3} \left(R_j^m \times T_j^n \times ICP_t \right) \theta_{mn} + \mathbf{X}_{jt} + \mu_{jt} \quad (12)$$

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 guerilla attacks and paramilitary attacks at the 5% level and for clashes at the 1% 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 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 (10). The results in Panel A of Table IV indicate that the oil shock exerts 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 coefficient in column (2), we consider the rise in attacks over 1998 to 2005, when the oil price rose by 1.37 log points. The coefficient implies that paramilitary attacks increased by .017 more in the oil municipalities relative to non-oil areas, which represents a 18 percent of the mean number of paramilitary attacks in the full period sample.

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.[10] The first and second stages are given by (11) 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 coefficients 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. The equivalent figures for a municipality at the 75th percentile are 7 percent, 12 percent 11 percent and 8 percent, respectively.

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. The coefficient in column (2) suggests that a 1 percent rise in the price of oil results in .001 more paramilitary attacks annually, which represents a 1.2 percent increase above the mean. In contrast, a 1 percent fall in the price of coffee results in 1 percent more attacks in the mean coffee region, 3 percent more attacks at the 75th percentile and 7 percent more attacks in the 100th percentile of the coffee intensity distribution. This indicates that coffee prices have a larger effect on paramilitary attacks in the above average coffee municipality, than oil prices in the oil region.

Next, we introduce additional controls for characteristics that differ across coffee versus non-coffee areas, and oil versus non-oil regions, as indicated by the summary statistics in Table I. We control for the gross primary and secondary educational enrollment rates in Panel A of Table V, and for the gini coefficient on land inequality in Panel B. In both cases, we interact the control variables with the price of coffee and the price of oil. The results show that the coffee and oil shocks remain significant across all three specifications. The results are statistically weaker in Panel B, but this is related to the fact that the land inequality measure is only available for a subset of the municipalities, which reduces the number of observations. Because these control variables are not available for all municipalities in the main sample, we also re-estimate our baseline specification (without the control interactions) and find that they are significant in the subset of observations used to estimate each of the regressions

[10] 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.

in Table V. We are thus able to verify that sample selection does not drive the results in these robustness checks.

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 C, we introduce linear time trends by department as an additional control. Relative to the baseline specification in Panel C of Table IV, 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.

Next, we explore the degree to which there are spatial spillovers in violence. A rise in violence in municipality j may cause neighboring areas to experience more violence if conflict disperses outward. We conceptualize this outward conflict dispersion as a positive spillover. Alternatively, violence in j may cause conflict to decrease in neighboring areas if armed groups move out of nearby regions and into j. We conceptualize this inward violence concentration as a negative spillover. The presence of a negative spillover would suggest that conflict intensification in region j arises in part from substitution of conflict away from other regions.

To test for the presence of spillovers, we assess the degree to which the coffee and oil shocks in municipality j cause violence to increase among j's neighbors, controlling for the neighbors' exposure to these shocks. We define neighbors as municipalities that share a contiguous border with j. In the case of coffee, we estimate

$$Ny_{jt} = \alpha_j + \beta_t + (\widehat{Cof_j \times CP_t})\delta + (\widehat{NCof_j \times CP_t})\zeta + \mathbf{X}_{jt}\phi + \mathbf{NX}_{jt}\eta + \varepsilon_{jt} \quad (13)$$

where Ny_{jt} are the average violence outcomes among j's neighbors, $\mathbf{NX}_{jt}$ are the average time-varying control variables (namely, log of population) in j's neighbors, and $NCof_j$ is the average coffee intensity in j's neighbors. The $\widehat{NCof_j \times CP_t}$ measures the neighbors' exposure to the coffee shock. If δ and ζ have the same sign, this is evidence of a positive spillover. Lets consider the case where both coefficients are negative. A negative ζ indicates that when coffee prices fall, violence rises more if the neighborhood is more coffee intensive.

A negative δ indicates that neighbors' violence is additionally higher if j has higher coffee intensity. On the other hand, if δ and ζ have opposite signs, this is evidence of a negative spillover. For example, if ζ is negative while δ is positive, this tells us that when coffee prices fall, higher coffee intensity in the neighborhood results in greater violence in the neighborhood, but higher coffee intensity in j has the opposite effect, by drawing conflict away from neighboring areas.

Panel A of Table VI presents the results from estimating equation (13). The only evidence of a significant spillover appears in column (2), in the case of a paramilitary attacks. The estimate of δ in the first row is positive, while the estimate of ζ in the second row is negative, which points toward a negative spillover or violence concentration. The coefficient of -.087 (for ζ) indicates that the price fall from 1997-2003 resulted in 14 percent more paramilitary attacks in a neighborhood of average coffee intensity. The coefficient of .024 (for δ) shows that the neighbors experienced 4 percent fewer paramilitary attacks if j has average coffee intensity, relative to the case when j cultivates no coffee. This is the sense in which paramilitary activity appears to move out of neighboring areas in the presence of the coffee shock. However, the estimate for δ is statistically significant at the 10 percent level, and thus presents weak evidence of a fairly small substitution effect.

To explore spillovers in the case of oil, we estimate

$$Ny_{jt} = \alpha_j + \beta_t + (Oil_j \times OP_t)\lambda + (NOil_j \times OP_t)\vartheta + \mathbf{X}_{jt}\phi + \mathbf{NX}_{jt}\eta + \omega_{jt} \quad (14)$$

where $NOil_j$ is the fraction of j's neighbors that produce oil or have petrol pipelines, and $NOil_j \times OP_t$ measures the neighbors' exposure to the oil shock. Panel B of Table VI presents the results from estimating (14). The results show no significant spillover effects. The estimate of ϑ is significant in column (2), indicating that neighborhoods with more oil production or pipelines experienced more paramilitary attacks when the price of oil increased. However, the estimates of λ in the first row are insignificant, indicating no additional effects based on the presence of oil in municipality j. Together, the spillover results from the oil and coffee shocks suggest that the rise in violence associated with these commodity prices primarily reflect a net increase in conflict activity, rather than a substitution away from neighboring areas. Moreover, there is no evidence to suggest that the rise in violence induced by these shocks spill over outward into neighboring areas.

In summary, our results in this section 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. These findings remain robust to a wide range of specifications and controls, including an instrument based on geological conditions. 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. This effect is robust to controlling for increased coca production in Colombia and the inclusion of linear trends by department, and reflect net increases in conflict activity.

These findings are consistent with the theoretical prediction that a rise in the price of the labor intensive commodity reduces conflict, while a rise in the price of the capital intensive commodity. increases conflict. In the next section, we examine the channels through which the commodity shocks affect conflict. There, we address the asymmetry of the findings for coffee and oil, examining why the coffee shock appears to affect all measures of violence, while the oil shock specifically affects paramilitary attacks.

6 Results– Mechanisms

In this section, we present direct empirical evidence on the channels through which the coffee and oil shocks affect civil conflict in Colombia. As predicted by the theory in Section 2, an increase in the price of the labor intensive good can lower conflict either by increasing wages or lowering state revenue, while an increase in the price of a capital intensive good can promote conflict by reducing wages or raising state revenue. A change in wages alters the opportunity cost of armed recruitment, while a change in municipal resources affects the incentive to steal these additional resources. We consider each of these two channels in the subsections below, and evaluate the extent to which they matter in the case of the coffee shock and the oil shocks.

6.1 Wages and the Opportunity Cost Channel

In this subsection, we determine the relative importance of the opportunity cost mechanism by examining the effect of the coffee and oil shocks on labor market outcomes. If the price of a commodity affects conflict through the labor market, then we should observe a differential effect on wages in the municipalities that produce that good more intensively. To test this hypothesis for the coffee shock, we estimate:

$$q_{ijt} = \alpha_j + \beta_t + (\widehat{Cof_j \times CP_t})\delta + \mathbf{X}_{ijt}\theta + \omega_{ijt} \tag{15}$$

where q_{ijt} is the (log) 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. Panel A of Table VII presents these results. 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 price of coffee increases agricultural wages by .17 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 15 percent in municipalities at the 25th and 75th percentile of the coffee intensity distribution.

To evaluate the effect of the oil shock on wages, we estimate:

$$q_{ijt} = \alpha_j + \beta_t + (Oil_j \times OP_t)\lambda + \mathbf{X}_{ijt}\theta + \nu_{ijt} \tag{16}$$

The results in Panel B of Table VII show that the oil shock has no discernible impact on wages in the oil region. Although the wages of workers employed across different sectors should be affected equally in general equilibrium, empirically, it would be useful to distinguish between workers in the oil versus non-oil sectors. The difficulty is that the sector of employment categories in the rural household surveys do not enable us to make this distinction. Therefore, we focus instead on the wages of all workers and those in the non-agricultural sector. As shown in Columns (1) and (3), these coefficients are both statistically indistinguishable from zero.

6.2 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 discernible effect on budgetary resources in local governments. The theory predicts that price shocks affect government resources through their effect on tax revenue. Therefore, in the case of coffee, we estimate equation (9), where the dependent variable is the log of total tax revenue collected by the municipal government. These results are shown in Panel A of Table VIII. The coefficient in column (1) indicates that the coffee shock does not have a significant effect on this outcome.

Although the theory makes a prediction about government revenue rather than spending, we also assess the effect of the coffee shock on expenditures undertaken by local government and by the NFCG, which spends revenue generated from taxing coffee exports on public goods such as schools and health clinics in the coffee region. This serves as a robustness check, since spending is an alternative measure of public resources that can be targeted for predation purposes. Because data on the Federation's expenditures are only available at the departmental (versus municipal) level, in Column (2), we estimate (9) at this higher level of aggregation with log NFCG spending as the outcome variable.[11] In columns (3)-(4) we also analyze government spending and the sum of government and NFCG expenditures. The sum may be the most appropriate spending measure, since these two funding sources have been used as substitutes, with municipal spending decreasing when the Federation has more resources at its disposal. However, the coefficients in columns (2)-(4) indicate that the coefficient on the coffee shock is statistically insignificant and close to 0 in magnitude for all three outcome variables, which suggests that changes in coffee prices do not affect these various forms of public spending.

In Panel B of Table VIII, we assess the effect of the oil shock on public resources by estimating equation (10), with tax revenue and government spending as the relevant outcome variables. The coefficient in column (1) indicates that the oil shock substantially increases tax revenue at the disposal of the municipal government: a 1 percent rise in the price of oil increases revenue by .13 percent more in the oil region. This suggests that the 137 percent increase in oil prices from 1998 to 2005 resulted in 20 percent more revenue in the oil municipalities,

[11] We also re-estimate our main violence results at the department level, but do not present these estimates for coniseness. We verify that the coffee shock continues to have a negative and signifiacnt effect on the four violence outcomes, and that the oil shock continues to have a positive, significant effect on the number of paramilitary attacks.

relative to non-oil areas. This result reflects the fact that foreign oil companies are required to pay the Colombian government royalties amounting to 20 percent of the value of their oil exports. Moreover, explicit revenue sharing agreements require that each level of government – central, departmental and municipal – receives a share of these resources.[12] In column (3), we look at the effect of the oil shock on government spending, at the department level. The coefficient implies that the oil shock also caused government expenditures to increase by an additional 45 percent in the oil region, relative to the non-oil region.

6.3 Interpretation

We interpret these findings as evidence the coffee shock affects political violence through the opportunity cost mechanism, and not through the rapacity mechanism. A fall in the price of coffee lowers the wages of agricultural laborers employed in the coffee region, which leads the guerilla and paramilitary to scale up their activities due to the availability of cheaper recruits in these areas. On the other hand, coffee prices do not affect tax revenue at the disposal of the municipal government, and therefore do not alter the armed groups' incentive to move into coffee regions with the intention of predating on public resources.

In contrast, the oil shock does not affect political conflict through the opportunity cost channel, but rather, through the rapacity channel. A rise in the price of oil does not alter the wages paid to workers but does affect both tax revenue and public expenditures undertaken in the oil region. Enlarged municipal budgets motivate armed groups to move into oil-rich areas to gain control over these resources. This suggests that the opportunity cost mechanism is more important in the case of the labor-intensive commodity, and that the rapacity effect is more important in the case of the capital-intensive commodity.

Since the oil shock increases the incidence of paramilitary attacks, but not guerilla attacks, the results also indicate that oil revenue affects incentives for paramilitary predation, but does not affect incentives for guerilla predation. We posit that this asymmetry arises in the Colombian context since the paramilitaries have stronger ties to the political elite. These links allow them to extort

[12] Law 141 of 1991 specifies that 32 percent of the revenue is allocated to the central government, 47.5 percent is allocated to the department, and 12.5 percent to the municipal government. The legislation also specifies that companies must pay a transport tax to the municipalities that contain oil and natural gas pipelines, which is why we count regions with pipelines as oil-related municipalities in our sample.

resources through the corruption channel. For example, as detailed in Section 3.2, mayors in six oil municipalities gave paramilitary groups control over half the municipal budgets between 2000 and 2003 (*El Tiempo*, 2007). Stronger links to politicians may also enable armed groups to obtain more precise information on budgetary resources available across regions, which could facilitate resource extraction through coercive activities, such as demanding a partial share of public contracts under threat of harm (*Semana*, 2007). While its evident that this type of coercion would be associated with more violence, even resource extraction through collusion with politicians can coincide with greater conflict, since the paramilitaries have to expel the guerilla to establish control when they arrive in a municipality.

7 Alternative Explanations

In this section we consider and present evidence against two alternative explanations of our findings: the presence of the illicit coca crop and changes in state capacity.

7.1 The Coca Mechanism

There are two ways in which the presence of coca may confound the findings presented in sections 5 and 6. 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. As shown in Table I, the pre-shock coca intensity (in 1994) is significantly lower in more coffee-intensive areas. In contrast, there is no significant difference in the 1994 coca intensity between oil and non-oil regions. This suggests that changes affecting coca production are more likely to introduce bias into how the coffee shock affects violence, rather than how the oil shock affects violence.

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 this eradication effort 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 IX, 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 IX 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 19 percent and 53 percent respectively in the mean coca municipality. This is similar to the Angrist and Kugler finding that violent deaths increased more in coca departments after 1994. However, we replicate this finding at the municipality level and show the direct link to political violence, by using data on civil war-related casualties instead of mortality statistics as our measure of violence.

Besides other contemporaneous policy changes, there is a second way in which coca may affect our findings. Changes in coffee and oil prices may have had a direct effect on the amount of coca cultivated across municipalities. Since armed groups fight to control proceeds from the drug trade, the rise in coca cultivation would then represent an alternative mechanism through which the price shocks affect civil war, beyond the opportunity cost and rapacity channels.

This is a clear concern in the case of the coffee shock since farmers may substitute away from coffee and into coca when coffee prices are low. 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 Peru (see Krauss 2001, Wilson, 2001a; Wilson 2001b and Fritsch, 2002). Theoretically, this alternative mechanism may also be a concern for the oil shock if oil regions produce agricultural commodities, since the Stolper-Samuelson theorem dictates that a rise in oil prices would lower wages, which would induce farmers to turn to coca in these regions. Empirically, the results in section 6.1 showed that the oil shock did not affect wages, which assuages this concern to a certain degree. Nonetheless, since the time varying coca intensity is significantly higher in the oil region than the non-oil region for the sample period (see Table I), we assess the effect of both the coffee and oil shocks on coca cultivation.

We do so in Panel A of Table X by re-estimating equation (9) and (10), using time-varying coca intensity as the outcome variable.[13] The coefficients in Column (1) indicate that neither the coffee shock nor the oil shock had a significant effect on coca cultivation. Because this sample is restricted to the subset of years and municipalities for which we have coca data, in columns (2) - (5), we re-estimate our violence outcomes for this sub-sample, and find that the basic results do not change.

In Panel B, we undertake a second falsification test to address this concern. If the commodity shocks affect conflict through the coca channel, then they should no longer exert a significant effect if we remove every municipality ever recorded to produce coca from the sample. This eliminates nearly one-quarter of the municipalities from the estimate. Moreover, we are only able to observe whether municipalities grow coca in the post-1994 period. Together, these restrictions reduce the number of municipality-year observations by nearly 50 percent relative to the full sample in the baseline specification (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

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

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 the commodity shocks did not lead to greater coca cultivation and have a significant effect on violence outcomes even in the non-coca municipalities. This suggests that coca cannot be the driving force through which coffee areas or oil areas experienced an increase in conflict.

7.2 State Capacity

If commodity price shocks induce differential changes in state capacity in the coffee and oil areas, then they may affect violence by altering security in these regions. In the case of coffee, it is possible that the fall in prices led to lower local law enforcement and diminished military presence in the coffee region, and this institutional deterioration rendered coffee municipalities vulnerable to attack from the guerillas and paramilitaries. In the case of oil, it is possible that the increase in government revenue (shown in Table VIII) led to greater expenditure on defense, and fuelled conflict as the government pursued armed groups more aggressively. This second explanation is somewhat inconsistent with the fact that the oil shock leads to a rise in paramilitary attacks but does not affect the number of clashes, many of which involve the military. However, clashes are not an ideal measure of government military activism, since they also include battles among the guerillas and paramilitaries.

We analyze two additional outcome variables to test for this alternative mechanism. First, we look at government attacks, where the military pursues a one-sided campaign (such as a bombing), which does not involve an exchange of fire with armed groups. Because attacks are unilateral events, they are a stronger indicator of how active the military is in a particular municipality, relative to the clashes variable. The ideal variable for measuring state presence would be the number of troops allocated to across municipalities. Although this data is not available, we are able to obtain department-level data on the number of police stationed in each region, which are a good measure of local law enforcement efforts.

The results for the coffee shock are displayed in Panel A of Table XI. Columns (1) and (2) show that the coffee shock has a significant negative effect on both government attacks and police allocation. In other words, when coffee prices fell, government attacks *increased* more in the coffee region. Moreover, there was an expansion of police forces stationed in the coffee areas, which suggests that a *decline* in law enforcement cannot account for the rise in violence over this period.

In contrast, the results in Panel B indicate that the oil shock did not have a significant effect on any of these variables. Thus the rise in violence associated with oil prices cannot be attributed to changes in the government's security efforts to defend oil reserves and pipelines. This suggests that the oil-induced rise in government revenue does not promote conflict by boosting state capacity, but rather by inviting armed groups who predate on state resources.

8 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 and capital-intensive commodities have opposite effects on political violence in Colombia. A *fall* in the price of coffee, a labor-intensive commodity, increases violence disproportionately in the coffee municipalities. In contrast, a *rise* in the price of oil intensifies violence in the oil areas, relative to the non-oil municipalities. These results are robust to controlling for a variety of alternative hypotheses, including coca eradication schemes under *Plan Colombia,* differential trends across regions, and potential endogeneity in the definition of a coffee intensive municipality.

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. The rapacity channel appears to be unimportant, since coffee prices do not appear to affect tax revenue in the coffee areas. On the other hand, rapacity is found to play a key role in the case of the capital-intensive commodity: the oil shock substantially increases local government revenue, encouraging paramilitary groups to move into oil areas to control these resources. Since the rapacity channel promotes paramilitary violence but not guerilla violence, the analysis also suggests that institutional features may be important in defining which groups respond to which incentives. In the Colombian case, we posit that ties between the paramilitary and local politicians facilitate predatory behavior by these armed groups, encouraging them to extract resources through corruption and collusion with local politicians.

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. 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.

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9 Data Appendix

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 complements the dataset with additional events provided in reports by human rights NGOs and by Colombian Government agencies.

Sample Size at the Municipal Level

The CERAC dataset includes 966 municipalities that experienced any civil war event between 1988 to 2005, of which only 965 experienced a guerilla attack. 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 paramilitary attacks, clashes and casualties, and 943 municipalities for analyzing guerilla attacks. 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 915 and 916 cases for guerilla attacks and other conflict outcomes, respectively. Since the oil indicator is 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 893 and 894 cases for guerilla attacks and the other outcomes 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 875 or 876 municipalities. When we control for education, the availability of the primary and secondary gross enrollment rates in 1988 reduces the sample to 829 municipalities. Finally, when we control for land inequality, the availability of the time invariant gini coefficient further reduces the sample to 722 municipalities. However, in specifications using these variables, we re-estimate our baseline specifications in these sub-samples, and confirm that sample selection induced by these missing observations do not affect our results.

Sample Size at the Department level

Our data on regional police allocation and NFCG spending are only available at the department level. Therefore, the analysis of public spending is also undertaken at the departmental level. The spending analysis is undertaken for

31 of 32 departments. The excluded department is the island of San Andres, which is considered to be an enclave economy given its heavy dependence on tourism.

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 DANE, the Colombian statistical agency. Consistent measures of income are available for the years 1996 to 2004. However, there are fundamental errors with the 1996 municipal coding: 89 percent of the municipal codes in this year do not match the official municipal codes in other data sources. For this reason, we exclude 1996 from the wages analysis.

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.

See the Data Appendix Table for a summary of the sample size and the source of the data for the key variables.

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Table I
Summary Statistics

	Mean	Std. Dev.	Mean	Std. Dev.	Difference in means
	Coffee intensity < 1.54		*Coffee intensity>1.54*		*Coffee >1.54 - Coffee<1.54*
Individual level variables:					
Hourly wage, thousands of Colombian pesos	1.091	3.860	1.062	1.674	-0.029
Municipal level variables:					
Population, thousands	21.549	26.474	28.182	27.979	6.632***
Coffee intensity, thousands of hectares, 1997	0.275	0.427	3.653	1.942	3.378***
Gross primary enrollment rate, 1988	1.284	0.413	1.415	0.299	0.131***
Gross secondary enrollment rate, 1988	0.340	0.217	0.368	0.176	0.028
Land gini coefficient	0.688	0.101	0.711	0.075	0.023**
Coca intensity, thousands of hectares, 1994	0.093	0.641	0.017	0.086	-0.076**
Coca intensity, thousands of hectares, 1994 & 1999-2005	0.144	0.848	0.015	0.104	-0.129***
Number annual guerilla attacks	0.493	1.518	0.690	1.528	0.197***
Number annual paramilitary attacks	0.084	0.442	0.126	0.530	0.0423***
Number annual clashes	0.455	1.256	0.677	1.536	0.222***
Number annual casualties	2.000	6.852	2.583	8.214	0.582***
Number annual govt. attacks	0.098	0.539	0.124	0.429	0.026**
Tax Revenue, billions of Colombian pesos	13.261	61.585	12.200	42.980	-1.062
Department level variables:					
Number Police, thousands	1.504	1.157	3.951	3.166	2.447***
Govt. spending, billions Colombian pesos	217.817	1188.085	213.460	642.517	-4.357
NFCG Spending, billions Colombian pesos	0.536	1.241	6.845	5.124	6.308***
	Non-oil		*Oil*		*Oil - Non-Oil*
Individual level variables:					
Hourly wage, thousands of Colombian pesos	1.057	2.387	1.151	5.247	.094*
Municipal level variables:					
Population, thousands	20.785	24.281	28.920	32.971	8.134***
Gross primary enrollment rate, 1988	1.299	0.389	1.340	0.422	0.042
Gross secondary enrollment rate, 1988	0.340	0.211	0.364	0.208	0.024
Land gini coefficient	0.691	0.096	0.694	0.099	0.003
Coca intensity, thousands of hectares, 1994	0.077	0.608	0.084	0.491	0.007
Coca intensity, thousands of hectares, 1994 & 1999-2005	0.097	0.642	0.191	1.073	0.094***
Number annual guerilla attacks	0.458	1.266	0.751	2.115	0.294***
Number annual paramilitary attacks	0.080	0.400	0.127	0.607	0.047***
Number annual clashes	0.465	1.269	0.590	1.442	0.125***
Number annual casualties	1.991	7.129	2.469	7.092	0.478***
Number annual govt. attacks	0.094	0.523	0.131	0.514	0.038***
Tax Revenue, billions of Colombian pesos	13.185	62.780	12.352	37.566	-0.832
Department level variables:					
Number Police, thousands	0.887	0.998	2.786	2.381	1.898***
Govt. spending, billions Colombian pesos	165.549	1252.621	239.792	965.521	74.243

Notes. Means and standard deviations of key variables are presented in this table. Difference in means are presented for municipalities below and above mean coffee intensity (of 1.54 thousand hectares) and for oil and non-oil areas. The data appendix includes further details on sample size and data sources.

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

	(1)	(2)	(3)	(4)
Dependent variables:	Guerilla attacks	Paramilitary attacks	Clashes	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	10,689	10,701	10,701	10,701
Number of municipalities	893	894	894	894
Panel B: Robustness checks				
(i) Remove earthquake municipalities				
Coca int x Log coffee price	-0.17	-0.065	-0.336	-1.212
	(0.094)*	(0.023)***	(0.066)***	(0.322)***
Observations	10,425	10,437	10,437	10,437
Number of municipalities	871	872	872	872
(ii) Remove DMZ municipalities				
Coca int x Log coffee price	-0.141	-0.048	-0.264	-0.938
	(0.077)*	(0.021)**	(0.070)***	(0.309)***
Observations	10653	10665	10665	10665
Number of municipalities	890	891	891	891

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 row (i) of panel B, we exclude 27 municipalities affected by an earthquake in the coffee region. In row (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

Dependent variables:	(1) Guerilla attacks	(2) Paramilitary attacks	(3) Clashes	(4) Casualties
IV coffee int x Log coffee price	-0.257	-0.104	-0.375	-0.948
	(0.127)**	(0.045)**	(0.124)***	(0.765)
Observations	9,788	9,799	9,799	9,799
Number of municipalities	892	893	893	893

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

Dependent variables:	(1) Guerilla attacks	(2) Paramilitary attacks	(3) Clashes	(4) Casualties
Panel A: The oil shock				
Oil x Log oil price	-0.095	0.098	-0.054	0.003
	(0.110)	(0.035)***	(0.094)	(0.333)
Observations	16377	16395	16395	16395
Number of municipalities	915	916	916	916
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	15981	15999	15999	15999
Number of municipalities	893	894	894	894
Panel C: The coffee and oil shocks				
Coffee int x Log coffee price	-0.196	-0.061	-0.285	-0.873
	(0.072)***	(0.022)***	(0.087)***	(0.363)**
Oil x Log oil price	-0.073	0.108	0.009	0.18
	(0.111)	(0.035)***	(0.081)	(0.344)
Observations	15981	15999	15999	15999
Number of municipalities	893	894	894	894

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-C, 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 V
The Effect of the Oil and Coffee Shocks on Violence: Robustness Checks

Dependent variables:	(1) Guerilla attacks	(2) Paramilitary attacks	(3) Clashes	(4) Casualties
Panel A: Control for education				
Coffee int x Log coffee price	-0.193	-0.061	-0.307	-0.96
	(0.068)***	(0.022)***	(0.086)***	(0.359)***
Oil x Log oil price	-0.057	0.106	0.015	0.225
	(0.114)	(0.039)***	(0.080)	(0.369)
Observations	14922	14922	14922	14922
Number of municipalities	829	829	829	829
Panel B: Control for land inequality				
Coffee int x Log coffee price	-0.193	-0.048	-0.283	-0.578
	(0.081)**	(0.022)**	(0.101)***	(0.269)**
Oil x Log oil price	-0.091	0.086	-0.047	0.098
	(0.118)	(0.035)**	(0.080)	(0.380)
Observations	12996	12996	12996	12996
Number of municipalities	722	722	722	722
Panel C: Control for department trends				
Coffee int x Log coffee price	-0.149	-0.072	-0.267	-1.046
	(0.079)*	(0.028)***	(0.133)**	(0.494)**
Oil x Log oil price	-0.043	0.101	0.198	0.032
	(0.105)	(0.038)***	(0.335)	(0.084)
Observations	15981	15999	15999	15999
Number of municipalities	893	894	894	894

Notes . Variables not shown include municipality and year fixed effects and log population. Robust standard errors clustered at the department level are in parentheses. The interaction of coffee intensity with the internal coffee price is instrumented by the interaction of coffee intensity with the export volume of Brazil, Vietnam and Indonesia. Panel A also includes the interaction of the 1988 gross primary and secondary enrollment rates with the oil price, and the interaction of these rates with the internal coffee price, instrumented by the interaction with the export volume of Brazil, Vietnam and Indonesia. Panel B also includes the interaction of the land gini with oil price and the interaction of the gini with the internal coffee price, instrumented by the interaction with the export volume of Brazil, Vietnam and Indonesia. Panel C also includes linear time trends for each of the 32 departments in Colombia. *** is significant at 1% level, ** is significant at 5%, * is significant at 10% level.

Table VI
Examining Spatial Spillovers

Dependent variables:	(1) Neighbors' guerilla attacks	(2) Neighbors' paramilitary attacks	(3) Neighbors' clashes	(4) Neighbors' casualties
Panel A: The coffee shock				
Coffee int x Log coffee price	-0.059	0.024	-0.053	0.027
	(0.041)	(0.012)*	(0.039)	(0.151)
Neighbors' coffee int x Log coffee price	-0.251	-0.087	-0.304	-1.028
	(0.095)***	(0.020)***	(0.099)***	(0.408)**
Observations	15981	15981	15981	15981
Number of municipalities	893	893	893	893
Panel B: The oil shock				
Oil x Log oil price	0.03	-0.018	-0.049	-0.234
	(0.092)	(0.021)	(0.065)	(0.230)
Neighbors' oil x Log Oil price	-0.246	0.094	-0.003	0.372
	(0.159)	(0.042)**	(0.161)	(0.374)
Observations	16377	16377	16377	16377
Number of municipalities	915	915	915	915

Notes. Robust standard errors clustered at the department level are shown in parentheses. For a given municipality j, neighbors are defined as municipalities that share a contiguous border with j. Variables not shown include municipality and year fixed effects, log of population, and log of neighbors' average population. In Panel A, Neighbors' coffee intensity is defined as the average coffee intensity of the j's neighbors. In this panel, the interaction of coffee intensity and neighbors' coffee intensity with the internal price of coffee are instrumented by the interaction of these variables with the export volume of Brazil Vietnam and Indonesia. In Panel B, Neighbors' oil is defined as the fraction of j's neighbors that either produce oil or contain petrol pipelines. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table VII

The Effect of the Coffee and Oil Shocks on Wages

	(1)	(2)	(3)
Subsample:	All workers	Agricultural workers	Non-agricultural workers
Panel A: The coffee shock			
Coffee int x Log coffee price	0.09	0.113	0.072
	(0.024)***	(0.023)***	(0.065)
Observations	52353	34502	17851
Panel B: The oil shock			
Oil x Log oil price	0.022	0.045	-0.030
	(0.062)	(0.086)	(0.071)
Observations	53153	35039	18114

Notes. The dependent variable in Panels A and B are the log of wages. Variables not shown include municipality and year fixed effects, log of population, 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 VIII
The Effect of the Coffee and Oil Shocks on Revenue

Level:	*Municipality*	*Department*		
	(1)	(2)	(3)	(4)
Dependent variables:	Log tax revenue	Log NFCG spending	Log govt. spending	Log govt. plus NFCG spending
Panel A: Effect of coffee shock				
Coffee int. x Log coffee price	0.017	-0.001	0.001	-0.001
	(0.032)	(0.003)	(0.002)	-0.003
Observations	8621	165	338	272
Panel B: Effect of oil shock				
Oil mun x Log oil price	0.128	-	0.332	-
	(0.055)**	-	(0.166)**	-
Observations	8826	-	338	-

Notes. Variables not shown include department and year fixed effects, log of population and linear time trends by department. Robust standard errors clustered at the department level are shown in parentheses. 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. *** is significant at the 1% level, ** is significant at the 5% level, * is significant at the 10% level.

Table IX
The Effect of the Coffee and Oil Shocks: Controlling for Coca

Dependent variables:	(1) Guerilla attacks	(2) Paramilitary attacks	(3) Clashes	(4) Casualties
Panel A: Control for coca intensity interacted with prices				
Coffee int x Log coffee price	-0.19	-0.062	-0.293	-0.881
	(0.072)***	(0.022)***	(0.086)***	(0.363)**
Oil x Log oil price	-0.055	0.111	0.004	0.207
	-0.112	(0.037)***	-0.077	-0.341
Observations	15691	15709	15709	15709
Number of municipalities	875	876	876	876
Panel B: Control for coca intensity interacted with post-1994				
Coffee int x Log coffee price	-0.191	-0.061	-0.288	-0.888
	(0.072)***	(0.022)***	(0.087)***	(0.361)**
Oil mun x Log oil price	-0.055	0.111	0.004	0.199
	(0.112)	(0.037)***	(0.08)	(0.343)
Coca int x post1994 dummy	0.038	0.015	0.101	0.879
	(0.033)	(0.021)	(0.051)**	(0.236)***
Observations	15,691	15,709	15,709	15,709
Number of municipalities	875	876	876	876

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 X
Testing the Coca Substitution Mechanism

	(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	7119	7127	7127	7127
Number of municipalities	894	893	894	894	894
(ii) The oil shock					
Oil x Log oil price	-0.112	-0.237	0.142	-0.052	-0.299
	(0.132)	(0.183)	(0.069)**	(0.072)	(0.500)
Observations	7303	7295	7303	7303	7303
Number of municipalities	916	915	916	916	916
		Panel B: Effect on violence removing every coca municipality			
(i) The coffee shock					
Coffee int. x Log coffee price	-	-0.122	-0.044	-0.16	-0.566
	-	(0.078)	(0.017)***	(0.066)**	(0.161)***
Observations		8,141	8,141	8,141	8,141
Number of municipalities		686	686	686	686
(ii) The oil shock					
Oil x Log oil price	-	-0.097	0.057	-0.093	-0.141
	-	(0.107)	(0.032)*	(0.065)	(0.247)
Observations		11929	11929	11929	11929
Number of municipalities		665	665	665	665

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.

Table XI
Testing the State Capacity Mechanism

Level:	*Municipality*	*Department*
	(1)	(2)
Dependent Variables:	Govt. attacks	Log police
Panel A: The coffee shock		
Coffee int. x Log coffee price	-0.032	-0.002
	(0.014)**	(0.0011)**
Observations	15999	564
Panel B: The oil Shock		
Oil x Log oil price	0.01	0.07
	(0.035)	(0.065)
Observations	16395	564

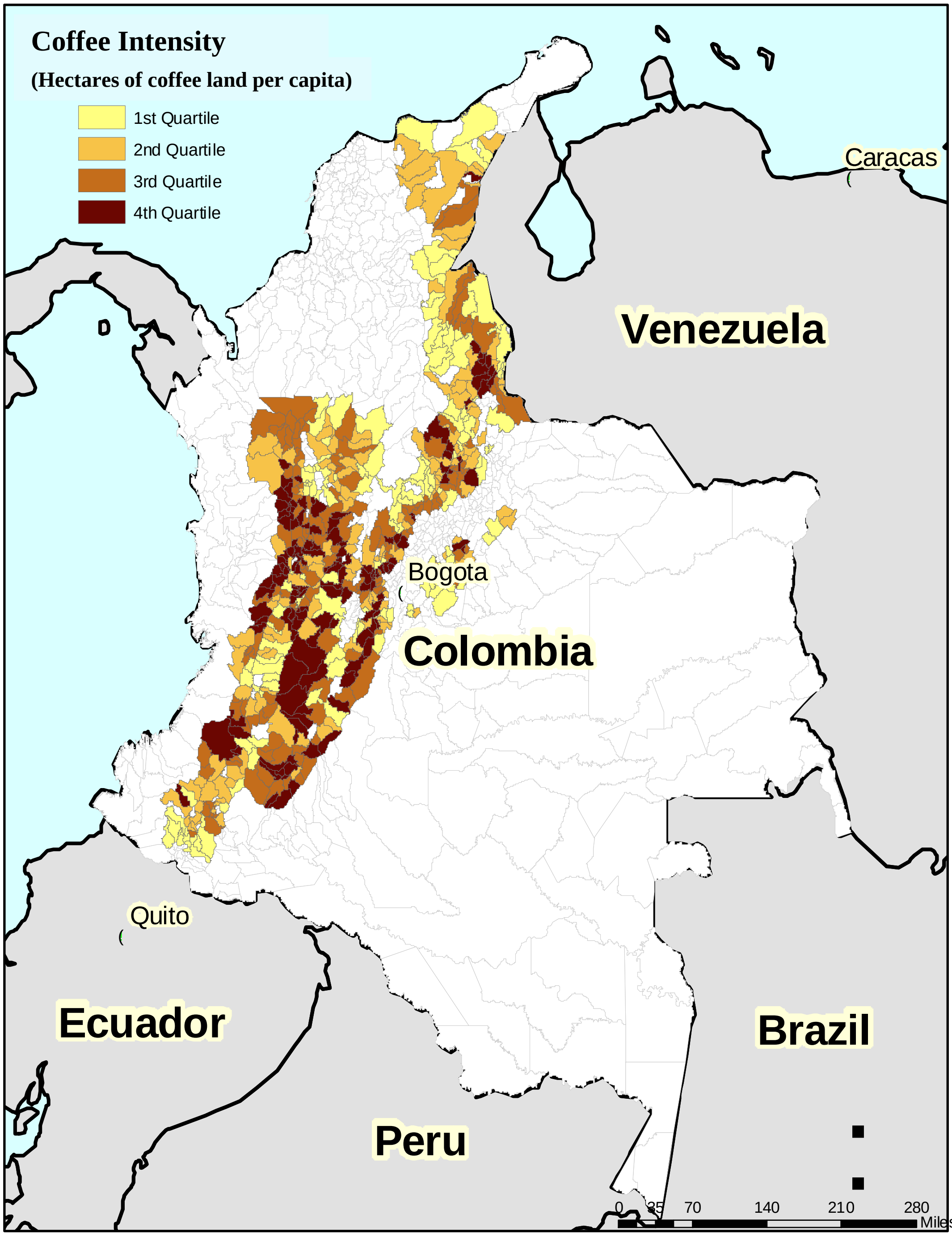
Notes. Variables not shown include municipality and year fixed effects, log of population and linear time trends by department. Robust standard errors clustered at the department level are shown in parentheses. The interaction of coffee intensity and the internal price of coffee is instrumented by the interaction of coffee intensity with the international price of coffee. *** 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

	Sample Size:		From:
Municipal level variables:	*Years*	*Municipalities*	*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 govt. attacks	1988-2005	944	CERAC
Number annual guerilla attacks	1988-2005	943	CERAC
Population, in thousands	1988-2005	916	CEDE
Coffee intensity, in thousands of hectares, 1997	1997	894	NFCG
Coca intensity, in thousands of hectares	1994, 1999-2005	894	DNE, UNODC
Coca intensity, in thousands of hectares, 1994	1994	876	DNE
Gross primary enrollment rate, 1988	1988	829	CEDE
Gross secondary enrollment rate, 1988	1988	829	CEDE
Tax Revenue, in billions of Colombian pesos	1993-2003	751	CGN
Land gini coefficient	1997	722	CEDE
Department-level variables:	*Years*	*Departments*	*Source*
Number Police, in thousands	1988-2005	32	NPD
Govt. spending, billions Colombian pesos	1993-2003	31	NPD
NFCG Spending, billions Colombian pesos	1988-2005	31	NFCG
Individual level variables:	*Years*	*Individuals*	*Source*
Hourly wage, thousands of Colombian pesos	1997-2004	6500 per year, on average	DANE (ENH survey)
Prices:	*Years*		*Source*
Internal coffee price, thousands of 2006 pesos per pound	1988-2005	n/a	NFCG
International coffee price, thousands of 2006 pesos per pound	1988-2005	n/a	NFCG
International price of crude oil, thousands of 2006 pesos per barrel	1988-2005	n/a	IFS

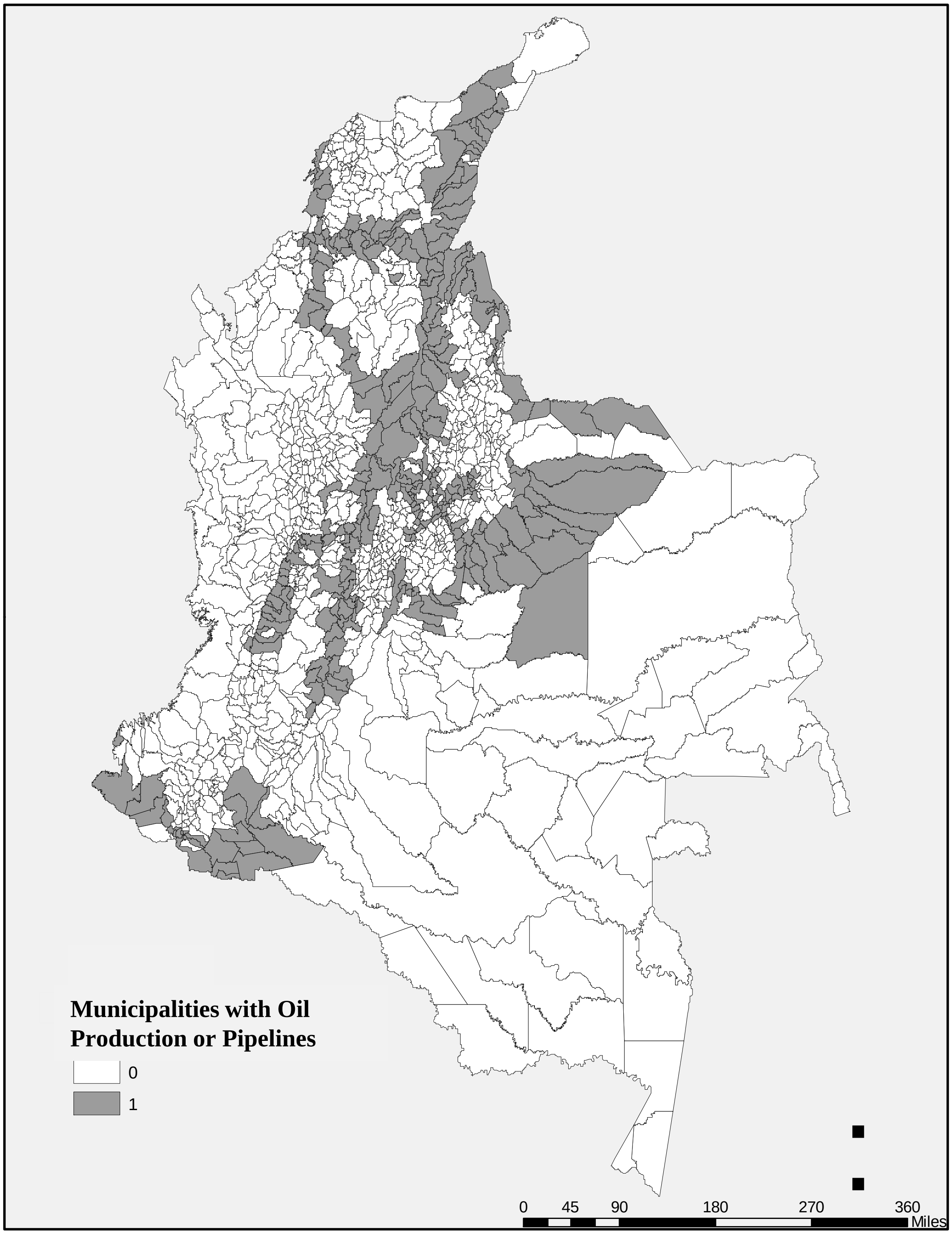
Notes. This table lists the sample size and data source of key variables. The ENH survey is not a panel of households; thus the number of individuals in the sample varies from year to year and the average number of individuals sampled across years is listed above. *Acronyms defined in the text

Figure 1. Coffee Intensity of Colombian Municipalities



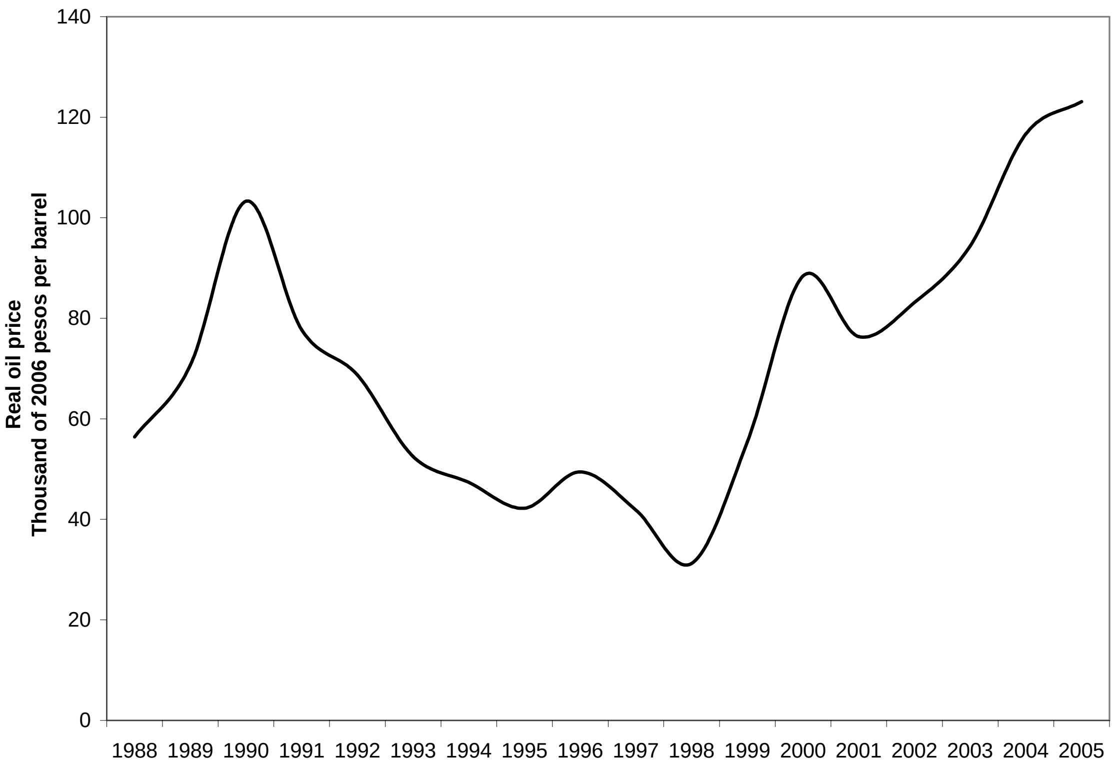
Source: National Federation of Coffee Growers

Figure 2. Municipalities with Oil Reserves or Oil Pipelines



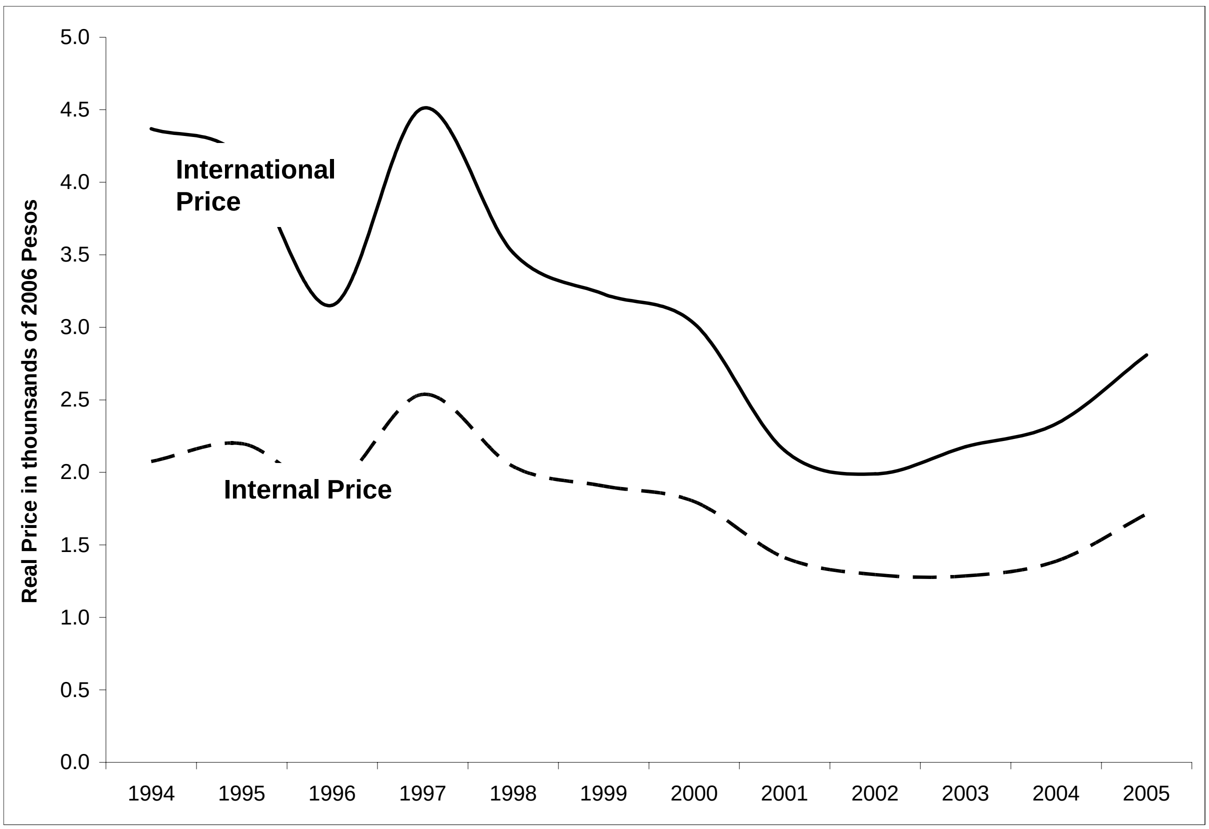
Sources. Shape: IGAC, Data: National Planning Department and Ministry of Mines

Figure 3. Real Price of Oil



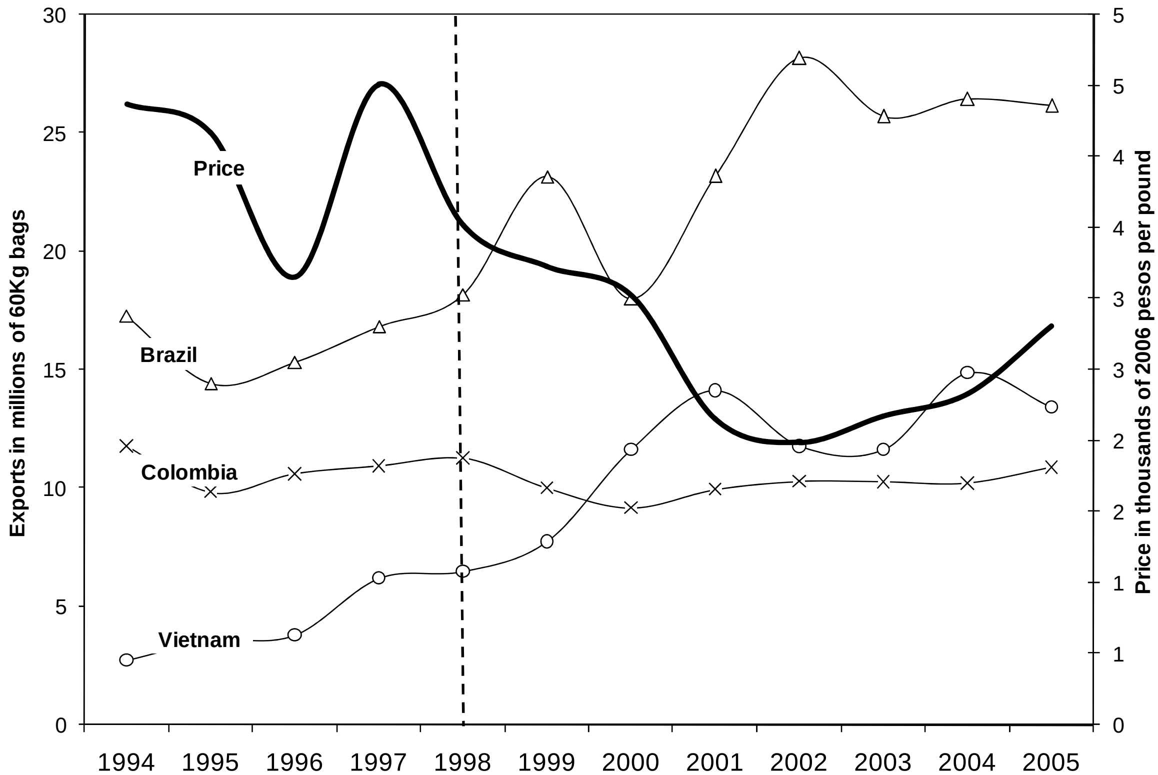
Source: International Financial Statistics

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

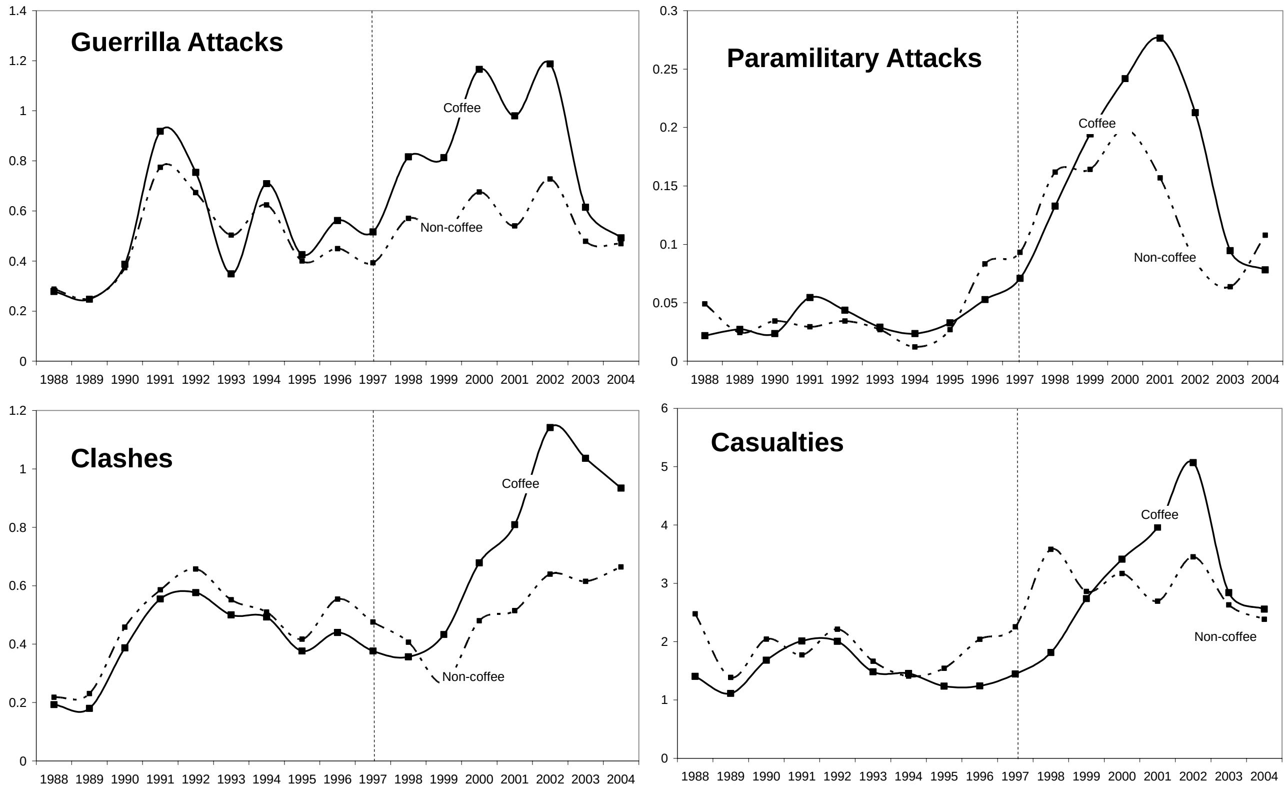


Figure 7. Mean Violence in Oil and Non-Oil Municipalities

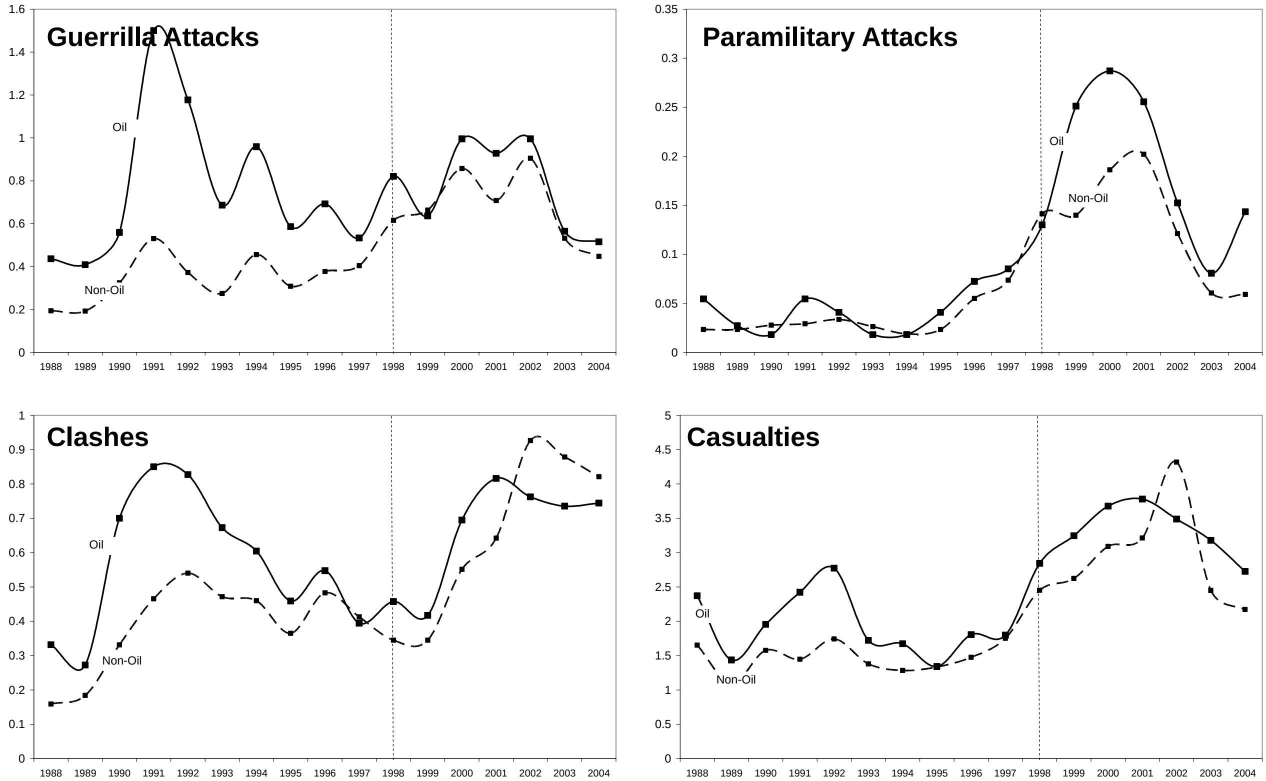
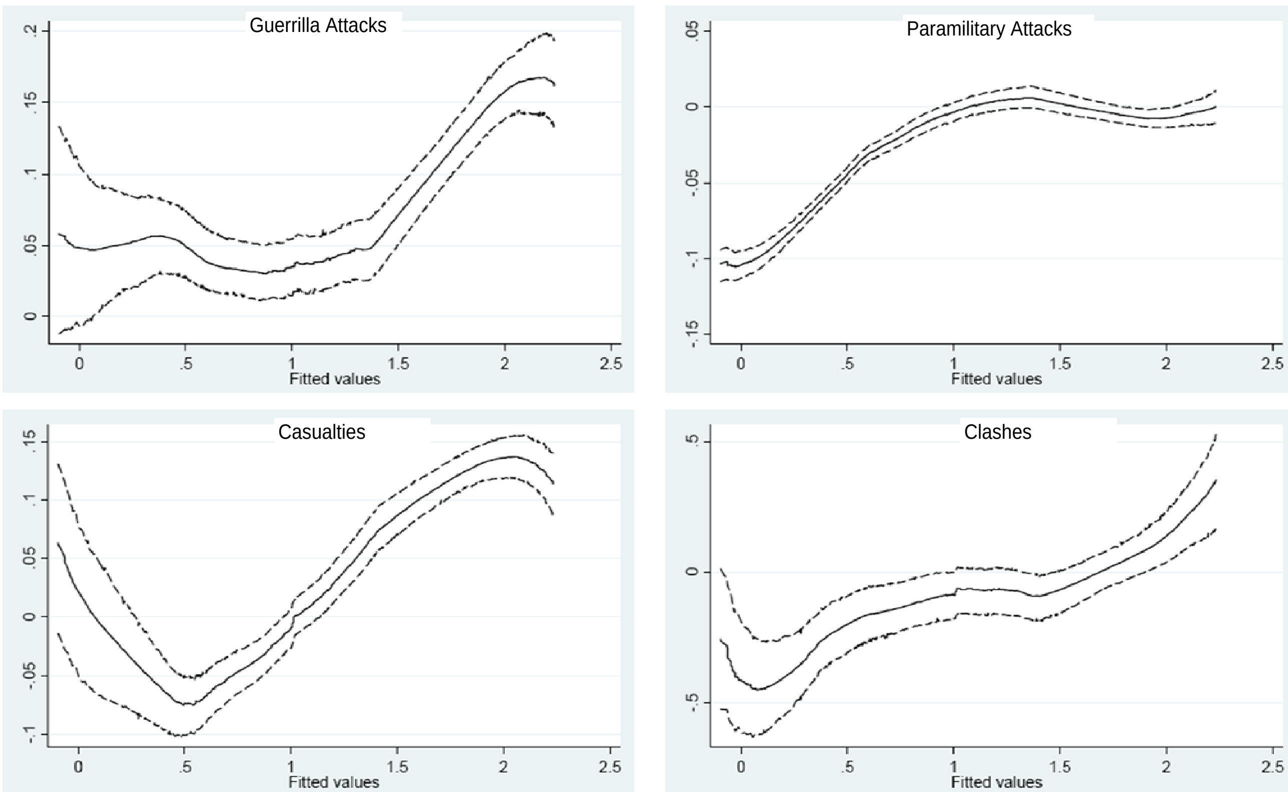


Figure 8. Non-parametric Plots: Predicted Coffee Intensity and the Rise in Conflict



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.