Opium for the masses? Conflict-induced narcotics production in Afghanistan*

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July 12, 2013

Abstract

To explain the rise in Afghan opium production we explore how rising conflicts change the incentives of farmers. Conflicts make illegal opportunities more profitable as they increase the perceived lawlessness and destroy infrastructure crucial to alternative crops. Exploiting a unique data set, we show that Western hostile casualties, our proxy for conflict, have a strong impact on subsequent local opium production. Using the period after the planting season as a placebo test, we show that conflict has a strong effects before and no effect after planting, indicating causality.

Keywords: Conflict, narcotics production, resource curse, Afghanistan
JEL Codes: D74, H56, K42, O1

*First version: April 2008. We thank Astrid Sandsør for excellent research assistance. We are also grateful to Philippe Aghion (the editor), Jens Chr. Andvig, Abdul Aziz Babakarkhail, Erik Biørn, Antonio Ciccone, Oeindrila Dube, Joan Esteban, Jan Terje Faarlund, Raquel Fernández, Jon H. Fiva, Steinar Holden, Alfonso Irarrazabal, Rocco Macchiavello, Halvor Mehlum, Debraj Ray, Carl-Erik Schulz, Tore Schweder, Gaute Torsvik, Bertil Tungodden, and two anonymous reviewers for valuable comments. In addition we have benefited from comments from participants at the Annual Meeting of the Norwegian Economics Association, Oslo 2008, the CMI development seminar, Bergen 2008, the ESOP/CSCW Workshop on Conflicts and Economic Performance, Oslo 2008, the Nordic Conference in Development Economics, Stockholm 2008, the ESOP workshop on Development and Inequality, Oslo 2008, the 4th Annual Conference on Economic Growth and Development, New Delhi 2008, the 5th SFB/TR15 workshop Berlin 2009, the research seminar at Norwegian University of Science and Technology, Trondheim 2009, the 24th Congress of the European Economic Association, Barcelona 2009, the workshop on Economic Development in Namur 2009, and the International Society for the Study of Drug Policy conference, Los Angeles 2010.

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1 Introduction

Opium production in Afghanistan has skyrocketed since 2002. From an already high level it has more than doubled in five years (Figure 1). Why? We claim that a substantial part of the increase is caused by rising violent conflicts, vanishing legal opportunities, and declining law enforcement. The development illustrates how war conditions are both destructive and creative: military actions destroy existing lines of production and create new illegal opportunities helped by the declining rule of law and the deterioration of infrastructure and irrigation. Many Afghans have therefore turned to illegal poppy cultivation as a 'sigh of the oppressed' under extreme political instability with violent conflicts and economic stress. The result is conflict-induced opium production, where the total incomes from the illegal crop (evaluated with prices at the border) amount to more than 40 per cent of the legal GDP in the country.

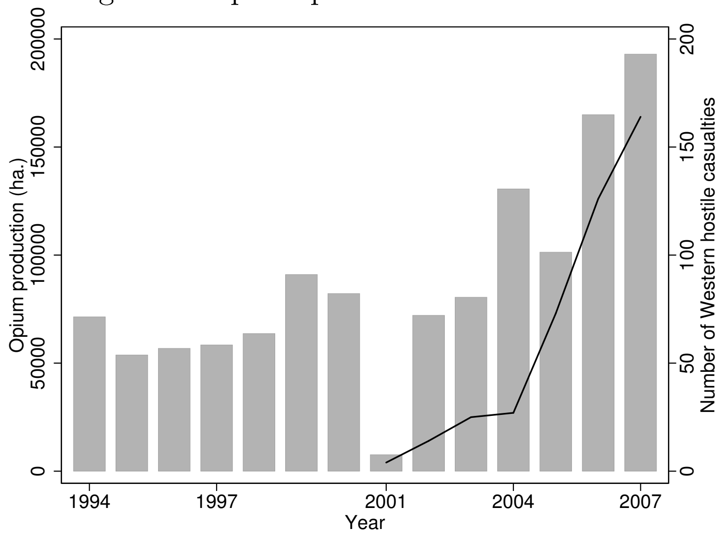
Yet, illegal production in conflict areas is more often explained by drugs-for-arms strategies where strongmen organize the production to finance military campaigns. There is no reason to reduce the importance of the drugs-for-arms link also in the case of Afghanistan. Opium production has probably helped finance holy wars against the Soviet occupation, violent power contests among warlords, the rise of Taliban to power, and the resistance against the Western intervention. Clearly, if the Taliban movement finances military campaigns through opium trade, there is a link from opium to conflict for the country as a whole.

In this paper, however, we emphasize the reverse linkage, the so far neglected mechanism of how conflicts spur opium production. We denote it *conflict-induced narcotics production*. It relies on more fragmented power where local producers react by raising drug production, not because they want to hoard cash to buy arms, but because the production decisions reflect a new situation with alternative sources of profit, power, and protection. A two ways linkage between opium production and conflict may constitute a vicious circle. In this paper our ambition is to identify the conflict-induced mechanism and to estimate its magnitude.

Conflict-induced narcotics production stems from narcotics being less affected by fighting than alternative crops. Opium is more drought resistant than wheat, the main alternative crop. It also takes up little space relative to its value and it can easily be transported off roads. Military activities that destroy infrastructure such as irrigation and roads therefore make opium relatively more profitable than wheat. It is also rather easy to take advantage of these new profit opportunities since violence and political instability make it possible to ignore the law.[1] The social stigma attached to illegal activities easily vanishes, expected punishment declines, and local protection is taken over by militia leaders and warlords who can earn a living by protecting poppy cultivators, opium

[1]Large production notwithstanding, opium has been illegal in Afghanistan since 1945 (UNODC, 1949).

Figure 1: Opium production and casualties



Notes: Bars depict hectares of land devoted to opium production and the line depicts hostile casualties. The extremely low level of opium production in 2001 is due to the Taliban's ban on poppy cultivation in this year (see discussion and references in footnote 11). Source: UNODC (2007a) and iCasualties.org.

traders, and laboratories.

To explore empirically whether violent conflicts induce subsequent opium production, we have gathered a unique data set with information from the 329 Afghan districts on areas under opium cultivation and the localization of conflict. To locate conflicts, we use information on the deaths of Western soldiers. Before 2001 there are no consistent conflict data, but we provide a brief historical account of how the outbreak of non-opium conflicts spurred opium cultivation. From 2001 onward we have information on casualties in NATO's ISAF forces and US forces in Operation Enduring Freedom, plotted in Figure 1.[2] To minimize the endogeneity problem, we do not attempt to use information on Afghan casualties as these may stem from conflicts over control of opium fields.[3] Below we argue that during our sample period the Western forces tend not to be involved in poppy eradication or other actions against narcotics production, indicating that our measure of conflict vary exogenously to opium production.

To study whether it is fighting that causes increases in opium production rather than opium production that causes fighting, we investigate the effects of fighting before and after the planting season for opium. On the one hand, if production causes fighting, the Taliban and other rebel groups would be equally interested in fighting for the control of the area both before and after the planting season. We should then expect a positive

[2]While the two plotted time series suggest that there is a correlation between conflict and opium production, it is not possible to say anything about causation at the level of aggregation used in the Figure.

[3]Proper data on Afghan casualties are not available from before 2007, hence outside the period we are focusing on. Some data could possibly be obtained from the CIDNE database leaked through WikiLeaks, but as the quality of these data are still uncertain we have chosen not to do so.

relationship between conflict and opium production both before and after the end of the planting season. On the other hand, if fighting causes production, we should only expect a relationship between conflict and opium production before the end of the planting season, and no such relationship after. Our regressions show that only conflict before the planting season has an impact on production, a clear indication of conflict-induced narcotics production.

We also check whether opium production could be caused by the mere presence of Western soldiers, and not by fighting in itself, by comparing the effect of hostile and non-hostile casualties on poppy cultivation. Hostile casualties have a strong effect, whereas non-hostile casualties have no effect. Finally, we show that the effect of conflict on opium production is much lower where law enforcement is good, supporting our assertion that conflict-induced narcotics production relies on institutional failure.

Our main result is the causal link from conflicts to opium production. To place this result in a more general setting of how destructive war conditions give rise to creative illegality, we present a simple model that emphasizes how violent conflicts increase the predicted value of lawlessness, inducing more illegal activities. Lawlessness includes fragmentation and the absence of central governmental control, the value of lawlessness the relative "price" of illegal to legal activities, and the predicted value of lawlessness a credibly demonstrated absence of central control. It is impossible to come up with a complete test of this detailed story behind conflict-induced narcotics production, however, as Afghanistan is highly resistant to empirical research due to a general lack of data. This also explains some of the crude choices made in the empirical part of the paper.

In accordance with our findings, the surge in opium production is caused by a combination of institutional failure and the availability of particular resources. This can constitute a development trap, a variant of the "resource curse" (see e.g. Sachs and Warner, 1995, 1997, 2001). In general, the resource curse can be a misnomer as in most cases it is the combination of bad institutions and "lootable" resource rents that leads to these kinds of development failures (Mehlum, Moene, and Torvik, 2006). Similarly, Fearon and Laitin (2003) and Collier and Hoeffler (2004) argue that civil conflict in weak states is associated with natural resources.[4]

Thus the problem in Afghanistan is not the resources or high productivity of opium per se, but rather the circumstances for resource rent extraction. In fact, the whole Afghan opium trade becomes so valuable just because the country has such bad institutions where

[4]For further discussions, see Humphreys (2005), Lujala, Gleditsch, and Gilmore (2005), and Fearon (2005). In a series of papers Besley and Persson (2008a,b) explore the relationship between state capacity and (internal and external) conflict. Skaperdas (1992) emphasizes the absence of protected property rights, while Esteban and Ray (2011) explore the salience of non-economic factors such as ethnicity and religion for the emergence of conflict (see also Keen, 2000). Acemoglu and Robinson (2001) and Brückner and Ciccone (2011) discuss the impact of economic shocks on regime change. Comprehensive surveys of the economics literature on civil war is provided by Collier and Hoeffler (2007) and Blattman and Miguel (2010).

the de facto power of groups can deviate so much from their de jure power.[5] Institutions and power that obeyed international conventions would restrict opium production to legal medical use.

In their survey, Blattman and Miguel (2010) argue that "researchers ought to take a more systematic approach to understanding war's economic consequences" (p. 8) and that "the most promising avenue for new empirical research is on the subnational scale, analyzing conflict causes, conduct, and consequences at the level of armed groups, communities, and individuals" (p. 8). They also argue that the "causal line from poverty to conflict should be greeted with caution. One reason is that this line can be drawn in reverse. Conflicts devastate life, health, and living standards [...] Warfare also destroys physical infrastructure and human capital, as well as possibly altering some social and political institutions" (p. 4). Our paper follows suit by looking at the consequences of local conflict on local production, with obvious linkages to subsequent poverty, in a country that is deemed tremendously important both for political stability in Central Asia and for total drug production in the world.

The literature on civil war, surveyed by Blattman and Miguel (2010) and Collier and Hoeffler (2007), focus more on the causes of conflicts than on what conflicts cause—also in the case of illegal activities. Most of the coca and opium crops are in fact grown in conflict areas (Cornell, 2005) and the drug-for-arms mechanism is natural to explore in the explanation of conflicts and war. The identification of a positive effect of coca production on conflicts in Colombia is derived convincingly by Angrist and Kugler (2008). They explore how an exogenous increase in coca prices and production lead to an increase in violence and rebellion activities in areas where the production increased. The financing of conflict through illegal trade in drugs is considered a defining feature of many wars. In the survey by Cornell (2005) on the interaction of narcotics and conflict the drugs-for-arms perspective dominates completely. In addition to the prominent paper by Angrist and Kugler (2008), the list of studies looking at the causes of conflict includes Fearon (2004), Miguel, Satyanath, and Sergenti (2004), Ross (2004), Kaldor (2007), Collier, Hoeffler, and Rohner (2009), and UNODC (2009).

On a subnational scale, the link from economic activities to conflict is studied by Dube and Vargas (2012), who investigate how price shocks may stimulate violent conflicts in Colombia. A price drop in a labor-intensive activity works through the local labor market by lowering the opportunity cost of joining the militia; a price increase of capital-intensive goods works through the gains from rent appropriation. Similarly, Hidalgo, Naidu, Nichter, and Richardson (2010) study how adverse economic shocks cause the rural poor to invade large land holdings in Brazil. Both these papers consider the effects

[5]Conditions of violent conflict increase the importance of de facto power as groups might become stronger relative to their size by engaging in collective action, revolts and the use of arms (Acemoglu and Robinson, 2006; Weber, 1978).

of economic shocks on subsequent conflict. The link from conflict to economic activities is studied by Guidolin and La Ferrara (2007), who explore how violence raises the value of firms extracting "conflict diamonds" in Angola, and Collier (1999), who identifies how civil war shifts production from vulnerable to less vulnerable activities in Uganda.

In Section 2 we provide a brief overview of the background of opium in Afghanistan, emphasizing how large increases follow the outbreak of serious conflicts. Section 3 sets up a simple model that highlights the main mechanisms behind the association between conflicts and opium cultivation. Section 4 contains the main part of the paper: our empirical findings, including a number of tests for causality and robustness. Section 5 concludes by contrasting our explanation to other alternatives.

2 Background

The climate and physical conditions in Afghanistan fit tremendously for opium production.[6] As these conditions are not new, it may seem puzzling that Afghanistan's history as a major opium producer only goes back three decades, see Table 1. An explanation for the shift in opium production, we assert, is the emergence of an alternative system of profit, power and protection, i.e. the value of lawlessness, associated with increasing conflicts. While violent conflicts may create an environment that raises opium revenues as local governance increase and infrastructure deteriorates, the costs associated with processing and transportation seem to be largely unaffected by war conditions.[7] For instance, Afghanistan has a large number of small, often family run, opium laboratories producing about 10kg of heroin per day (UNODC, 2003b, p. 139f). Some are even mobile, which is particularly important in areas with violent conflicts and contested power.

Looking back over the recent three decades, significant increases in opium production follow outbreaks of serious conflicts. The first dramatic increase came after the Soviet occupation in 1979 (UNODC, 2003b, p. 89).[8] The occupation threw the society into chaos, and gave rise to ineffectual governments lacking control over the whole territory, prompting "unscrupulous warlords to take advantage of the situation by encouraging farmers to shift to poppy cultivation" (Misra, 2004, p. 127).[9] In this period warlords were

[6]Average yield in Afghanistan is about 40 kg/ha compared to for instance only about 10 kg/ha in Burma, the former major global producer of illicit opium (UNODC, 2008). In Indian test stations, which generally have much higher yields than an average farmer, yields of a maximum of 60 kg/ha have been obtained (Kapoor, 1995, p. 66).

[7]The process of transforming raw opium to heroin is also fairly simple requiring only commonly available chemicals and a rudimentary laboratory easily established and operated (See e.g. Booth (1996, 77f) for details of the process).

[8]The uprising against the Soviets was not a reaction by the state elite in Kabul. The old regime lacked the organizational base to lead any popular movement. It favored small local power holders, mainly landlords and khans, and the uprising against the Soviets "started as a mass-based movement [...] without any unified national leadership" (Rubin, 2002, pp. 184-5).

[9]Similarly, Rashid (2000, p. 119) concludes that "[e]ver since 1980, all the Mujaheddin warlords had

Table 1: Opium production in Afghanistan in a historical perspective

Year	Production
1932	75
1956	12
1972	100
1980	200
1990	1570
2000	3276
2007	8200

Notes: Production in metric tonnes. Source: CCINC (1972); UNODC (2003b, 2007a)

allied against the Soviet army.

After the Soviet withdrawal in 1989, and in particular after the fall of Najibullah's regime in 1992, warlords who earlier were unified against the Russians started to fight each other. It was a violent power struggle with shifting alliances between ethnic groups and between local commanders.[10] At the same time agriculture and trade revived. But "[m]uch of this renewed production took the form of opium growing, heroin refining, and smuggling; these enterprises were organized by combines of mujahidin parties, Pakistani military officers, and Pakistani drug syndicates." (Rubin, 2002, p. 183). The acceleration of opium production around 1989 is also noted by UNODC (2003b, p. 90). It is clear that Afghanistan took over as the poppy cultivation in Pakistan was dramatically reduced.

When the Taliban entered the scene in 1994, it acted as other warlords fighting its way to power; the area for poppy cultivation was expanded and new trade and transport routes were established (Rashid, 2000). The Taliban also extracted parts of the opium profits by levying the traditional *ushr* and *zakat* taxes on the opium traders (UNODC, 2003b, p. 92). The taxes on opium production were interpreted as a sign of its religious and political acceptance (ibid.).

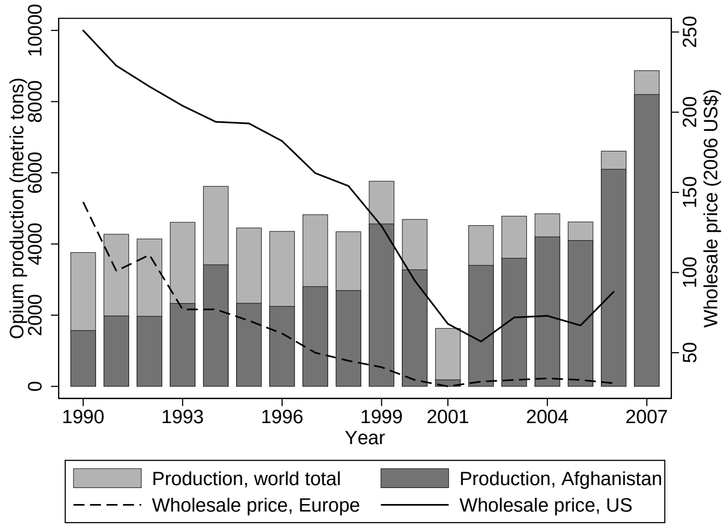
After the US intervention in 2001 joined by NATO forces, opium production has been on a dramatic rise, see Figures 2.[11] Afghanistan currently produces more than 90 per cent of the world's illicit production of opium. Alongside the expansion of opium production

used drugs money to help fund their military campaigns and line their own pockets". There are indications that covert US operations helped boost both the production of opium and smuggling of heroin through Pakistan (McCoy, 1991; Haq, 1996), and the occupation also brought Russian criminals into the drug networks in Afghanistan and Pakistan. This facilitated exports of opium to far off countries, and Afghan heroin was now smuggled through Central Asia, Russia, the Baltic countries and finally into Europe (Rashid, 2000, p. 120).

[10] Amalendu Misra (2004, p. 52) claims that between 1992 and 1996 "every major group had both allied with and fought against every other major group at one time or another" (see also Giustozzi, 2000; Kaplan, 2001).

[11] The extremely low level of opium production in 2001 is due to the Taliban's enforced ban on poppy cultivation this year. The ban is thoroughly discussed in Farrell and Thorne (2005) and the rest of the articles in the Special Focus issue on Taliban and Opium in the *International Journal of Drug Policy* (Volume 16, issue 2, 2005).

Figure 2: World production of opium and world market opium prices.



Notes: Wholesale price is in 2006 US $ / gram. Opium production is "Potential opium production" in metric tons, as measured by UNODC (2008). Since 2000, the only competitor to Afghan opium is opium from Myanmar. During the 90's, also Lao PDR, Pakistan, Vietnam, Mexico, and Colombia produced noticeable amounts of opium. Source: UNODC (2008).

over the last 15 years, wholesale prices have plummeted both in Europe and the US.

3 Conflict-induced opium: the mechanisms

To set the stage, we consider a simple model where farmers choose whether to grow a legal crop (wheat) or an illegal crop (opium poppy). They operate under the shadow of conflict where the army and rebel groups may end up in violent confrontations in the farmers' district in any period.

We consider a group of farmers, each with one unit of land. The growing cycle of one generation of opium is denoted a *period*. A period t consists of three seasons: planting, growing, and harvesting. Notice that a period does not have to coincide with a calendar year. Crop decisions are made in the planting season. What is grown on the land in earlier periods does not affect the fertility of the land for the two crops in subsequent periods, implying that each farmer can consider each period in isolation.

Since the quantity of family labor is given for each farmer, the marginal productivity of allocating more land to one crop is declining in the use of land to that crop. Allocating $(1 - n_t)$ units of land to wheat and n_t units of land to opium, yields a production of wheat equal to $A_t(1 - n_t)^\alpha$ with $\alpha \in (0, 1)$, and a production of opium equal to n_t^β with $\beta \in (0, 1)$. The parameter A_t captures the relative productivity of the two crops if the one unit of land is used entirely to either, reflecting the quality of the local infrastructure, in particular irrigation during the growing season. As discussed below, wheat production is more dependent than opium on irrigation (and also on storing facilities and roads), so the destruction of infrastructure harms wheat producing farmers more than opium producing farmers.

3.1 Lawlessness as protection

Opium production is illegal, so the production can be expropriated by the government. To model this, the profits to a farmer after the harvesting season in period t can be expressed as

$$\pi_t(n_t) = \theta_t p_t n_t^{\beta} + A_t(1 - n_t)^{\alpha} \tag{1}$$

where the variable θ_t is a dummy variable indicating whether the illegal production is confiscated in period t, or not. When making the crop decision, the values of θ_t and A_t are not perfectly known to the farmer, and he is maximizing $E\pi_t(n_t)$. The expected value $E\theta_t$ can be interpreted as the probability that the crops are *not* eradicated in period t. The relevant expectations, however, must be contingent on the information available.

Obviously, violent fighting during all three seasons[12] are relevant signals for the realized values of θ_t and A_t, and therefore for the final output. Yet, the impacts are not symmetric. The allocation of land is irreversible once the planting is done. Farmers can therefore adjust the crop decision to shocks of violent fighting during the planting season, but they cannot adjust the land allocation to later shocks of violent fighting in the growing season and the harvesting season. In the empirical part of this paper we employ this asymmetry to aid the identification of conflict-induced opium production. Violent fighting before planting is done should induce farmers to allocate more land to opium, while fighting after the planting is done should have no such effects.

The timing of events is as follows:

1. Before planting farmers and traders observe $\{\text{fighting}, \text{no fighting}\}$ in the local area, and treat it as a signal S_t of the actual conditions for growing the two crops in the subsequent period.

2. Based on the signal S_t, farmers make predictions for de facto lawlessness $E(\theta_t|S_t)$ and the quality of infrastructure $E(A_t|S_t)$.

3. The drug trader sets the farm gate price p_t of raw opium to be paid to the farmers after they harvest the crop.

4. Each farmer decides on the allocation of his one unit of land to opium n_t and wheat $(1 - n_t)$.

[12] Fighting in previous years are also relevant signals, but to keep the exposition as simple as possible we disregard this feature. This has no impact on the validity of the empirical approach.

De facto lawlessness favors opium, protecting the growers against eradication and confiscation. Violent fighting means more lawlessness and farmers' confidence in the local warlord goes up.[13] Hence, we assert that

$$E\left(\theta_t|\text{fighting}\right) > E\left(\theta_t|\text{no fighting}\right) \tag{2}$$

Likewise, violent fighting is also important for irrigation since wells can be damaged by military action (together with other types of infrastructure such as storing facilities and roads), implying that the factual and predicted value of A_t declines. Hence, we assert that

$$E\left(A_t|\text{fighting}\right) < E\left(A_t|\text{no fighting}\right) \tag{3}$$

One reasonable (but of course simplified) mechanism that can generate the inequalities (2) and (3), incorporates how the effective lawlessness depends on the ability of the local warlord to protect the opium producers. Violent confrontations can be considered an implicit test of his military strength. If the army arrives, which happens with probability q, the warlord fights whenever he is strong enough.

Assume now that the warlord is expected either to be strong, $E\theta_t = \theta^H$, or to be weak $E\theta_t = \theta^L < \theta^H$, and that he only confronts the army if he is strong. A confrontation would then be a credible signal that $E\theta_t = \theta^H$. If there is no confrontation, it implies that either the warlord is weak or that the army did not arrive. In both cases the strength of the warlord is not revealed. Formally,

$$E\left(\theta_t|S_t\right) = \begin{cases} \theta^H & \text{if } S_t = \text{fighting} \\ \tilde{\theta}_t & \text{if } S_t = \text{no fighting} \end{cases} \tag{4}$$

What are reasonable beliefs about the expected lawlessness $\tilde{\theta}_t$ when there is no fighting in the planting season? Let the prior belief of having a strong warlord be $\Pr(\theta^H) = \omega_t$, based on past experience including fighting activities in previous years. Even though the farmer has observed fighting in previous years, and hence concluded that the warlord was strong at that point, he cannot be sure that the warlord is still strong, as the warlord's strength depends on shifting alliances. The probability of observing a confrontation in

[13] Opium is more likely to be cultivated in areas where the influence of the central authority is smaller. For instance, after a successful ban on opium production in Nangarhar, there was evidence of a return of opium the year after, and the areas where opium was re-introduced tended "to be furthest from institutions of state governance and enforced security. They are more often subject to tribal and informal institutions of governance." (Roe, 2008, p. 70).

period t is q. Bayesian updating yields

$$Q_t \equiv \Pr\left(\theta^H | \text{no fighting}\right) = \frac{(1-q)\omega_t}{1-q\omega_t} \tag{5}$$

where $(1-q)\omega_t$ is the probability of the event that there is a strong warlord and no confrontation, and $1-q\omega_t$ the probability of no fighting. This implies that

$$\tilde{\theta}_t \equiv E\left(\theta_t | \text{no fighting}\right) = Q_t\theta^H + (1-Q_t)\,\theta^L \tag{6}$$

Clearly $E\left(\theta_t | \text{fighting}\right) = \theta^H > E\left(\theta_t | \text{no fighting}\right) = \tilde{\theta}_t$, and the rise in expected lawlessness from a violent confrontation before planting is $E\left(\theta_t | \text{fighting}\right) - E\left(\theta_t | \text{no fighting}\right) = (1-Q)(\theta^H - \theta^L)$.[14]

Similarly, the irrigation system (and other types of infrastructure) can be damaged by military actions. If it is damaged, we assert that it can be repaired to its normal level, but only after harvesting is over. When this is the case, each period t starts with the level $\bar{A}$. If there is fighting, the infrastructure deteriorates by a factor $\delta < 1$ to $\delta\bar{A}$.

Accordingly, if there is fighting in the planting season, the quality of the infrastructure is $\delta\bar{A}$ and the warlord is considered strong when the crop decision is made. The yield crucially depends on irrigation during the growing season. With probability $(1-q)$ there are no further hostile confrontations in the growing season and irrigation persists at the $\delta\bar{A}$ level. With probability q, however, there is fighting again in the growing season and the infrastructure is further deteriorated by the factor δ. Thus, the expected quality of the infrastructure during the growing season can be expressed as

$$E\left(A_t | \text{fighting}\right) = [(1-q) + q\delta]\delta\bar{A} \tag{7}$$

When there is no fighting prior to the planting, the initial level is $A_t = \bar{A}$ and the farmers are uncertain whether the warlord is strong or not. Again, in the growing season the infrastructure remains unaffected if there are no hostile confrontations, which happens with probability $(1-q)$. With probability q, however, there is a hostile encounter in the growing season. The irrigation facilities are then deteriorated by δ if (with probability Q_t) the warlord is strong and fight back, but it remains unaffected (with probability $1-Q_t$) when the warlord is weak and therefore backs off. Hence, in this case the expected irrigation level can be expressed as

$$E\left(A_t | \text{no fighting}\right) = [(1-q) + q(Q_t\delta + 1 - Q_t)]\bar{A} \tag{8}$$

[14] The drugs-for-arms mechanism, which we do not considered here, would imply positive feedback from past opium production to the prior beliefs that the warlord is strong ω_t, the actual military strength of a strong warlord θ^H, and the probability of confrontations with the army q. This feedback would not affect the main point, however, namely that there is a positive effect of conflict on opium production in the planting season and no effect of conflict on opium production in the growing season.

Clearly, $[(1-q)+q\delta]\delta < (1-q)+q(Q_t\delta+1-Q_t)$, and hence $E(A_t|\text{fighting}) < E(A_t|\text{no fighting})$.

3.2 Farmers and drug traders

Let us now return to the crop decision. Focusing on interior solutions to $\max_{n_t} E\pi_t(n_t)$, the first order condition of each farmer, $dE\pi_t(n_t)/dn_t = 0$, yields $n_t = n_t(p_t, S_t)$ that must satisfy

$$\frac{n_t(p_t, S_t)^{1-\beta}}{[1-n_t(p_t, S_t)]^{1-\alpha}} = p_t \frac{E(\theta_t|S_t)}{E(A_t|S_t)}\frac{\beta}{\alpha} \tag{9}$$

The fraction $E(\theta_t|S_t)/E(A_t|S_t)$ expresses the predicted value of local lawlessness, i.e. the predicted *relative* "price" of illegal to legal activities. Clearly, the relative price is highest when $S_t = \text{fighting}$. Thus the share of land allocated to poppy cultivation increases when there is fighting just before planting—as long as the farm gate price of raw opium p_t remains constant. The farm gate price of raw opium, however, is set by drug traders who also would like to benefit from the improved conditions for poppy cultivation.

In setting the farm gate price of raw opium p_t, the drug trader treats the farmers as hirelings. He sets p_t and let the farmer decide how much to produce. The expected income of the drug trader is determined by the difference between the expected selling price outside the district, the exogenously given P_t, and the endogenous buying price at the farm gate, p_t, times the output of each farmer. The expected profit of the drug trader is thus $E\Pi_t(p_t) = (P_t - p_t)E(\theta_t|S_t)n_t^\beta$, where $n_t = n_t(p_t, S_t)$ from (9). The first order condition for maximum profits is $-n_t(p_t, S_t) + [P_t - p_t(n_t, S_t)]\,\beta(dn_t/dp_t) = 0$. Combined with (9) we thus have two conditions for determining $p_t = p_t(S_t)$ and $n_t = n_t(p_t, S_t) \equiv n_t(S_t)$, that (after some manipulation) can be expressed as

$$\frac{E(\theta_t|S_t)}{E(A_t|S_t)}P_t = \frac{1-\alpha n_t(S_t)}{\beta(1-n_t(S_t))}\frac{\alpha n_t(S_t)^{1-\beta}}{\beta(1-n_t(S_t))^{1-\alpha}} \equiv H(n_t(S_t)) \tag{10}$$

and

$$\frac{p_t(S_t)}{P_t} = \frac{\beta(1-n_t(S_t))}{1-\alpha n_t(S_t)} \equiv M(n_t(S_t)) < 1 \tag{11}$$

where $H'(n_t) > 0$ and $M'(n_t) < 0$. Thus, we find that $n_t(\text{fighting}) > n_t(\text{no fighting})$ from (10) and that $p_t(\text{fighting}) < p_t(\text{no fighting})$ from (11), implying that

- the share of land used to cultivate the illegal crop increases when the predicted value of lawlessness goes up with violent conflicts prior to planting,
- more conflicts that induce more opium cultivation go together with a *lower* farm gate price of raw opium.

The above analysis was undertaken in an essentially static framework, hence implicitly assuming that the type of the warlord is redrawn every period. This is of course implausible. However, as long as the warlord's type is not perfectly known to all farmers in all areas, we would still expect to see the same pattern with a fixed warlord type, and if we allow for warlord types to evolve over time in a correlated way, we would certainly expect to see the same patterns.

Conflicts obviously also imply social costs affecting the welfare of the population, including the loss of lives, security, property and international recognition. Our small model does not capture these effects. It only focuses on how the relative profitability of different crops changes with conflicts, emphasizing how conflicts tend to raise the illegal opportunities (predicted lawlessness) and to lower the opportunity costs of illegal activities (the destruction of infrastructure). That farmers become more confident in local lawlessness stimulates illegal production. This confidence also magnifies the impact of any destruction of infrastructure that erodes the profitability of legal opportunities. The drug trader, or the warlord, take advantage of the situation by lowering the farm gate price of the illegal crop. They gain from a lower farm gate price, but they do not gain by lowering it so much that illegal production would not increase.

In sum, hostile encounters tend to raise the production of illegal crops. Strong warlords and drug traders are among the clear winners, benefiting from a higher illegal production at a lower cost. Yet, each of them may also be 'a benefactor to those he robs', as Mancur Olson (2000) considered a general characteristics of stationary warlords.

4 Conflict-induced opium: The magnitudes

The simple model above reflects important features of the fractionalized power structure of rural Afghanistan. Local warlords in varying alliances with rebellion groups dominate many districts, but are without complete control over land allocations. The Taliban movement and other rebel groups go in and out of alliances with local commanders and militia leaders. Poppy cultivators differ both in their dependence on land owners and in their asset holdings (Mansfield, 2001, 2004, 2005). Most commonly, the farmer decides on the allocation of land between opium and wheat. Almost 90 per cent of Afghan farmers claim that they have this independence.[15]

[15] UNODC (2004) report that in the 2003-2004 season, 87 per cent of poppy growers and 81 per cent of non-poppy growers decided what to plant on their own. There is some geographical variation, however, a larger proportion of farmers do not decide what to plant on their own in the south than in the rest of the country. Land ownership also varies across the country, although the vast majority of farmers own the land they farm. Sharecropping is more common in the North Eastern and Eastern regions (UNODC, 2004, Table 23). In some parts of the literature the role of the traditional credit system, salaam, is also emphasized as a stimulant to opium production. This is further discussed in Willumsen (2006), who finds that the empirical support for this is limited to a small group of farmers who devote all their land to poppy cultivation.

The independence of local warlords relative to the central authority in Kabul may establish the necessary confidence in local illegality for opium production to rise. Warlords' incomplete control over land allocations means that opium production becomes more dependent on the predicted value of lawlessness and thus more sensitive to conflicts. War conditions and local military action raise both the farmers' confidence in local governance and the profitability of opium relative to wheat production.

As stated, the Afghan soil and climate conditions favor opium production—opium can grow almost everywhere in the country. The cultivation requires much labor[16] and little land, which fit the Afghan situation. In addition, dried raw opium takes up little space relative to its value, and it can easily be stored and kept as savings in a country with few other opportunities to store wealth.

Wheat, the main crop, is much more dependent on proper infrastructure than opium. Martin and Symansky (2006, p. 26), for example, state that

> "Opium is relatively drought-resistant, making its cultivation easier than wheat in areas where irrigation is limited. Moreover, dry opium is easy to store and transport, which, given the poor state of roads and stocking facilities in Afghanistan, gives it an advantage over other crops."[17]

Conflicts destroy irrigation systems (both wells and distribution facilities), roads, and other infrastructure. Indeed, soldiers are often killed—our measure of where conflicts take place—in operations that destroy such infrastructure in contested areas. One example is the 12th day of Operation Medusa, where

> "[h]eavy gates to walled compounds were blown open, a warren of Taleban tunnels and bunkers were destroyed by explosives and grenades were thrown into wells and fired through doors [...] But it is gruelling, dangerous work. At least 20 Nato troops have been killed in the battle, and [...] Nato claimed to be in control of only 65 per cent of the Panjawyi area". (The Times, 2006)

Since opium production is relatively less affected by such destruction than wheat, the value of the parameter A in the model tends to go down after violent conflicts. A lower A increases the *value* of lawlessness as the opportunity costs of opium decline, inducing more opium cultivation—a shift away from vulnerable activities, one of the costs of conflict identified by Collier (1999).

[16]To collect the opium from the poppy, the pod of the plant has to be cut, a procedure known as lancing. As all the poppies do not mature at the same time, the farmer has to go over the same area several times lancing the mature pods. Once a pod has been cut open, the opium oozes out and is collected. This process is repeated until the plant stops yielding.

[17]Similar points have been made by Barth (2008, pp. 44-45) and UNODC (2003b, p. 89 and p. 99).

4.1 Empirical strategy and data

Which effects can we identify?

In accordance with the model, opium production should rise in districts where lawlessness and infrastructure are eroded by violent conflicts. Due to a lack of data we are unable to disentangle the exact links of the story. We therefore focus on the reduced form effect of conflict on opium production, demonstrating that there is a causal link from conflict to opium. To establish this link is in itself important, as it runs contrary to the standard interpretation of conflict and narcotics production. Focusing on conflict-induced opium production, we must obviously recognize the reverse link from opium to conflicts, implying that we have to confront some endogeneity issues.[18]

We identify that conflicts strongly induce opium production, which is clear from Table 3 once we note—as we show in detail below—that our measure of local conflicts (casualties from hostile encounters) is arguably more exogenous to opium production than other measures of conflict. To strengthen the causal interpretation of our findings, we also show that conflict has a strong effect on opium production before and during the planting season and that there is no relationship after, clearly indicating that opium production is conflict-induced and not vice versa.

Data on opium production and conflicts

Our measure of opium production, the hectare of land dedicated to opium production, is based on data from the United Nations Office on Drugs and Crime (UNODC, 2007a), that has surveyed opium production in Afghanistan since 1994. Its approach was initially based on surveying opium production in a number of villages and then aggregating. From 2002, parts of the data are instead based on satellite imagery, using differences in spectral reflectance of different crops to identify the area under opium cultivation. This is combined with annual field surveys to determine yields. See UNODC (2007a) for further details of the survey methodology.

The data on conflict are drawn from iCasualties.org, that bases its data mostly on press releases from the US Department of Defense and CENTCOM.[19] The data in iCasualties list every casualty by name, cause of death, and location. We separate between hostile and non-hostile casualties, and use the reported location to measure casualties by district. Some casualties are not reported with a sufficiently precise location to code their district. These are coded at the province level, so we have somewhat richer data at the province

[18]The model presented above focused on the conflict-induced narcotics production channel, but can readily be extended to accommodate a reverse causality cf. footnote 14.

[19]This is the same source used by Greenstone (2007) and Iyengar and Monten (2008) to measure casualties in Iraq.

level.[20,21]

There are no data on the direct amount of fighting available for the period we study. One approach could be to use the number of combat activities by year, but data on such events are scarce and mostly based on media coverage. Also, these data have not been coded so far. More importantly, basing our empirical inference on such data would lead us into severe endogeneity issues, as all internal power struggles between different warlords and traders over future opium production would lead us to conclude that fighting causes opium production, although in this case the causality would go the other way around.

Instead, we base our measure of conflict on casualties from hostile encounters involving Western ISAF forces or US forces in the Operation Enduring Freedom (OEF). Afghani casualties are not available, but Western casualties are. The placement of Western forces is arguably more exogenous relative to opium production than more general data on where fighting occurs.[22]

The casualties data are skewed, mostly since in one encounter there may be several Western casualties. We have therefore chosen to focus on a dummy for whether there were casualties or not in a given area, albeit using the actual number of casualties gives almost identical results (adjusting the coefficient for the average number of causalities).[23] The number of casualties in an area may not be the best indicator of the seriousness of the conflict in that area. A shot-down helicopter, for instance, causes a large number of casualties, but the number of casualties does not necessarily indicate that the conflict is more serious than a single soldier dying on the ground while fighting. Using the dummy for conflict also minimizes measurement error if the reporting of the exact location is correlated with other characteristics of the area where the conflict took place. The localization of districts where Western casualties have been reported and the average measured production of opium is shown in Figure 3. Descriptive statistics of the data can be found in Appendix Table A-1.

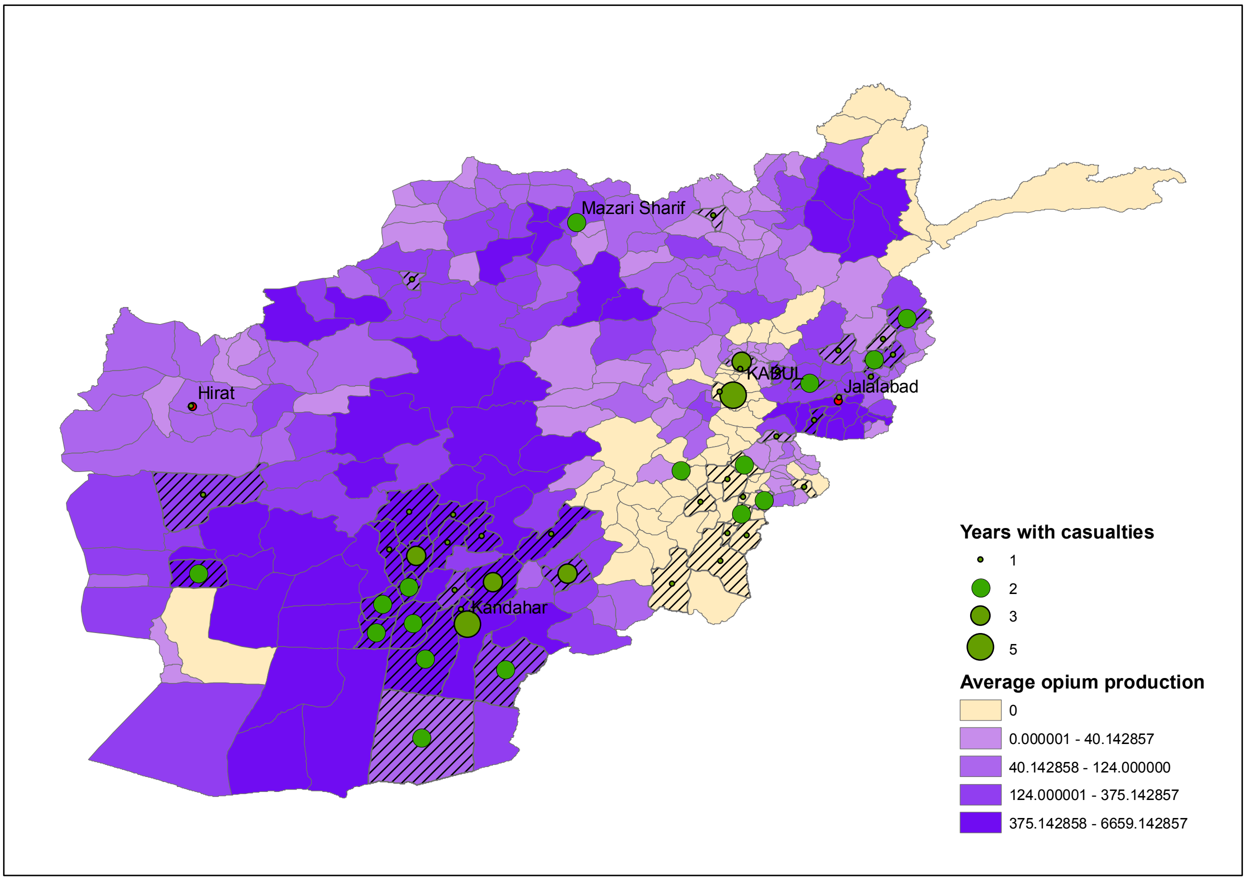
[20]In total, 433 casualties are attributable to a province. 269 of these can also be attributed to a district. Using casualties at the province level instead of at the district level gives qualitatively similar findings, but with larger standard errors, which is not surprising given the large amount of spatial information we are discarding (details available upon request) [see Table B-1].

[21]Data on civilian casualties from 2005 onward are available from Empirical Studies of Conflict (see also Bohannon, 2011). As this would only give us two years of relevant data, we have chosen not to employ these data. Studies employing the data on civilian causalities include Condra, Felter, Iyengar, and Shapiro (2010) and Berman, Callen, Felter, and Shapiro (2011). The CIDNE data, leaked through WikiLeaks, list violent encounters in the period 2004 to 2009, hence partially overlapping our sample. We have decided not to use them as the nature and quality of the data are uncertain.

[22]As this is an imperfect measure of conflict which is bound to miss some conflicts, our estimates are downward biased and should be seen as a lower bound on the true effect.

[23] [see Columns (1)-(3) in Table B-2] The exception is the Granger test in Table 5, where some of the standard errors increase somewhat.

Figure 3: Localization of opium production and fighting



Notes: District with fighting in at least one year are hatched.

Are casualties exogenous to opium production?

As mentioned, the placement of Western forces is arguably more exogenous relative to opium production than more general data on where fighting occurs. Western ISAF forces tend not to involve themselves in fighting related to opium production. This is made clear in the description of their mandate.[24] Neither have US soldiers focused on fighting drugs: "until recently, American officials acknowledge, fighting drugs was considered a distraction from fighting terrorists." (New York Times, 2007).

To verify that Western soldiers are really not involved in opium eradication, or more precisely provision of security for eradication programs, we use data on the area of opium eradicated for 2006 and 2007 from UNODC (2006b, 2007a). If we are not able to reject the null hypothesis of zero correlation between eradication and Western casualties, this is a strong indication that the conflict variable we use is exogenous to opium production. The eradication is led by the Afghan government, and the figures on the size of the eradicated

[24] "ISAF aims at: [...] provide support to the Afghan government and internationally-sanctioned counter-narcotics efforts through intelligence-sharing and the conduct of an efficient public information campaign, as well as support to the Afghan National Army Forces conducting counter-narcotics operations. ISAF, however, is not directly involved in the poppy eradication or destruction of processing facilities, or in taking military action against narcotic producers" (`http://www.nato.int/isaf/topics/mandate/index.html`, accessed on Aug. 28, 2008).

Table 2: Correlation between eradication of opium and Western hostile casualties in 2006 and 2007

	(1)	(2)	(3)
Casualties, district	110.9	14.25	-12.92
	(78.76)	(34.44)	(31.43)
Casualties × 2007		163.5	169.9
		(127.8)	(119.9)
Opium production, lagged			0.0506**
			(0.0233)
Opium prod, lagged × 2007			-0.0276
			(0.0275)
2007	9.202	-3.970	0.364
	(18.79)	(14.54)	(12.63)
Constant	23.14*	29.61***	15.85*
	(11.69)	(10.87)	(8.495)
R^2	0.040	0.060	0.101
N	658	658	658

Notes: Contemporaneous correlation between the area of opium eradicated and Western combat casualties. Both eradicated area and casualties are measured at the district level. 2007 is a dummy for observations in 2007 and * 2007 indicate interactions with this dummy
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

areas are verified by the UNODC. Unfortunately, we have not been able to find verified figures on eradication at the district level from before 2006.

The contemporaneous correlation between casualties and area eradicated in 2006 and 2007 can be found in Table 2. Column (1) shows the pooled estimate over the two years, while columns (2) and (3) provide separate effects for 2006 and 2007 by interacting the casualties variable with a dummy for 2007. Column (3) also introduces controls for lagged opium production. As can be seen from columns (1)-(3), there is no correlation between eradication and casualties in 2006. In 2007, the correlation is stronger but still not statistically significant, see row 2 in the table.[25] The reason for interacting the casualties variable with a dummy for 2007 in columns (2) and (3) is that the American soldiers changed their strategy from 2006 to 2007. The Taliban offensive in the spring of 2006 and especially the resignation of Secretary of Defense Donald Rumsfeld in December 2006, led to a change in attitude among defense officials on the role of opium in funding the insurgency (New York Times, 2007). Clearly, the findings in Table 2 support the attitude and the change in the US strategy. Since the change of strategy was around the turn of the year 2006-7, we avoid using data on casualties for 2007 (or later years) to predict opium production in 2008 (or later).

[25]The p-values for the t-test that the correlation in 2007 is 0 versus different from 0 is 0.154 and 0.180 for columns (2) and (3) resp.

4.2 Magnitudes

Our core results are shown in Table 3, where we regress opium production on contemporaneous and lagged conflict with two-way fixed effects. There are trends in both opium production and our conflict variable (see Figure 1). Consequently, we introduce period dummies in most of our specifications, which also accounts for changes in national and international policies, world market prices of opium, etc. We also control for district fixed effects, so variables such as the quality of the soil, ethnic composition, former Taliban control and so on cannot drive the results.

Table 3 (commented on below) reports a strong and highly significant effect of lagged conflict on subsequent opium production at the district level, even after controlling for district and year fixed effects and contemporaneous conflicts. In this table the identification is based on two-way fixed effects, i.e. we assume that, conditional on the other right-hand-side variables and the fixed effects, the placement of the soldiers is exogenous to opium production. Section 4.3 provides a number of tests that all indicate that the line of causality goes from conflict to opium production, as assumed in Table 3.

Column (1) of Table 3 shows that there is a strong, positive, and significant contemporaneous correlation between casualties and opium production, after controlling for year and district (two-way) fixed effects. However, as the planting season starts in October (UNODC, 2003b, p. 31), one-year lagged effects of casualties on opium production seem to be a better test of our hypothesis of a positive relationship between conflict and opium production. From Column (2) we see that there is a strong and positive effect of one-year lagged casualties on opium production, and this holds even when we control for two-way fixed effects together with contemporaneous and two-year lagged casualties (Column (4)).[26]

The estimated coefficients are large. Using specification (2), where we have the lowest estimate, going from no conflict to conflict is estimated to lead to an increase in the area under cultivation of 368.3 hectares. This area on average produces about 14.7 metric tonnes of dry opium, which can be transformed into about 1.2 metric tonnes of heroin or more then six million user doses of 200 mg.[27] Another way to grasp the magnitude is that it is 1.56 times the median production of opium producing districts.[28]

Also note that the value of the estimated parameter of lagged conflict on opium pro-

[26]The results also hold when we include district specific linear time trends (results available on request) [see Columns (4)-(6) in Table B-2].

[27]One kg of heroin requires 11-13 kg of opium(UNODC, 2003b, p. 133). Doses vary a lot, from 1-5mg for initial doses to about 1g for very experienced users. The study by Gschwend, Rehm, Blättler, Steffen, Seidenberg, Christen, Bürki, and Gutzwiller (2004) reports an average daily consumption of 474mg among heavy users.

[28]Since the opium production data are somewhat skewed, see summary statistics in Table A-1, we have also run the same regressions as in Table 3 with log of opium production as the dependent variable. The results are the same, with conflict raising subsequent opium production by 50 per cent in the main specification in column (2), showing that the results in Table 3 are robust to outliers in opium production (results not shown, but available on request) [see Table B-4].

Table 3: Effects of Western combat casualties on opium production

	(1)	(2)	(3)	(4)
Casualties, district	608.6*			565.2*
	(322.9)			(305.1)
Casualties, district lagged		368.3***		392.8***
		(141.5)		(144.6)
Casualties, district two lags			-193.9	-119.7
			(323.3)	(314.2)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.064	0.034	0.024	0.040
N	2303	1974	1645	1645

Notes: Effects of contemporaneous and lagged Western combat casualties on opium production (2001-2007). Casualties at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

duction has almost the same numerical value in columns (2) and (4), i.e. it seems to be robust to different specifications. Again, these regressions control for everything that is constant at the district level, so it is not differences in levels across different districts that are generating the results. With two-year lags the relationship is negative, but not statistically significant, see column (3). As mentioned above, using conflict measured at the province level rather than at the district level yields similar results, but estimated less precisely.[29,30]

4.3 Which way does the causality go?

The analysis so far is based on conflict affecting subsequent opium cultivation, but this may not be sufficient to assure a causal relationship. Below we present some approaches to corroborate that the causality runs from conflict to opium production.

Before vs. after the planting season

If our hypothesis is correct, there should be a break at the end of the planting season: conflict during the planting season should have a strong effect on opium production, whereas conflict once the opium has been planted should have no effect.[31] It is therefore

[29] In Table 3 we have clustered the standard errors on province-year. Clustering on province instead of province-year, i.e. taking into account potential auto-correlation in the error structure, gives almost identical standard errors (results not shown, but available on request) [see Table B-7].

[30] The fit of the estimated models may appear modest. However, the R^2s are computed net of district fixed effects. R^2s including district dummies are somewhat above 0.5.

[31] One could imagine that the yield was affected by conflict after the planting season due to for example a conflict-created increase in price creating incentives to get more opium out of each opium pod by repeating the cutting, or conflict destroying irrigation systems in the growing season. But our measure

a sharp test of the link from conflict to opium to compare the effect of conflict on the area under opium cultivation during and directly after the planting season.

In Afghanistan, opium is either planted in the fall, in October and November, or in the spring, in March (UNODC, 2002, 2003a, 2005, 2006a, 2007b).[32] Planting later than this significantly reduces yields, and is therefore uncommon. This is also confirmed by agronomic studies; although the optimal planting date depends on agro-climatic conditions, germination is hindered in early sowing and late sowing leads to too fast maturity and reduced opium yields; by planting 10 days after the optimal day, yields are reduced by 13 percent (Yadav, 1983, p. 86).

Figure 4 shows the growing cycle for two years in the case of fall planting. "Periods" correspond to the periods used in the model in Section 3, which do not typically coincide with calendar years. Conflict activities during the planting season of period t may affect the area under cultivation observed in the harvesting season. Conflict during the growing and harvesting seasons should not have any impact on the area under cultivation in period t, but could have an impact on the area in period $t + 1$ and subsequent periods.

Any effect from opium production to conflict, however, should be independent of whether we are in the planting season or not. If the battles were over the opium territory, warlords would be equally interested in fighting back during the planting season as directly after. For this reason we can treat conflict in the period after the planting season as a placebo, enabling us to verify the direction of causality between conflict and opium production.

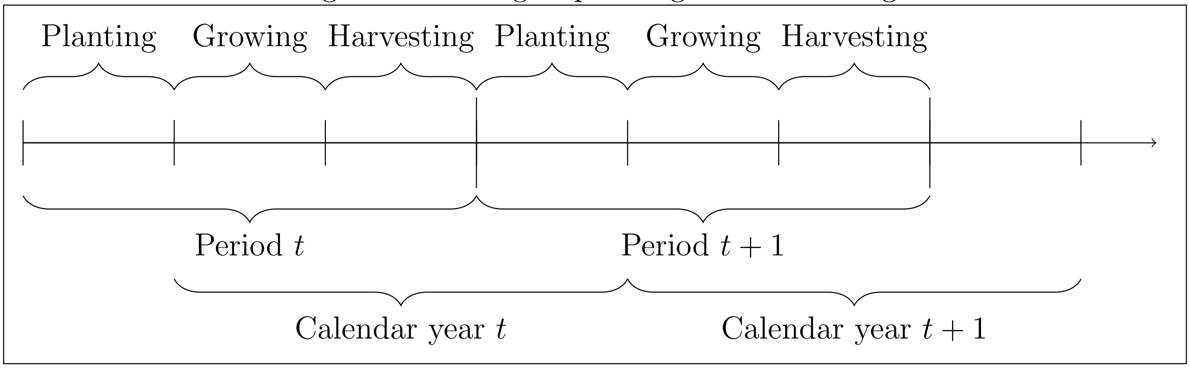
In Table 4, we regress the area under opium cultivation (measured in the harvesting season) on the number of casualties in the preceding seasons. In Columns (1) and (2), we regress opium production in period t on the presence of Western casualties resp. before and during the planting season.[33] Columns (3) and (4) measure the effect in the control group, i.e. the effect of conflict directly after the planting season has ended. Column (3) includes casualties from a period equally long as the planting season variable. Due to well known seasonal patterns in Taliban conflict activity, there is less conflict in this period than in September to November; the mean of the conflict variables is reported at the bottom of the table. Therefore, we also try the same experiment using a two month

of opium production is the hectare of land allocated to opium, not the yield. The supply curve is hence vertical once the planting season has ended, and this argument therefore does not apply.

[32]Some districts plant both in the fall and the spring season. As we only have figures on annual opium production, we have coded these districts as having both fall and spring planting and adjusted the control period after planting accordingly. In Table 4, the districts that have two planting seasons have the dummy 'Casualties, planting season' equal to 1 if they experience casualties during the *first* planting season, the dummy 'Casualties, after planting' is equal to 1 if they experience casualties in the period after the *second* planting season (since after the first planting season interfere with the dummy for the second planting season), and the dummy 'Casualties, shortly before planting season' is equal to 1 if they experience casualties before the *first* planting season (as shortly before the second planting season interfere with the dummy for the first planting season).

[33]See notes to Table 4 and footnote 32 for precise definitions.

Figure 4: Timing of planting and harvesting



longer control period, shown in Column (4). Notice that in all these regressions, the outcome variable is the same, opium production in period t. However, the explanatory variables differ as they are fighting activities at different periods of the growing cycle.

From Table 4 we see that there is a sharp difference in the estimated effect of conflict on opium production before and during the planting season relative to directly after. The estimated effects before and during are strongly significant. The effect of casualties directly after the planting season is much smaller in numerical value, and it is far from significant.[34] The same pattern emerges when we include all periods in Columns (5) and (6). We have also undertaken a similar analysis month for month [included as Figure B-1]. As the total number of casualties is limited, results are not very precise. There is still a clear pattern of strong and statistically significant results before and in the beginning of the planting season. The effect declines through the planting cycle and becomes small and insignificant in the growing season.

Conflict after the planting season cannot affect our measure of opium production, land allocated to opium, in the same period. However, it does provide more information about the political environment. In the model in Section 3 such knowledge was included in the prior knowledge ω_t. Hence fighting in the growing and harvesting seasons in period t may affect opium production in period $t+1$. We have tested this empirically by estimating all the specifications in Table 4 using lagged casualties data [Included as Table B-3]. Although no coefficients are significant at conventional levels, conflict in the previous growing season has a substantial impact whereas conflict in the previous planting season has very little effect.

Two lines of criticism can be waged against these results: First, the planting season might differ from the non-planting season in ways that blur our interpretation. This is taken care of since we include district fixed effects specific to the individual regression—we hence only exploit variation in fighting and opium production within a district and within

[34]Since we use dummies for casualties in consecutive three months periods in Table 4, the average of the estimated coefficients should not necessarily equal the effect of the year dummy used in Table 3.

Table 4: Effects of Western combat casualties in and out of the planting season

	(1)	(2)	(3)	(4)	(5)	(6)
Casualties, shortly before planting season	750.9***				605.7**	604.0**
	(267.7)				(245.3)	(241.2)
Casualties, planting season		629.8**			508.4*	533.5*
		(309.5)			(305.2)	(319.4)
Casualties, after planting season (short window)			50.98		-87.74	
			(327.2)		(342.0)	
Casualties, after planting season (long window)				-127.2		-212.1
				(178.4)		(202.5)
Mean cas.	0.00760	0.0122	0.00912	0.0203		
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.036	0.036	0.030	0.030	0.039	0.040
N	1974	1974	1974	1974	1974	1974

Notes: Effects of Western combat casualties in and out of the planting season on opium production (2001-2007). The fall planting season is in October and November, while the spring planting season is in March. 'Casualties, planting season' is a dummy for casualties during a three months period prior to the end of the planting season (Sep.–Nov. for fall planting, Jan.–Mar. for spring planting); 'Casualties, shortly before planting season' is a dummy for casualties during a three months period prior to 'Casualties, planting season' (Jun.–Aug. for fall planting, Oct.–Dec. for spring planting); 'Casualties, after planting season (short window)' is a dummy for casualties during a three months period after the planting season (Jan.–Mar. for fall planting, Apr.–Jun. for spring planting); while 'Casualties, after planting season (wide window)' is a dummy for casualties during a five months period after the planting season (Jan.–May. for fall planting, Apr.–Aug. for spring planting). Mean cas. is the mean of the casualties variable used in the same column. Data at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

a time window, not across districts nor across time windows.[35] Second, insurgents may fight harder during the planting season to control more resources to tax in the future. It seems unreasonable, however, that insurgents, in accordance with this argument, should stop fighting back directly after the planting season.

In addition it should be noted that the placebo also provides evidence against another alternative interpretation of our findings, namely that Western forces attack areas of rising warlord power that therefore tend to have greater poppy cultivation. Again, if this was the case there is no reason that there should be a sharp decline at the end of the planting season.

Granger causality

The direction of causality from conflict to opium is also supported by the results from a Granger (1969) causality test, shown in Table 5. The two columns show the results

[35] As an observation of opium production is district-year, the relevant two-way fixed effects are district and year. Note that the fixed effects are not common across specifications, hence we only exploit variation in fighting within time windows, not across windows.

Table 5: Granger causality test

	Opium prod.	Casualties
Opium production, lagged	0.643**	0.0000166
	(0.250)	(0.0000121)
Casualties, district lagged	461.8*	-0.282***
	(261.3)	(0.109)
χ^2	3.123	1.866
p-value	0.077	0.172
District FE	Yes	Yes
Year FE	Yes	Yes
N	1645	1645

Notes: Effects of lagged Western combat casualties and opium production on current Western casualties and opium production. Casualties at the district level. The equations are estimated using the Arellano and Bond (1991) procedure, since they contain a lagged endogenous variable on the right hand side. χ^2 is the test statistic of a χ^2 test of lagged casualties being different from zero in column (1) and of lagged opium production being different from zero in column (2). p-value is the p-value of this test.
Robust standard errors in parentheses. * significant at 10%; ** at 5%; *** at 1%.

from regressions of current opium production and conflict on one-year lags of the two.[36] Again we see that lagged casualties have a significant effect on opium production, whereas lagged opium production has no significant effect on conflict. We can conclude that conflict Granger-causes opium production. In other words, we can reject that the correlation we observe between conflict and subsequent opium production is caused by Western soldiers going into areas where they have learned that there is a lot of opium production combined with opium production being positively correlated over time.[37]

Table 5 may seem to indicate that conflict in a given year reduces the probability of conflict next year, as it is negatively autocorrelated. This, however, is an artifact of a regression towards the mean effect. Whereas the probability of conflict next year is a mere 3.3% in districts without conflict this year, the probability is 37.3% if Western casualties were observed this year. It follows that conflict in one year is a good predictor of conflict the year after.

Instrumental variables

An obvious approach to get around the possible endogeneity issues noted earlier would be to find an instrument for conflict. But finding an instrument for conflict turns out to be difficult, particularly as little data are available for Afghanistan for the period we study. If we had an instrument for opium production, however, we could both test whether there

[36] We have also performed the Granger causality test with two and three lags with fairly similar results (results not reported, but available upon request).

[37] Granger causality does not, however, necessarily imply that conflict causes opium production as there may be omitted factors driving both. Still, this would be a problem with any empirical technique to investigate causality except true randomized experiments. See Geweke (1984) for further discussion.

is a causal effect of opium on conflict, and, using an independence assumption outlined in Hausman and Taylor (1983), test whether there is a causal effect of conflict on opium.

A common instrument for agricultural production in poor countries is deviation from trend in rainfall (see among others Paxson, 1992; Miguel, Satyanath, and Sergenti, 2004; Hidalgo, Naidu, Nichter, and Richardson, 2010). Even though opium is more drought resistant than wheat, poppy cultivation, as with the cultivation of all other crops, requires some water during the growth cycle (Kapoor, 1995, Ch. 4). Therefore, rainfall is likely to be correlated with opium production. We use data on monthly precipitation from the Global Precipitation Climatology Project One-Degree Daily Precipitation Data Set,[38] that provides data on daily precipitation on a 1×1 degree level. As there are few reasons to believe that rainfall affects the area under opium cultivation, though, we use the total production in metric tonnes as our measure of opium production in this section.

It seems unlikely that rainfall should have any direct impact on western hostile casualties. We can then use the econometric model

$$Y_{it} = \alpha_i^Y + \alpha_t^Y + \beta C_{it} + \delta R_{it} + \epsilon_{it}^Y \quad (12)$$

$$C_{it} = \alpha_i^C + \alpha_t^C + \gamma Y_{it} + \epsilon_{it}^C \quad (13)$$

where Y is opium production, C conflict, and R rainfall. The justification for the exclusion restriction in equation (13) is that conflict is here measured as a dummy for whether there have been hostile casualties in a district on a *yearly* basis. Even though deviations from normal rainfall such as snow storms may influence the timing of the Western forces' operations somewhat, it seems unlikely that this should have any effect on whether the operations are implemented or not. Thus, it seems unlikely that rainfall affects conflict directly the way we measure it. Furthermore, if we assume independence between the residuals, i.e. $E\epsilon_{it}^Y \epsilon_{it}^S = 0$, then the predicted residual $\hat{\epsilon}_{it}^Y$ from (12) can be used as an instrument in (13).

We present results from estimations of the system in Appendix Table A-2. Columns (1) and (2) show estimation of equations (12) and (13) using OLS. We see that there is a strong correlation between the two variables. In columns (3) and (4) we use the instrumental variables approach outlined above. Although rainfall is a strong instrument for opium production, there is no significant impact of opium production on casualties. We can hence reject that the opium-conflict correlation uncovered above is driven by opium affecting conflict.

Following the Hausman and Taylor (1983) approach of assuming uncorrelated residuals, we can use the residuals from this regression as instruments for conflict. Doing this, we see from Column (4) in Table A-2 that there is a strong effect of casualties on opium

[38] Available from `http://www1.ncdc.noaa.gov/pub/data/gpcp/1dd/`. The observations are interpolated by kriging using a spherical semivariogram (see e.g. Chilés and Delfiner (1999) for details), and averages are then taken for each district.

production. In Columns (5) to (8) we undertake the same analyses using lagged variables with similar conclusions.

The IV estimates obviously depend on the identifying assumption $E\epsilon_{it}^{Y}\epsilon_{it}^{S} = 0$ being true. As we have district and year fixed effect, this reduces to the absence of year/district specific effects affecting both conflict and opium production. The fact that the relationship also hold using lagged variables further strengthens our claim that there is a casual effect from conflict to subsequent opium production, and not vice versa.

4.4 Extensions

Where is the effect strongest?

Our mechanism should be stronger in areas in which the government has less control and where it is easier to extract opium profits, i.e. areas in which there is more lawlessness. In terms of our model, such weak central control is captured by a high level of θ. The combination of bad institutions and "lootable" resource rents is emphasized as an especially bad case in the resource curse literature (Mehlum, Moene, and Torvik, 2006).

To demonstrate that conflicts are particularly harmful where governmental law enforcement is weak, we have run regressions where we proxy bad institutions with the (altitude-weighted) distance to Kabul.[39] The distances are calculated using GIS data made available by Afghanistan Information Management Services.[40] The estimates are reported in Appendix Table A-3.

Law enforcement is clearly best in Kabul, the area in which the government has full control and where there is a strong presence of Western forces,[41] and declining in the distance from the capital. Since there is no reason to believe that the measurement error introduced by this proxy for government control is non-classical, the estimates can be seen as lower bounds on the true values.

We find that the effect of casualties is stronger further away from Kabul, and only in the half of the sample furthest away from Kabul do we find any relationship between fighting and opium production. Government control is better in the north than the south and east. As we use distance from Kabul as a proxy for government quality, this is exactly what we want to pick up. It could also be argued that this effect is driven by the heavy presence of foreign troops in certain areas far from Kabul, in particular Kandahar, Helmand, and Herat. However, this has been the case over the entire period we study and hence should be controlled for by the district fixed effects.

[39] This approach is also adopted by e.g. Buhaug and Rød (2006); Buhaug, Gates, and Lujala (2009); Raleigh and Hegre (2009).

[40] Available from http://www.aims.org.af/.

[41] As Kabul is the seat of both government offices and important international operations and organizations, it is also a key target for terrorist activities. However, this is a feature of being the capital, and not of lawlessness being particularly high in Kabul.

4.5 Robustness

Does our conflict variable capture conflict?

While hostile casualties indicate violent fighting, non-hostile casualties indicate the presence of Western soldiers in a district without indicating occurrences of violent fighting. To show that our measure of conflict actually captures something meaningful, we have correlated hostile and non-hostile casualties at the district level with responses to the National Risk and Vulnerability Survey (NRVA) in 2005. The NRVA has a section on "Household shocks", where respondents among other things are asked whether the household during the last 12 months has experienced insecurity/violence, theft, reduced agricultural water, and whether it has stopped producing opium this season.[42] In Table 6, we show correlations between the average response to the questions at the district level and hostile and non-hostile casualties.

First, we see that there is no significant difference in the average number of respondents that report that they have experienced no shocks in areas where casualties of either type are observed, meaning that the results in the rows below are not caused by differences in the number of people answering this section of the questionnaire in areas where casualties are observed.

In the second row, we see that in the areas where hostile casualties are reported, significantly more households report that they have experienced insecurity and/or violence in the last 12 months. There is, however, no difference between the areas where non-hostile casualties are observed and where no casualties are observed. This indicates that our conflict measure (hostile casualties) and non-hostile casualties indeed capture some real differences in conflict levels.

In the third row, we see that significantly fewer people report to have stopped producing opium this season in areas where hostile casualties are observed, which is consistent with the evidence provided above.

In the fourth and fifth row, we note that significantly fewer people report problems with reduced agricultural water quality and / or quantity and theft in areas where non-hostile casualties are observed, perhaps indicating that in these areas there is less instability and more rebuilding of infrastructure is taking place.

Combining information on 'insecurity / violence' with information on 'reduced agricultural water quality / quantity' in Table 6, we get a rough indication of changes in the value of lawlessness (insecurity relative to resources to legal crops) in different areas: While the value of lawlessness seems to go up in areas with hostile casualties (as insecurity increases and water supply declines), the value of lawlessness seems to decline in

[42] The exact wording of the question is "In the last 12 months has the household been negatively affected by any of the following?", and the shocks we present in Table 6 are "No shocks experienced", "Insecurity / violence", "Grew opium last season but not this season", "Reduced agricultural water quality and or quantity", "Theft and/or violence".

Table 6: Relationship between the conflict measure and household survey responses from the National Risk and Vulnerability Survey (NRVA) 2005

	Casualties		Constant
	Hostile	Non-hostile	
No shocks experienced	0.0432	0.00374	0.414***
	(0.0886)	(0.0899)	(0.0204)
Insecurity / violence	0.154**	-0.0241	0.0559***
	(0.0746)	(0.0594)	(0.0106)
Stopped producing opium this season	-0.0254***	-0.0117	0.0391***
	(0.00855)	(0.0107)	(0.00908)
Reduced agricultural water quality / quantity	0.0789	-0.0981***	0.110***
	(0.0581)	(0.0354)	(0.0143)
Theft and/or violence	0.000402	-0.00358***	0.00525***
	(0.00281)	(0.000871)	(0.000855)

Notes: Results from regressing responses to questions from NRVA 2005 and dummies for hostile and non-hostile casualties in 2004 and 2005. The NRVA responses (0 = No, 1 = Yes) are the average responses at the district level, aggregated using the sampling weights provided by NRVA (the result are virtually the same without the sample weights), while both hostile and non-hostile casualties are measured at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

areas with non-hostile casualties (as insecurity declines and water supply increases). This again supports the assertion that areas with hostile casualties experience an increase in the value of lawlessness, inducing opium production.

Conflict or just the presence of Western soldiers?

One mechanism that could generate the positive correlation in Table 3, could be the following: When Western forces have control over an area, it is easier to smuggle drugs out since these forces have an explicit policy of not intervening in drugs trade (see quotes above). Another potential mechanism is that Western presence indicates weaker local warlords which allows the farmers to capture more of the opium rents, inducing higher poppy cultivation.

To test for this, we separate between the effects of hostile and non-hostile casualties, where non-hostile casualties as explained earlier indicate the presence of Western soldiers in a district without indicating occurrences of conflict. We want to test whether both hostile and non-hostile casualties have an effect on opium production versus the alternative of only hostile casualties having an effect.

Table 7 reports the results from this analysis. The coefficients on hostile casualties are of about the same numerical values as in Table 3. The coefficients on non-hostile

Table 7: Effects of Western combat and non-hostile casualties on opium production

	(1)	(2)	(3)	(4)
Hostile casualties	624.1*			569.1*
	(329.4)			(303.3)
Hostile casualties, lagged		340.8**		434.0***
		(138.4)		(163.0)
Hostile casualties, two lags			-188.4	-63.55
			(333.1)	(323.3)
Non-hostile casualties	-132.9			-29.88
	(118.4)			(129.8)
Non-hostile casualties, lagged		191.6		103.3
		(210.5)		(180.8)
Non-hostile casualties, two lags			-38.45	-327.4
			(137.4)	(205.5)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.064	0.034	0.024	0.041
N	2303	1974	1645	1645

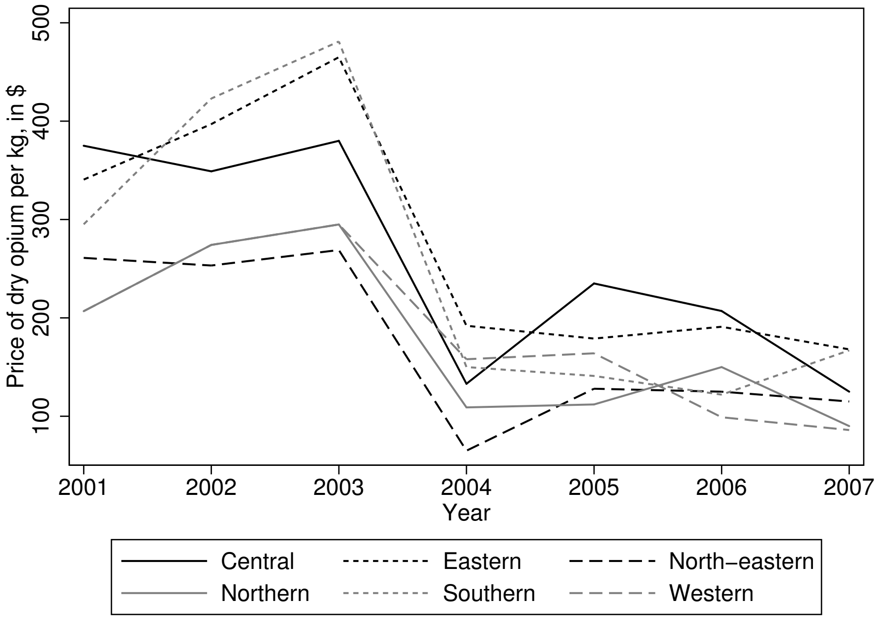
Notes: Effects of contemporaneous and lagged Western combat and non-hostile casualties on opium production (2001-2007). Casualties at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

casualties, however, are sometimes negative and always insignificant, indicating that there is no effect on opium production from the presence of Western soldiers; only conflict increases subsequent opium production.

Caused by price movements?

One could imagine that the results discussed so far could be driven by price increases. UNODC (various issues) has collected opium prices at the farm gate level from household surveys, although they are only broken down at the level of six regions. The data are shown in Figure 5. While the geographical variation at a point in time is rather large, indicating segmented markets, it should be noted that the trends are fairly parallel across districts over time, so that most of the variation comes in the time series. The constant differences in prices across districts will be picked up by the district fixed effects, while the parallel trends will be picked up by the year fixed effects. Note also that the prices are not increasing, but decreasing, consistent with the model's implication for endogenous movements in farm gate prices after violent conflicts from Section 3.

Figure 5: Farm gate prices of opium



Notes: The graph shows the estimates farm gate value of opium production by year, broken down by six broad regions.

An artifact of the change in measurement technology?

Since 2002, the surveying of opium production has been conducted by satellite imagery in some of the districts. Although it seems like the use of satellite imagery is mostly due to increased efficiency in the data collection, the initial explanation was that the level of conflict in some of the provinces was so high that it was impossible to survey the production in these areas using on-the-ground surveyors.

As the measurement technology may influence the reported opium production and be correlated with conflict, we have re-run the regressions in Table 3 while controlling for satellite measurement. The results are reported in Appendix Table A-4. First, using satellite measurement seems to increase the measured area under opium production, but this is most likely an artifact of the ban on opium production in 2001 (see discussion in footnote 11). Second, when we control for measurement by satellite, the estimates remain very close to those reported in Table 3, so our findings are not driven by a spurious effect from the measurement technology. As the satellite variable is highly endogenous—correlated with conflict since this was the original reason for using satellite, and possibly correlated with opium production since the production estimates are based on a different measurement technology—we did not include satellite as a separate control in the regressions reported above.[43]

[43] As an additional robustness check, we have re-estimated the regressions reported in Table 3 on the sample of districts measured by satellite. The effects are actually somewhat stronger, and are available upon request [included as Table B-5].

Another worry concerning the measurement of opium production is that the number of districts surveyed has increased over time, especially during the 1990's. Apparently, at least in the beginning, UNODC only surveyed districts in which they believed there was opium production. We have therefore run the same regressions as in Table 3 using only districts that had positive opium production in at least one year during the 1990's (that is, we use only the districts where the surveying started sometime during the 1990's). The results are literally unchanged, but as the sample size is reduced, the standard errors increase somewhat (results not shown, but available on request).

Driven by a general increase in farming activities?

The relationship that we observe between conflict and opium production might reflect a general increase in farming activities, due for example to an influx of returnees causing more land scarcity, which in turn increases opium production. To test this we have collected data on wheat production, made available by FAO. Unfortunately, wheat data are only available at the province level. Running the two-way fixed effects model in Table 3 with wheat production rather than opium production as the dependent variable (with all variables measured on the province level), we find no significant relationship between the two variables (results not reported). However, we also get insignificant results when running opium production at the province level on casualties at the province level after taking out two-way fixed effects. Province level data seem to contain too little geographical information to be able to pin down the effect of conflict precisely. There is almost no correlation between wheat production and opium production,[44] however, indicating that it does not seem to be the case that the relationship we observe is due to a general increase in farming activities.[45]

Just spatial dependency?

As opium production is mainly located in some provinces (Helmand, Kandahar, and Farah) and the presence of foreign troops is clustered in certain areas, there is probably spatial dependence in the data. This is taken care of throughout the paper by clustering standard errors at the province-year level. One may still worry whether this solves the problem completely. To check whether clustering of standard errors is enough to solve the problems related to spatial dependency, we have estimated a version of Table 3 including

[44]The correlation coefficient between wheat and opium production on pooled data is 0.02. Taking out province fixed effects, the partial correlation coefficient is 0.01. Taking out year fixed effects in addition, reduces the coefficient to -0.05.

[45]It should be noted that the lack of correlation between wheat and opium does not invalidate the model in Section 3, where the choice between opium and wheat was emphasized. The overall area used for opium production in Afghanistan is surprisingly small, in 1999 only 1.2 per cent of the total arable land was dedicated to opium production, corresponding to 4.5 per cent of the land used for wheat cultivation (UNODC, 2003b). Since opium is such a small part of the total agricultural production, it is not strange that we do not find a correlation between the two measures of land use at the aggregated province level.

spatial lags using the procedure for estimating spatial panel data models developed by Hughes (2011) and Elhorst (2010). Specifically, we estimate models where opium production in one district may be affected by opium production levels and fighting activity in neighboring districts, often referred to as spatial Durbin models. The results are similar to those obtained in Table 3, albeit slightly smaller in magnitude.[46] Significance levels are unchanged. As one might expect, both opium production and conflict in neighboring provinces have positive effects.

5 Conclusion

In Afghanistan warlords and drug traders seem to obtain an increasing share of a growing pie: Between 2002 and 2007 opium production was more than doubled at the same time as farm gate prices to cultivators dropped to one third of their 2002-level and whole sales prices of heroin in Europe and the US remained more or less constant. This is happening in a social setting where Afghan opium producers seem not to be forced to allocate more land to opium. On the contrary, 90 per cent of them insist that they decide on the land allocation themselves.

In explaining these puzzling observations we focus on the consequences of war, on how rising conflicts change the power of local leaders and the incentives of farmers living in the conflict areas. The changes follow because conflicts are destructive, destroying physical capital and infrastructure, and because conflicts are creative, opening up new opportunities for economic activities. Opium production in Afghanistan benefits on both fronts.

We capture this in a simple model emphasizing how rising conflicts increase the predicted value of lawlessness which in turn induces higher opium cultivation at the same time as farm gate prices of opium are reduced. Exploiting a unique data set, we show that Western hostile casualties, our proxy for conflict, have a strong impact on subsequent local opium production. We argue that this proxy vary exogenously to opium, both by referring to statements from US and NATO forces claiming that they are not involved in military actions against opium producers, and by showing a zero correlation between eradication of opium production and Western casualties. We show that the causal direction is from conflict to opium, and not vice versa, both by a placebo test and by instrumenting opium production with rainfall.

A number of alternative mechanisms could perhaps also explain our main result, the effect from conflict to opium production. First, if it were the case that the warlords only fought back in areas with much opium, the positive correlation between casualties and subsequent opium production could still be observed even with the placement of the soldiers being random. But there is no support for this story about defending opium in

[46]The results are available upon request [See Table B-6].

particular, since we show that hostile casualties only have an effect prior to the planting season. If the battles were over the opium territory, warlords would be equally interested in fighting back directly after the planting season as during the planting season.

Second, it might be the case that Western forces attack areas of rising warlord power, areas which also have higher opium production. But it is hard to reconcile this mechanism with the sharp decline at the end of the planting season.

Third, it might be the case that attacks by Western soldiers weaken local warlords allowing the farmers to capture more of the rent from opium production and hence increasing production, or that production increases due to smuggling routes being safer when Western soldiers are in the area due to their non-intervention policy. But these two mechanisms are hard to reconcile with the absence of an effect of the *presence* of Western soldiers, as captured by the occurrence of non-hostile casualties.

Finally, it might be the case that higher levels of conflict have increased the risk of production in general, and that what we are capturing is really only the result of higher prices associated with production in a more risky environment. But prices have decreased, not increased, over the period, which is inconsistent with such a mechanism. We therefore conclude that part of the dramatic rise in Afghan poppy cultivation in the period 2002-2007 seems to be a consequence of the rising violent conflicts in the country. This is why we claim that a substantial part of the narcotics production in Afghanistan is conflict-induced.

We believe that there also may be a strong drugs-for-arms mechanism at work in Afghanistan, although this is not the topic of our paper. Our focus on those conflicts that are exogenous to opium production enables us to identify the link from conflict to opium production. Due to this exogeneity, however, we are unable to quantify the traditional drugs-for-arms mechanism with our data. If both conflict-induced narcotics production and drugs-for-arms mechanisms are at work at the same time, the combination of the two may create a vicious circle: More intense conflicts stimulate more opium production enabling warlords, militia leaders, and other strongmen to finance military campaigns escalating the conflicts further.

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A Additional tables

Summary statistics can be found in Table A-1, Table A-2 shows the instrumental variables estimation, Table A-3 provides interaction effects of distance to Kabul, and Table A-4 shows that what we are capturing is no spurious effects from the use of satellite measurement of opium production.

Table A-1: Summary statistics for key variables

	mean	sd	min	max
Opium production	325.71	1094.49	0.00	22769.00
Casualties, district	0.12	0.94	0.00	24.00
Casualties dummy, district	0.04	0.19	0.00	1.00
Non-hostile casualties, district	0.05	0.58	0.00	15.00
Non-hostile casualties dummy, district	0.02	0.13	0.00	1.00
Satellite	0.37	0.48	0.00	1.00
Distance to Kabul	2.60	1.94	0.00	7.88
N	2303			

Table A-2: Instrumental variables estimation of the association between opium production and conflict

	(1) Casualties	(2) Production	(3) Casualties	(4) Production	(5) Casualties	(6) Production	(7) Casualties	(8) Production
Opium production	0.000623***		0.0000380					
	(2.59)		(0.05)					
Casualties		25.51**		23.98**				
		(2.42)		(2.34)				
Opium production, lagged					0.000788**		0.00134	
					(2.24)		(1.24)	
Casualties, lagged						15.23*		14.66*
						(1.75)		(1.67)
N	2303	2303	2303	2303	1974	1974	1974	1974
R^2	0.0557	0.0612	0.0423	0.0612	0.0470	0.0312	0.0423	0.0312
Estimator	OLS	OLS	2SLS	2SLS	OLS	OLS	2SLS	2SLS
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Effect of contemporaneous and lagged conflict and opium production on opium production and conflict. Opium production is measured in tonnes of dry opium, and instrumented with rainfall each month during the growing cycle. Casualties are measured at at the district level and are instrumented with residuals from the preceding estimation.

Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table A-3: Effect of distance from Kabul

	(1)	(2)	(3)	(4)
Casualties, district	-703.0**			
	(323.3)			
Casualties, district lagged		-313.7*		-55.83
		(165.3)		(97.49)
Casualties, district two lags			116.5	
			(319.5)	
Casualties × Distance	3758.5**			
	(1694.3)			
Casualties lagged × Distance		1970.7***		
		(685.0)		
Cas × Distance, two lags			-946.1	
			(1912.4)	
Cas. lagged × Far from Kabul				758.9***
				(284.2)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.096	0.040	0.025	0.038
N	2303	1974	1645	1974

Notes: Effects of contemporaneous and lagged Western combat casualties and interactions with (height-weighted) distance to Kabul on opium production (2001-2007). Casualties at the district level. Distance is the altitude-weighted distance from Kabul to the mid-point of the district. "Far from Kabul" is a dummy for districts for which this value is above the median.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table A-4: Controlling for observation by satellite

	(1)	(2)	(3)	(4)	(5)	(6)
Casualties, district			624.3*			566.7*
			(321.9)			(299.8)
Casualties, district lagged				370.1***		393.7***
				(140.4)		(143.1)
Casualties, district two lags					-193.7	-117.3
					(328.4)	(318.2)
Observation by satellite	234.0*	36.36	245.9**	40.36	1.636	19.92
	(128.1)	(129.7)	(123.2)	(127.8)	(136.6)	(126.5)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.057	0.030	0.072	0.034	0.024	0.040
N	2303	1974	2303	1974	1645	1645

Notes: Effects of observation by satellite and contemporaneous and lagged Western combat casualties on opium production (2001-2007). Data at the district level. Column (2) excludes 2001.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

B Additional estimation results (not intended for publication)

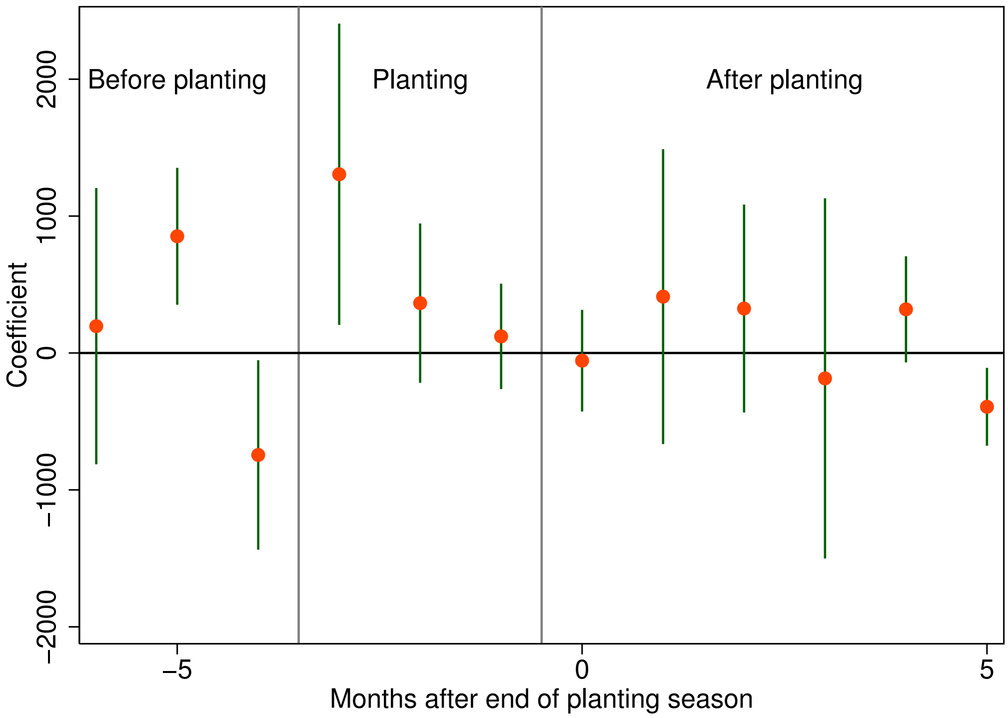
Table B-1 mimics Table 3, using casualties at the province level instead of at the district level, with opium production still at the district level. Table B-2 provides further robustness checks: Columns (1)-(3) mimics Columns (4)-(6) in Table 3 using the number of casualties instead of a dummy indicating casualties, while Columns (4)-(6) in Table B-2 adds district specific linear time trends to the regressions in Column (4)-(6) in Table 3. Regressions with log opium production can be found in Table B-4. Table B-5 shows the effect of casualties on opium production in districts where opium production is observed by satellite. Table B-7 mimics Table 3, but with standard errors clustered on province instead of province-year. Finally, Table B-6 shows estimates from a spatial lags model to see the effect of spatial dependence.

Table B-1: Effects of Western combat casualties on opium production. Casualties measured at the province level

	(1)	(2)	(3)	(4)
Casualties, province	32.01			-79.81
	(96.46)			(115.8)
Casualties, province lagged		159.6		193.4
		(116.7)		(149.7)
Casualties, province two lags			148.0	158.6
			(167.0)	(169.3)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.050	0.034	0.026	0.033
N	2303	1974	1645	1645

Notes: Effects of contemporaneous and lagged Western combat casualties on opium production (2001-2007). Casualties at the province level, opium production at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Figure B-1: The effect of conflict through the growing cycle



Notes: The graph shows the results from individual regressions of opium production on conflict in a single month prior to harvesting. Dots denote point estimates and lines 95 % confidence intervals.

Table B-2: Effects of Western combat casualties on opium production. Conflict measured by the *number* of casualties ((1)-(3)) and robustness to district specific linear time trends ((4)-(6))

	(1)	(2)	(3)	(4)	(5)	(6)
Casualties count, district			113.6***			
			(39.43)			
Casualties count, district lagged	92.81***	70.86***	41.54**			
	(29.18)	(19.05)	(19.69)			
Casualties count, district two lags			-18.35			
			(62.83)			
Casualties, district						417.8*
						(231.1)
Casualties, district lagged				177.9*	177.2**	340.2**
				(92.43)	(83.45)	(162.0)
Casualties, district two lags						-173.8
						(383.0)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	No	Yes	Yes
District specific linear trend				Yes	Yes	Yes
R^2	0.006	0.033	0.039	0.547	0.552	0.665
N	1974	1974	1645	1974	1974	1645

Notes: Effects of contemporaneous and lagged Western combat casualties on opium production (2001-2007). Columns (1)-(3) use the number of casualties rather than a dummy. Columns (4)-(6) adds district specific linear time trends.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table B-3: Effects of Western combat casualties in and out of the planting season using lagged casualties

	(1)	(2)	(3)	(4)	(5)	(6)
Casualties, shortly before planting season	254.9				152.6	310.4**
	(154.1)				(225.0)	(132.6)
Casualties, planting season		-40.88			-75.71	-123.0
		(123.3)			(116.0)	(122.5)
Casualties, after planting season (short window)			307.2		292.3	
			(328.1)		(348.9)	
Casualties, after planting season (long window)				198.1		206.5
				(199.1)		(204.7)
District FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.024	0.024	0.024	0.024	0.024	0.024
N	1645	1645	1645	1645	1645	1645

Notes: Effects of Western combat casualties in and out of the planting season on opium production (2001-2007). The fall planting season is in October and November, while the spring planting season is in March. 'Casualties, planting season' is a dummy for casualties during a three months period prior to the end of the planting season (Sep.–Nov. for fall planting, Jan.–Mar. for spring planting); 'Casualties, shortly before planting season' is a dummy for casualties during a three months period prior to 'Casualties, planting season' (Jun.–Aug. for fall planting, Oct.–Dec. for spring planting); 'Casualties, after planting season (short window)' is a dummy for casualties during a three months period after the planting season (Jan.–Mar. for fall planting, Apr.–Jun. for spring planting); while 'Casualties, after planting season (wide window)' is a dummy for casualties during a five months period after the planting season (Jan.–May. for fall planting, Apr.–Aug. for spring planting). Mean cas. is the mean of the casualties variable used in the same column. Data at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table B-4: Effects of Western combat casualties on *log* opium production

	(1)	(2)	(3)	(4)
Casualties, district	0.0335			0.00623
	(0.189)			(0.191)
Casualties, district lagged		0.516***		0.510***
		(0.152)		(0.145)
Casualties, district two lags			-0.207	-0.138
			(0.275)	(0.279)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.181	0.040	0.026	0.030
N	1080	1035	939	939

Notes: Effects of contemporaneous and lagged Western combat casualties on log opium production (2001-2007). Years with no opium production are treated as missing. Casualties at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table B-5: Effects of Western combat casualties on opium production in districts observed by satellite

	(1)	(2)	(3)	(4)
Casualties, district	955.5*			884.6*
	(492.9)			(452.7)
Casualties, district lagged		551.0***		475.8**
		(198.9)		(211.2)
Casualties, district two lags			-468.6	-225.0
			(683.2)	(610.6)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.066	0.048	0.042	0.065
N	859	859	785	785

Notes: Effects of contemporaneous and lagged Western combat casualties on opium production (2001-2007) in years and districts where opium production was measured by satellite. Casualties at the district level.
Standard errors are clustered on province-year. * significant at 10%; ** at 5%; *** at 1%.

Table B-6: Effects of Western combat casualties controlling for spatial lags

	(1)	(2)	(3)	(4)	(5)
W×Opium production	0.0692***	0.0661***	0.0647***	0.0685***	0.0630***
	(0.00511)	(0.00521)	(0.00564)	(0.00610)	(0.00629)
Casualties		561.0***			491.3***
		(97.13)			(113.2)
W×Casualties		98.23**			74.12
		(43.56)			(51.94)
Casualties, lagged			275.3**		265.3*
			(124.5)		(139.2)
W×Casualties, lagged			229.3***		244.9***
			(54.92)		(61.39)
Casualties, two lags				-260.0	-239.1
				(176.9)	(177.8)
W×Casualties, two lags				199.1**	215.5***
				(78.37)	(78.77)
N	2303	2303	1974	1645	1645

Notes: Effects of contemporaneous and lagged Western combat casualties in current and contiguous districts and contiguous opium production on opium production. All casualty measures are at the district level. "W" denotes spatial lags. All estimations include district and year fixed effects.
* significant at 10%; ** at 5%; *** at 1%.

Table B-7: Effects of Western combat casualties on opium production, standard errors clustered on province

	(1)	(2)	(3)	(4)
Casualties, district	608.6			565.2
	(386.9)			(345.2)
Casualties, district lagged		368.3**		392.8**
		(154.8)		(155.5)
Casualties, district two lags			-193.9	-119.7
			(172.9)	(169.7)
District FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.064	0.034	0.024	0.040
N	2303	1974	1645	1645

Notes: Effects of contemporaneous and lagged Western combat casualties on opium production (2001-2007). Casualties at the district level.
Standard errors are clustered on province, *not* province-year. * significant at 10%; ** at 5%; *** at 1%.