Diamonds and violence in Africa. Uncovering relationships and mechanisms.

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Abstract

This paper investigates whether an increase in the international price of diamonds impacts violent activity in African countries that are diamond abundant and if so, through which mechanism(s). It concludes that an increase in the diamond price is positively related to violence in countries abundant in primary diamonds, but unrelated to violence in countries with secondary diamonds. This result makes it possible to distinguish between two potential theoretical mechanisms connecting resources and violence: insecure property rights raising the returns to conflict and the wage rate changing the opportunity costs of conflict. The findings support the latter, but not the former. Results are robust to using different diamond prices, instrumenting for diamond price and controlling for cyclical effects, but not to controlling for the presence of other resources.

1 Introduction

"For every hand taken in marriage, another hand is taken away". This slogan accompanies an internet advertisement featuring a black hand, cut off at the wrist, wearing a diamond ring.[1] It speaks to the idea that diamond production and/or trade cause conflict, violence and human suffering. The international community seems to have endorsed this idea as well: in 2003 the Kimberley Process Certification Scheme entered into force, requiring signatory countries to ensure that all shipments of diamonds in and out of the country are accompanied by a certificate stating that these are not 'conflict diamonds', rough diamonds used by rebel movements to finance conflict against legitimate governments. This paper aims to examine the proposed link between diamonds and conflict, by investigating whether and through which mechanism(s) variation in the international price of diamonds is related to violent activity in diamond-abundant areas.

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Research on diamonds and conflict is part of a larger literature on resources and civil war, results of which are inconclusive on a number of fronts. Taking 'natural resources' as a single category, an often used method is to run a logit regression with a dummy variable for conflict onset or occurrence in a country-period as a dependent, and resource exports as a percentage of GDP as one of the explanatory variables. Employing this type of analysis, Collier and Hoeffler conclude in a number of papers (Collier and Hoeffler, 1998, 2004; Collier et al., 2009) that natural resource exports and war risk are positively related. However, other authors fail to find similar results. Natural resources exports over GDP does not enter significantly in the model by Fearon and Laitin (2003), who argue that Collier and Hoeffler's results are an artefact of their use of five-year periods as unit of analysis, coding of ongoing wars and list-wise deletion of missing data. Elbadawi and Sambanis (2002) reach similar conclusions. Hegre and Sambanis (2006) run a large number of regressions, systematically including all possible combinations of 88 potential explanatory variables and conclude that the relationship between resource exports and civil conflict is not robust.

Other research focuses on the relationship between specific resources and conflict, estimating similar models but replacing natural resource exports over GDP with various indicators for oil and diamond export and/or production. Three studies focussing on diamonds are especially relevant to this paper. All three use the Fearon and Laitin (2003) data as a starting point.

First, Lujala et al. (2005) construct a database, DIADATA, including known instances of diamond occurrence, date of discovery and date of first production. The data distinguishes between primary diamonds (extracted in technologically advanced mines) and secondary diamonds (which can be extracted using more artisanal techniques). Using DIADATA, Lujala et al. create several dummies for the occurrence and production of primary and secondary diamonds. They find no effect of production of either diamond type on war risk in general, but conclude that secondary diamond production increases the chance of ethnic war onset and occurrence. Primary diamond production is unrelated to conflict, as is the occurrence of both primary and secondary diamonds.

Secondly, Humphreys (2005) collects data on the quantities of diamonds mined (without distinguishing between secondary and primary diamonds). He concludes diamond production increases the risk of war onset, but decreases the duration of conflict.

Finally, Ross (2006) augments Humphreys' dataset on the quantities of diamonds produced and calculates its $ value using the country-specific diamond price, extrapolated back using a diamond price index. He multiplies the values with the Lujala et al. (2005) et al. dummies for primary and secondary diamond production to arrive at indicators for the value of primary and secondary diamond production. In contrast to Lujala et al., Ross finds that primary diamonds are positively related to the onset of civil, national, ethnic and non-ethnic conflict. Secondary diamonds are unrelated, except to separatist conflict, and both are unrelated to conflict duration.

As is clear from the above, the jury is still out on the question whether resources and war risk are systematically related. Even if such a relationship were established questions remain as to whether this is a causal relationship and the mechanism through which they are related.

Drawing convincing causal conclusions is extremely difficult because the above studies exploit cross-country variation in the occurrence of war and resource production, and there may be any number of country-specific factors jointly determining both. Furthermore, exports and production of resources may be endogenous to violence. This problem is especially pressing when using natural resource exports over GDP, as GDP may decline more steeply than natural resource exports in anticipation of conflict, leaving open the possibility that the ratio between the two increases as a result of conflict rather than the other way around. However, measures based on natural resource production are not free of endogeneity issues. It is not hard to imagine that actual or measured resource production responds to (the threat of) conflict. More formally, the theoretical models employed in this paper suggest that production and export of natural resources increase as a result of conflict. Indeed there is evidence that the observed relationship between resources and civil war disappears when using more exogenous measures of resource abundance (see for example Brunnschweiler and Bulte, 2009; Rigterink, 2010).

As for the mechanisms that link natural resources and conflict: there is no shortage of suggestions as to how they are related (some authors even speak of an 'embarrassment of mechanisms' (Humphreys, 2005)) but again little definitive evidence. Natural resources may increase the opportunities to make money during war, increase the value of trying to capture the state, weaken state accountability, lower economic growth or spur grievances among the population (Collier and Hoeffler, 2005; Humphreys, 2005; Ross, 2004). Despite the many suggestions, very few formal models existed predicting the impact of natural resources on the incentive to wage conflict until recently. Formal models are deemed essential, to describe the mechanisms linking resources and conflict more accurately and to guide the choice of variables to be included in empirical research.

Because of the above issues, there has been a call for more theoretical models and empirical research exploiting within-country variation, based on formal theoretical models and employing exogenous measures of research abundance (see for example Besley and Persson, 2008; Blattman and Miquel, 2009). A number of studies of this type will be highlighted in the next section. This paper intends to contribute to this body of research by focussing on diamonds and violence. Diamonds feature prominently in the international policy scene and the distinction between primary and secondary diamonds will prove interesting in distinguishing between different mechanisms that could theoretically connect resources and war, but to the best of my knowledge, the relationship between diamonds and violence has not yet been investigated exploiting within-country variation.

This paper will first introduce two theoretical models on the relationship between resources and conflict. One (Garfinkel et al., 2008) formalizes the idea that natural resources increase the returns to violence, as they can be valuable assets easily expropriated (depending on the security of property rights). It predicts that as the international price of a contested resource increases, conflict activity in regions abundant in this resource increases. A second model (Dal Bó and Dal Bó, 2004) arrives at a similar prediction, but through a different mechanism. It poses that natural resources may decrease the costs of waging conflict. As the price of a natural resource with a capital intensive production process increases, the returns to labour and thereby the opportunity costs of waging conflict decrease in countries producing this resource. Since neither of the models includes a government, a third model (Besley and Persson, 2008) will be briefly introduced.

The predictions of the two main models are especially interesting in the case of diamonds. Primary diamonds are associated with a capital-intensive production process and relatively secure property rights, while the property rights of secondary diamonds can more easily be contested and production is labour-intensive. Therefore, the model by Garfinkel et al. (2008) predicts that secondary diamond price is more strongly related to conflict than primary diamond price, while the model by Dal Bó and Dal Bó (2004) asserts that increases in primary diamond price would increase conflict activity whilst an increase in secondary diamonds decreases it. By investigating the effect of primary and secondary diamond price on violent activity, we can get an idea about the mechanism connecting diamonds and conflict: weak property rights increasing the returns to conflict or low wages decreasing its costs.

A barrier to investigating the impact of diamonds on conflict is the unreliability of diamond export data. As diamonds are so easily smuggled, any data on diamonds in a conflict zone should be treated with suspicion. Furthermore, as highlighted earlier, both models suggest diamond export and production are endogenous to conflict. Therefore, I use geographical data to estimate predicted primary and secondary diamond abundance for 48 African countries, arguing that geographical data are exogenous to conflict and more reliable than diamond export or production data.

In a fixed effects model, these measures of primary and secondary diamond abundance are then interacted with international diamond price, to investigate whether higher diamond price is associated with more conflict events in countries that are more diamond abundant. In this analysis, primary diamonds are positively related to conflict activity, while secondary diamonds are insignificant, yet consistently enter the regressions with a negative sign. This lends support to the Dal Bó and Dal Bó model, emphasizing the costs of conflict in terms of wages as a mechanism connecting resources and conflict, although an alternative explanation using the Besley and Persson (2008) model will also be considered. The results are reasonably robust to changing the measure of diamond price used, controlling for seasonal effects and instrumenting for diamond price using the production volume of the largest, peaceful diamond producers. They are not robust to controlling for the presence of other resources.

The remainder of this paper is organized as follows: section 2 introduces the theoretical models, section 3 describes the methodology, measure of diamond abundance and other data used, section 4 presents the main results and section 5 will go into the robustness of the results, before concluding.

2 Theoretical models

2.1 Garfinkel et al.: property rights and returns to conflict

Garfinkel et al. (2008) construct a model suggesting that an increase in price of natural resources leads to an increase in conflict when the property rights of (a fraction of the available) natural resources are contested, because an increase in the resource price increases the returns to conflict.

The model describes a country with N equally sized groups, indexed by i. All groups are endowed with an equal amount of land (T) and labour (L), property rights to which cannot be contested. Groups can use land to produce oil (O_i), labour can be allocated to producing butter (B_i) or to producing guns (G_i), all on a one-to-one basis. This makes the production of butter: $max[L - G_i, 0]$. The sum of guns produced over all groups is denoted by $\bar{G}$. p denotes the price of oil relative to the price of butter. The prices of butter, guns and labour are normalized to 1. Under free trade, the price of oil is exogenously set by the world market (the country can be considered 'small') and all goods including guns can be traded freely.

There is some amount of land T_0, property rights to which are contested by the groups in a winner-takes-all fashion. The more guns a group produces, the higher the probability it will obtain this land (π_i):

$$\pi_i = \begin{cases} \frac{G_i}{\bar{G}} & \text{if } \bar{G} > 0 \\ \frac{1}{N} & \text{otherwise} \end{cases}$$

Groups consume both oil and butter and have Cobb-Douglas preferences:

$$U_i(O_i, B_i) = (O_i)^{\alpha}(B_i)^{\beta} \tag{1}$$

where $\alpha \epsilon [0, 1]$ and $\alpha + \beta = 1$.

Timing in this model is as follows: (1) groups allocate their labour to butter and gun production, taking other groups' gun choices as given; (2) given the gun choices, one group obtains T_0. Expected total land endowment for group after this contest is denoted by $\tilde{T}_i$. Total land endowment after conflict for any group is either T or $T + T_0$; (3) production, trade and consumption takes place.

Solving by backward induction gives the following. Given $\tilde{T}_i$ each group maximizes (1) subject to budget constraint:

$$pO_i + B_i \leq p\tilde{T}_i + L - G_i$$

It can be shown that at the optimum, expected pay-off for group i (W_i) is:

$$W_i(\boldsymbol{G}, p) = \mu(p)(p(T + \pi_i T_0) + L - G_i) \quad (2)$$

where $\mu(p) = \beta^{\beta}(\alpha/p)^{\alpha}$ and bearing in mind $\tilde{T}_i = T + \pi_i T_0$.

Differentiating (2) with respect to G_i gives the optimal gun production (which is the same for all groups because they are *a priori* identical):

$$G_i^* = \frac{(N-1)pT_0}{N^2} \quad (3)$$

The result from (3) is that gun production increases in the price of the contested resource (p), given that some contested resources are present ($T_0 \neq 0$). The intuition for this is that as the contested resource increases in value, the expected returns to investing in guns increase. Gun production also increases in amount of contested land.

Garfinkel et al. (2008) also show that the excess demand for the contested resource is decreasing in the degree of property rights insecurity. This implies that a country would export more (import less) of the contested resource under conflict compared to a non-conflict benchmark. It suggests we cannot treat a countries' resource exports as exogenous to conflict.

2.2 Dal Bó and Dal Bó: wages and the cost of conflict

The model by Dal Bó and Dal Bó (2004) suggests that an increase in the price of a natural resource with a capital intensive production process increases conflict in countries where this resource is produced, whilst an increase in the price of a labour intensive resource decreases conflict in a producing country. This arises because the price increase (decrease), decreases (increases) the returns to labour and thereby the opportunity costs of conflict.

Dal Bó and Dal Bó construct a Stolper-Samuelson type model of a country with two productive sectors: sector 1 is capital intensive and sector 2 is labour intensive. In addition to the productive sectors, there is an expropriation sector (denoted by subscript A). Production in both productive sectors is q_1 and q_2 respectively. The price of good 1 relative to the price of good 2 is p and the price of good 2 is normalized to 1. Prices are exogenously determined by the world market (again, the country can be considered small). The country is endowed with fixed amounts of labour ($\bar{L}$) and capital ($\bar{K}$). Prices of capital and labour (before expropriation) are r and w respectively. Productivity in both sectors is indicated by a_{ij}, the amount of input j used to produce one unit of output in sector i. Because of the factor intensities of both sectors:

$$\frac{a_{1K}}{a_{2L}} < \frac{a_{1K}}{a_{2L}} \quad (4)$$

The expropriation sector uses only labour as an input (L_A is the amount of labour allocated to this sector). It expropriates a fraction $A(L_A)$ of the production of both productive sectors, where $A(L_A)$ is a continuous and concave function.

In equilibrium, a number of conditions must be satisfied. Under the assumption of perfect competition, firms earn zero profits:

$$ra_{1K} + wa_{1L} = p \tag{5}$$
$$ra_{2K} + wa_{2L} = 1 \tag{6}$$

Furthermore, the markets for production factors clear:

$$q_1 a_{1K} + q_2 a_{2K} = \bar{K} \tag{7}$$
$$q_1 a_{1L} + q_2 a_{2L} = \bar{L} - L_A \tag{8}$$

Finally, returns to labour in the expropriation sector and productive sectors must be equal. The return to labour in the expropriation sector is the value of the share of total production expropriated, per unit of labour. Under constant returns to scale, the value of total production equals the payments to the factors employed in the productive sector. The return to labour in the production sector is the share of the wage that is left to the worker after expropriation. This makes the final condition:

$$\frac{A(L_A)}{L_A}(r\bar{K} + w(\bar{L} - L_A)) = (1 - A(L_A))w \tag{9}$$

In absence of full specialization, the implications of this model are as follows. Using (5) and (6), we can write r and w as a function fo p. Differentiating with respect to p and bearing in mind (4), it can be shown that $\frac{dw}{dp} < 0$ and $\frac{dr}{dp} > 0$, implying that an increase in the price of the capital intensive output leads to a decrease in the wage and an increase in the price of capital. Intuitively, as the price of the capital intensive good increases, the capital intensive sector expands and the labour intensive sector shrinks. Not all labour freed up from the labour intensive sector can be rehired in the capital intensive sector at the same factor prices, as labour is relatively less productive in the latter sector, and wages decrease.

To examine the effect of an increase in the price of the capital intensive output on the size of the expropriation sector (measured by L_A), (9) can be written as:

$$A(L_A) = \frac{1}{\frac{r}{w}\bar{K} + \bar{L}} L_A$$

From the implicit function theorem, we know that that it is possible to express L_A as a function of p. Differentiating this function with respect to p, we obtain:

$$\frac{dL_A}{dp} = -\frac{\frac{\bar{K}L_A}{(\frac{r}{w}\bar{K}+\bar{L})^2}\frac{d(\frac{r}{w})}{dp}}{A' - \frac{1}{\frac{r}{w}\bar{K}+\bar{L}}}$$

which can be shown to be positive, as $\frac{d\frac{r}{w}}{dp} > 0$ and A is concave. The result of this model is that conflict (as measured by the size of the expropriation sector) increases with the price of the capital intensive resource. Conversely, conflict decreases in the price of the labour intensive resource.

Intuitively, as the price of the capital intensive resource increases, wages in the productive sector go down, decreasing the opportunity costs of allocating labour to the expropriation sector compared to the total value of production that can potentially be expropriated.

Using (7) and (8) it is possible to write q_1 and q_2 as a function of L_A and show that the production of the capital intensive good increases in the size of the expropriation sector, whilst production in the labour intensive sector decreases in L_A. Dal Bó and Dal Bó (2004) remark that the endogeneity of production to expropriation poses a challenge to empirical research attempting to estimate the impact of natural resources on conflict.

This model is tested in the context of Columbia by Dube and Vargas (2009), using an empirical set-up similar to the one employed in this paper. They investigate the impact of variation in the international prices of coffee (a resource they assume to be labour intensive) and oil (capital intensive) on the intensity of violence in oil and coffee producing districts of Columbia. They find that the interaction between international coffee price and a dummy indicating a coffee-producing district is negatively related to conflict intensity, while the interaction between oil price and an oil-producer dummy is positively related to violence. This result is robust to instrumenting for the oil and coffee-producer dummy using climatic variables and to instrumenting for coffee price using the export volume of other large coffee producers.

2.3 Besley and Persson: the 'prize' of government and the returns to conflict

As neither of the above models contains a government, this section will briefly describe a model that does, by Besley and Persson (2008). It predicts that an increase in the export price of natural resources increases conflict over government, because it increases the value of being the incumbent.

Besley and Persson model a country with two groups of equal size, living for various periods. At the start of each period, one group is the incumbent and the other the opposition. Timing is roughly as follows. (1) The value of natural resource rents that the incumbent group will receive at the end of the period is exogenously determined. (2) Both groups choose the size of their army. Costs of an army consist exclusively of labour costs. The incumbent can use public funds to finance the army; the opposition must tax its own group. (3) The incumbent group stays in power with some probability. This probability decreases in the size of the opposision army and increases in the size of the incumbent army. (4) The winning group determines policies; how natural resource rents are spent. The advantage of being the incumbent is that this group could possibly transfer more to itself than to the opposition group. The extent to which this is possible is constraint by institutions: the 'best' institutions require transfers to the incumbent's group and the opposition group to be equal. (5) Payoffs are realized.

When choosing a level of armament, groups maximize their own-group expected payoff. Intuitively, groups choose to arm when the advantage of being the incumbent weighted by the probability of obtaining government power given the size of the army, outweighs the costs of raising such an army. This will happen at a lower level of 'incumbent advantage' for the original incumbent: it has a cost advantage in arming because it can use public funds to pay for the army. Therefore, three situations are possible: no group decides to raise an army (peace), only the incumbent raises an army (repression) or both groups arm (civil war). Since the 'incumbent advantage' depends positively on the flow of resource income and negatively on the quality of institutions, the chance of conflict increases in the export price of natural resources and decreases in the quality of institutions. Besley and Persson conclude furthermore that the chance of conflict increases in the price of natural resources imported, as this decreases the wage rate and thereby the costs of raising an army.

Besley and Persson (2008) test their theoretical model in the same paper. Using a model with time- and country-fixed effects, they find that country-specific export and import prices of natural resources are indeed related to the incidence of conflict. Disaggregating resource prices, it seems that this result is driven by agricultural products' export and import prices and mineral and oil import prices. Mineral and oil export prices are not related to conflict incidence. Besley and Persson fail to find similar results in a cross-country setting, which they conclude is unsurprising given the problems associated with cross-country analyses.

3 Data and methodology

3.1 Diamonds: some geology, predictions and data

In light of the previous sections, diamonds are an interesting resource to investigate for two reasons. First, the distinction between primary and secondary diamonds enables testing empirically the mechanisms connecting resources and war identified by Dal Bó and Dal Bó (2004) and Garfinkel et al. (2008), as their models make opposite predictions on whether primary or secondary diamonds are positively related to conflict. Secondly, diamonds are found according to geological regularities, making it possible to use geological data to construct an exogenous measure of diamond abundance. Some geology of diamonds will illustrate both points.

Diamonds were formed deep beneath the earth's surface in the early phases of earth formation, over 1500 million years ago. They are transported to minable depths by two much younger types of 'host rock', kimberlite and lamproite. Between formation and transportation, tectonic activity has reformed large regions of the earth, destroying the diamonds in the process. Diamond have survived only in geological areas that have been stable for the last 1500 million years, a regularity that has become known as 'Cliffords rule' (Clifford,

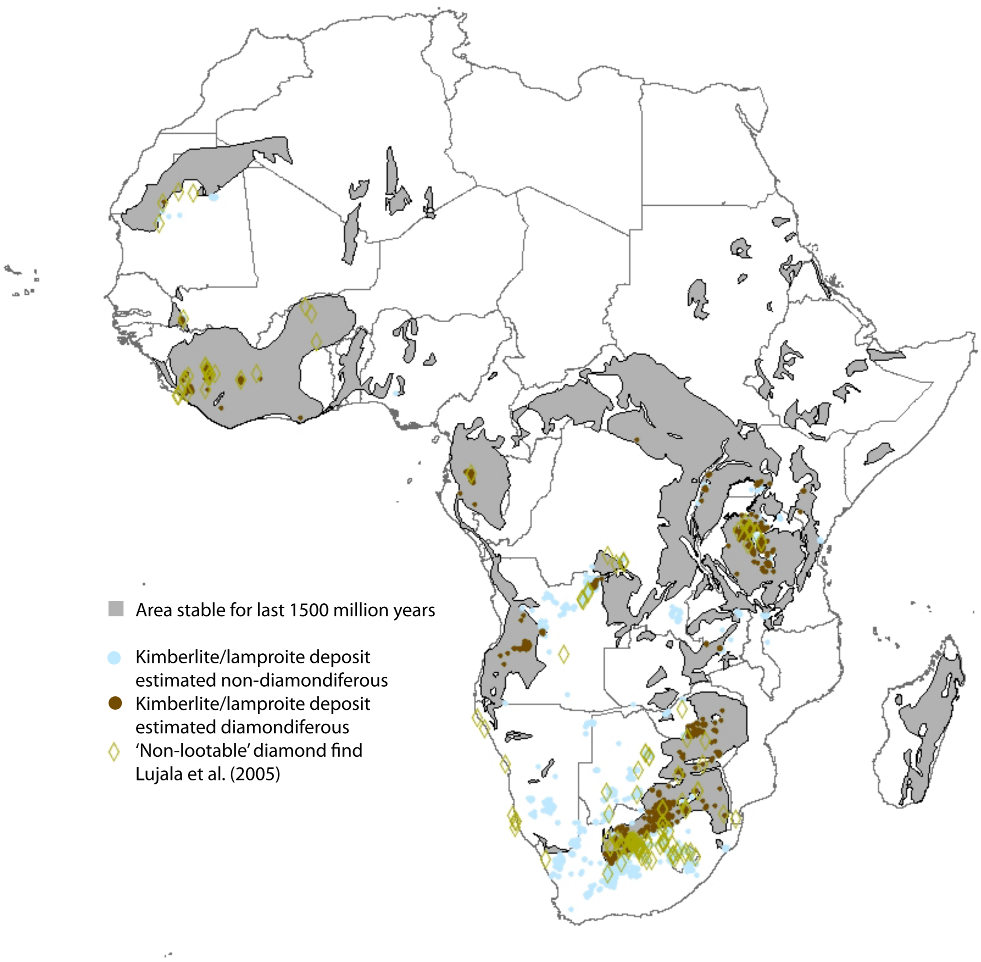
1966) (validity of which has been confirmed more recently by Janse and Sheahan (1995)). Minable primary diamond deposits are thus likely to occur where such a surviving source of diamonds and a transport medium (kimberlite or lamproite host rock) coincide (Helmstaedt and Gurney, 1995). Primary diamonds can be mined directly from kimberlite and lamproite pipes, which involves excavating and crushing large section of host rock to extract the diamonds. The production process of primary diamonds can therefore be considered capital-intensive. Because kimberlite and lamproite occur in pipes with a relatively small diameter (a few hundred meters to a kilometre) property rights over a primary diamonds are relatively easy to protect, at least compared to secondary diamonds.

Secondary diamonds are eroded and moved away from the host rock by rivers, sea, wind or a glacier. The latter two are of little importance to this research: there is only one economically viable aeolian diamond deposit (in Namibia) and glacial deposits are only of scientific interest (Marshall and Baxter-Brown, 1995). Viable deposits of diamond can be found as far away as 600 km from the original source. Although it may seem intuitive, it is not the case that deposits closer to the source are necessarily most interesting economically. Diamonds found do decrease in size further away from the source, but their quality increases as inferior diamonds get destroyed during transport and the diamonds are more rounded leading to less weight loss during the cutting process (Sutherland, 1982). Furthermore, the diamond grade of the deposit is at least as important as the quality and size of individual diamonds. 'Trap sites' (often in river bends with a hard bedrock), where relatively large amounts of diamonds are concentrated are most interesting to exploit. An ideal site is one where a young river samples an older river bed, sorting the diamonds further from other stones. On balance, the most economically significant deposits are found off-craton (outside the zones Clifford identifies) and secondary diamond deposits need not be close to a viable primary source (Marshall and Baxter-Brown, 1995). Secondary diamonds can be extracted with very basic means, manually sorting ordinary stones from diamonds. As they are often found in rivers spread over a relatively large territory, secondary diamonds display some characteristics of an open access resource and property rights are hard to protect. As Marshall and Baxter-Brown (1995) put it: "alluvial diamond mining is the preserve of the individual digger, or small private company or operator".

Thus, we have capital intensive primary diamonds with relatively secure property rights and labour intensive secondary diamonds with insecure property rights. According to the theoretical framework by Garfinkel et al. (2008), who emphasize the 'contestedness' of resources as a mechanism, the value of secondary diamonds would be related to conflict intensity, but primary diamond price less so. In contrast, the model by Dal Bó and Dal Bó (2004), in which the capital or labour intensiveness of the production process is central, predicts that primary diamond price is positively related to the intensity of violence, whilst secondary diamond price is negatively related. This provides a clear way to distinguish between the mechanisms both models identify.

The geological regularities in where diamonds are found can be used to construct an exogenous measure of diamond abundance. To predict an area's abundance in primary diamonds, I use the CONSOREM database of all know world kimberlite and lamproite occurrences (Faure, 2006) and information on the age of the bedrock compiled by the Geological Survey of Canada (GSC) (Chorlton, 2007). I select those areas older than 15 million years[2], as suggested by Clifford and then select those kimberlite or lamproite deposits that coincide with these regions. The number of these intersections in a given country is the measure of primary diamond abundance used. This is illustrated graphically in Figure 1, along with the Lujala et al. (2005) locations of 'non-lootable' diamond production.

Figure 1: Primary diamond abundance



As we can see, there is considerable overlap, making it reasonable to believe that the measure constructed indeed captures primary diamond abundance. Eighteen African coun-

[2]Areas classified by GSC as of an age between eo-Archean and Pealeo-Mesoproterozoic.

tries[3] are classified as having some primary diamonds, which is in congruence with geological knowledge (Janse and Sheahan (1995) list 16 countries where primary diamonds occur).

To measure secondary diamond abundance, one would ideally want to have information on erosion channels since the formation of kimberlite and lamproite. Unfortunately, this is not available. Data on modern rivers does exist (Global Runoff Data Centre, 2007), although modern rivers do not necessarily coincide with older ones. However, since we know how far meaningful deposits of secondary diamonds can be removed from the source, and that deposits are most concentrated where younger rivers sample old river beds, I employ the following strategy. I select all sections of modern rivers that are within a 600 mile radius of a predicted primary diamond source. The total length of all these segments in a given country is a measure of secondary diamond abundance. Visually, this again coincides reasonably within secondary diamond production (see Figure 2). This measure predicts 37 African countries to have some secondary diamonds. This is more than Janse and Sheahan (1995) record, which likely reflects both some inaccuracies in my secondary diamond measure and the fact that secondary diamond finds are harder to record.

Table 1 shows that the constructed measures of diamond abundance are correlated reasonably strongly with the dummy variables for primary and secondary diamond production Lujala et al. (2005) use. Predicted secondary diamond abundance is significantly correlated with estimates of the total quantity of diamonds minded by Humphreys (2005), but primary diamond abundance is not. This fact is not easily explained, especially since the exact opposite applies to the Lujala et al. indicators for primary and secondary diamonds.

To sum up, there is considerable evidence that the measures constructed indeed capture primary and secondary diamond abundance. These measures will be used to test the different predictions of the models by Dal Bó and Dal Bó and Garfinkel et al. described.

3.2 Methodology

I estimate the following model:

$$\text{VIOLENCE}_{ct} = \beta_1 \text{PRIM}_c \times \text{PRICE}_t + \beta_2 \text{SEC}_c \times \text{PRICE}_t + \beta_3 \text{PRICE}_t + \beta_4 X_{ct} + \alpha_c + \varepsilon_{ct} \qquad (10)$$

where the dependent variable is the number of violent events in country c in period t (I experiment with various period lengths, so the period may be a month, quarter or year), PRIM_c and SEC_c represent the predicted primary and secondary diamond abundance of country c as described in section 3.1, PRICE_t is the nominal price of diamonds on the international market in period t and X_{ct} is a vector of country-period specific control variables, always including GDP per capita and population size and either the inflation level or exchange rate of the national currency against the US $. The latter two are included because the same nominal price of diamonds in dollars may provide a stronger incentive for conflict

[3] Angola, Boswana, Cote d'Ivoire, DRC, Gabon, Ghana, Guinea, Kenya, Liberia, Mali, Mauritania, Sierra Leone, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

Figure 2: Secondary diamond abundance

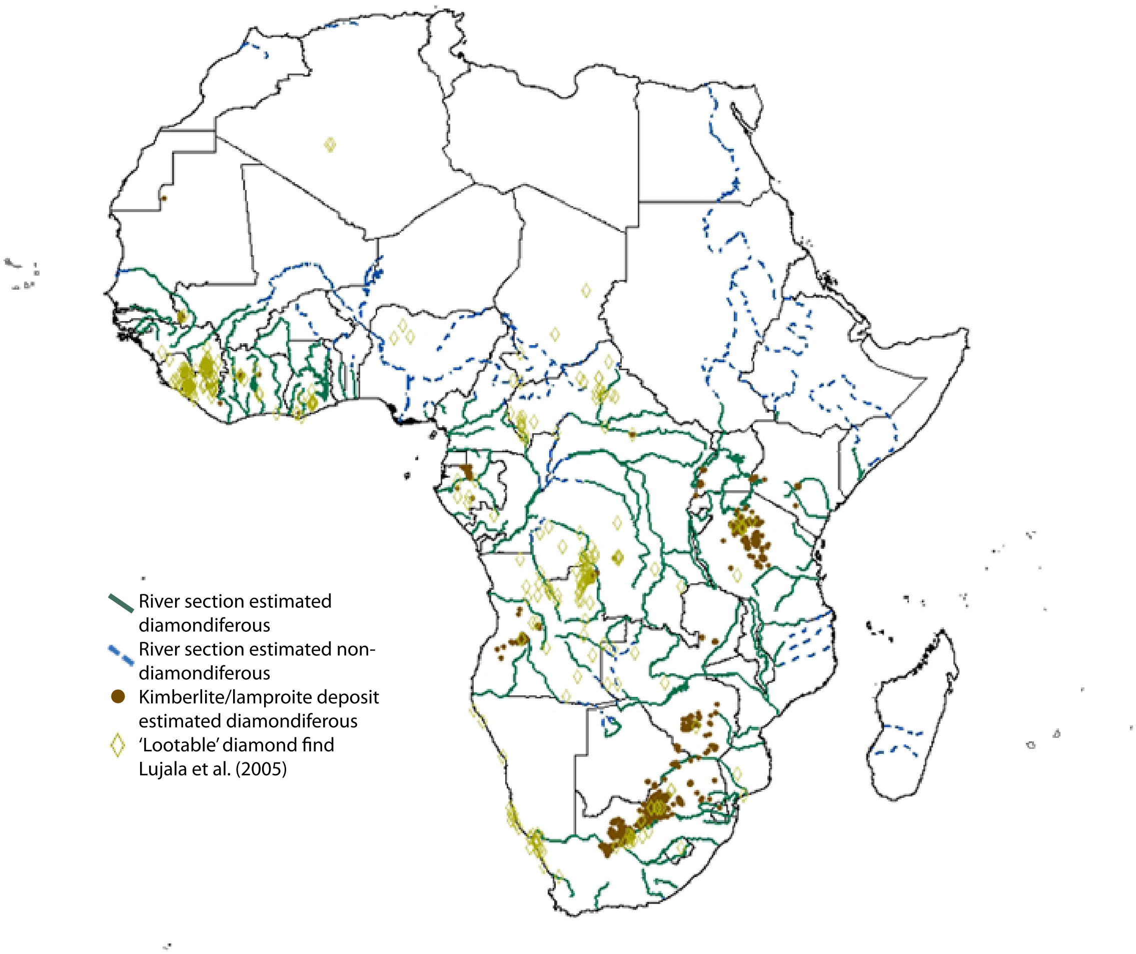


Table 1: Correlation coefficients for various measures of diamond abundance

	Primary diamond abundance	Lujala et al. primary diamond dummy	Humphreys quantity of diamonds mined
Primary diamond abundance	1.0000		
Lujala et al. primary diamond dummy	0.4297*** (0.0023)	1.0000	
Humphreys quantity of diamonds mined	-0.0216 (0.8866)	0.3542** (0.0157)	1.0000

	Second. diamond abundance	Lujala et al. second. diamond dummy	Humphreys quantity of diamonds mined
Second. diamond abundance	1.0000		
Lujala et al. second. diamond dummy	0.4644*** (0.0009)	1.0000	
Humphreys quantity of diamonds mined	0.5544*** (0.0001)	0.1393 (0.3559)	1.0000

p-values in parentheses

*** p<0.01, ** p<0.05, * p<0.1

For Lujala et al. and Humphreys data, values for the latest year available are used in a country with high inflation or a weak exchange rate. I include country-fixed effects. Standard errors are clustered at the country level.

This allows testing the hypotheses derived from the theoretical models in sections 2.1 and 2.2. The model by Garfinkel et al. suggests that β_2 is larger than 0 and significant and β_1 is insignificant. By contrast, Dal Bó and Dal Bó's model predicts β_1 to be positive and significant and β_2 to be negative and significant.

Bearing the criticisms on earlier studies on diamonds and conflict in mind, I include country-fixed effects, thereby using only within-country variation. This eliminates concerns about country-specific time-invariant characteristics that may impact both diamond abundance and violence. The use of an interaction term between diamond abundance and diamond price mitigates concerns about time-specific factors driving both diamond price and violence (the state of the world economy is an obvious one that comes to mind). Such factors would only constitute a problem to the analysis if these influence the level of violence more strongly in diamond abundant countries than in countries without diamonds. Intuitively, the analysis is analogous to examining the effect of a treatment (a change in diamond price) on a treated group (those countries with diamonds) and a control group (countries without diamonds).

3.3 Data

In addition to the indicators for diamond abundance, I use the following data. The intensity of violence is measured by the number of violent events as recorded by the Armed Conflict Location and Event Dataset (ACLED) (Raleigh and Hegre, 2005). This dataset contains data conflict events in the period January 1997–July 2010, including the date of occurrence and geographic location and distinguishes between eight types of events: (1) violence against civilians; (2) battle - no change of territory; (3) battle - government regains territory; (4) battle - rebels overtake territory; (5) riots/protests; (6) non-violent activity by a conflict actor; (7) headquarters or base established; (8) non-violent transfer of territory. My default indicator of the intensity of violence is the number of events of the first four types; events six through eight are clearly not violent, and riots and protests not necessarily so. Because one may or may not believe that riots and protests are driven by the same factors as other types of violence, I also run some regressions including riots and protests in the indicator for conflict intensity. Data on conflict events is only systematically available for Africa, limiting the sample to African countries. This continent is also the largest single producer of diamonds, amounting to over half of world production (Janse and Sheahan, 1995), making this limitation to the sample acceptable.

With regard to diamond prices, I would ideally like to have data on the price of rough (unpolished) diamonds. However, the structure of the diamond market makes it extremely difficult to obtain this data. The Central Selling Organisation (CSO), a branch of De Beers, controls 75% of the market for rough diamonds and sales take place during non-public 'sightings' rather than through the open market, an altogether rather secretive process

(Saldern, 1992; Yoeli, 2003; Spar, 2006). Data on polished diamonds is publicly available. Since rough diamonds are an important input in the production of polished diamonds, it seems reasonable to use polished diamond prices as a proxy for rough diamond price in the analysis. As a check, I also use the value per carat of rough diamond exports of the countries signatory to the Kimberley process as an indicator of rough diamond price (which is only available quarterly and for the period 2004 to 2009).

I obtain data on the market closing price of polished diamonds of different sizes (0.3 to 3 carats), colours and clarities through Datastream. Because I do not have an *a priori* reason to believe that one particular type of diamond is most strongly associated with conflict or that one type is representative of all diamonds in general, I use principal component analysis to extract a common factor from all available diamond prices. This factor has an eigenvalue of 8.3523 and it captures approximately 42% of variation in individual prices. A cursory look at the factor weights suggests that the prices of larger diamonds (1-3 carats) receive a larger weight than the price of smaller diamonds. The common factor thus obtained is the indicator for diamond price used in the subsequent analysis. Alternatively, I use the 'polished prices diamond price index', also obtained through Datastream. However, since it is unclear through what method the makers arrive at this index, this is not the main source of data used. Data on diamond price is only available from 2002, limiting the research period to January 2002-July 2010. Since Datastream provides data diamond price on a daily basis, it is possible to calculate the average diamond price by month, quarter and year.

Data on GDP per capita in constant prices and on population size is taken from the World Development Indicators and is recorded on a yearly basis. Consumer Price Index (CPI) and exchange rate of the local currency to the US $ are taken from the IMF International Financial Statistics and Datastream respectively. The average per month, quarter and year is either available or can be calculated using these sources.

4 Results

Table 2 displays the results of running regression (10), using the data described. Because I have no *a priori* beliefs about the time frame within which diamond price would influence conflict activity, I use monthly, quarterly and yearly data in columns (1), (2) and (3) respectively. In these regressions, the coefficient on the interaction between primary diamond abundance and diamond price is consistently significant and positive. By contrast, the interaction term including secondary diamond abundance is not significantly related to conflict activity and its coefficient has a negative sign in all regressions. This would indicate that an increase in diamond price leads to an increase in violence in countries that are abundant in primary diamonds, but does not affect (or if anything affects negatively) conflict activity in countries with secondary diamonds. This lends support to the theoretical model by Dal Bó and Dal Bó (2004), illustrating how an increase in the price of a capital intensive resource leads to a decrease in the wage rate and decreased costs of conflict. This

Table 2: Basic results

VARIABLES	(1) Monthly FE	(2) Quarterly FE	(3) Yearly FE	(4) Monthly FE	(5) Monthly FE
Prim. diamonds	0.0126**	0.0424**	0.168**	0.0136**	0.0136**
* diamond price	(0.00560)	(0.0181)	(0.0820)	(0.00619)	(0.00570)
Second. diamonds	-0.0209	-0.0747	-0.242	-0.0161	-0.0222
* diamond price	(0.0168)	(0.0522)	(0.251)	(0.0172)	(0.0178)
Diamond price	-0.148	-0.474	-1.509	-0.142	-0.0685
	(0.347)	(1.135)	(5.181)	(0.371)	(0.369)
GDP	0.00699	0.0214	0.0657	0.00724	0.00579
	(0.0117)	(0.0360)	(0.147)	(0.0127)	(0.0127)
Population	-0.118	-0.317	-1.676	-0.118	-0.135
	(0.204)	(0.609)	(2.545)	(0.190)	(0.208)
Exchange rate	-3.53e-05	-4.86e-05	-0.00129	-2.97e-05	
	(0.000579)	(0.00180)	(0.00745)	(0.000748)	
CPI					-0.000691***
					(4.84e-06)
Dependent incl./ excl. protests	Excl.	Excl.	Excl.	Incl.	Excl.
Observations	4193	1397	349	4193	4098
# countries	44	44	44	44	44

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

model's prediction that the price of labour intensive secondary diamonds is negatively related to conflict is less strongly supported by these results. These results are consistent with those obtained by Dube and Vargas (2009).

None of the control variables enters regressions (1)-(3) significantly. The coefficient on diamond price is consistently negative, which is expected if we believe that the diamonds price to a certain extent reflects the state of the world economy and that conflict is less likely in more favourable economic conditions. The signs of the coefficients on GDP and population are surprising (we would expect GDP to be negatively related to conflict and population size positively), but insignificant. Finally, the exchange rate enters the regression with a negative coefficient, confirming the presupposition that the same nominal diamond price would form less of an incentive for conflict in countries with a highly valued exchange rate.

The results in the first three columns are not sensitive to changing the dependent variable to include the conflict event type 'riots and protests' (column 4). Nor do the results change when I include the CPI instead of the exchange rate of the local currency (column 5). Similar results are obtained when using quarterly and yearly data (not shown). I do not use the CPI in the subsequent regressions, because it contains a number of outliers (notably Zimbabwe), which may be the reason why its coefficient is strongly significant.

A disadvantage of controlling for either the exchange rate of the CPI is that two countries are dropped: Eritrea and Liberia. The latter seems especially problematic, since it is associated with both secondary diamonds and conflict. However, results do not change qualitatively when not including either CPI or exchange rate, allowing both countries back into the sample.

In Table 3, I experiment with different diamond prices: a diamond price index (available on a monthly, quarterly and yearly basis) and the value per carat of the exports of signatories to the Kimberly Process (KP), only available quarterly. The interaction term between primary diamond abundance and diamond price is no longer significant in regressions (1) and (3), although the sign does not change. Overall however, a picture similar to that in table 2 emerges: a diamond price rise increases conflict activity in areas with primary diamonds, but is unrelated to violence in areas abundant in secondary diamonds, supporting the Dal Bó and Dal Bó model. The results thus do not seem to be driven solely by the choice of the indicator for diamond price.

5 Robustness

5.1 Endogeneity of diamond price

One concern with the results in the previous section may be that the diamond price is endogenous: it may increase as a result of conflict activity in diamond abundant areas as opposed to violence in these areas increasing because diamonds become more valuable. Although this seems reasonable at first sight, a look at production numbers and the structure of the diamond market casts doubt on whether diamond-abundant countries in conflict have a market position such as to meaningfully influence the diamond price. In 2003, four out of the world's five largest diamond producers, both by volume[4] and by value[5] of production, have been peaceful over the entire research period (Spar, 2006). Furthermore, it is universally accepted that the diamond price is to a large extent determined by De Beers, through its cartel (the CSO). It seems reasonable to believe that supply conditions impact the diamond price less than the strength of the market position of De Beers (which has re-

[4]Largest producers by volume (% of world production): Australia (22%), Botswana (22%), DRC (18%), Russia (13%), South Africa (9%).

[5]Largest producers by value (% of world production): Botswana (26%), Russia (18%), Canada (15%), South Africa (11%), Angola (10%).

Table 3: Different diamond prices

VARIABLES	(1) Monthly FE	(2) Quarterly FE	(3) Quarterly FE	(4) Yearly FE
Prim. diamonds *	0.0561	0.195*		0.803*
diamond price index	(0.0356)	(0.104)		(0.437)
Second. diamonds *	-0.101	-0.439		-1.909
diamond price index	(0.183)	(0.519)		(2.127)
Diamond price index	-2.824	-8.411		-30.58
	(3.417)	(10.43)		(43.82)
Prim. diamonds *			0.0154	
KP export value p/crt			(0.0142)	
Second. diamonds *			-0.000956	
KP export value p/crt			(0.0169)	
KP export value p/crt			-0.00832	
			(0.538)	
Controls include GDP, population and XCR	YES	YES	YES	YES
Observations	4193	1397	1045	349
# Countries	44	44	44	44

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

cently been threatened by diamond extracting companies in Russia, Australia and Canada operating increasingly independently) (Bergenstock and Maskulka, 2001; Spar, 2006; Yoeli, 2003).

Despite these arguments the reader may not convinced, and believe that supply conditions do influence diamond price. Therefore, I instrument for diamond price using the lagged export volume of the largest peaceful diamond producers, following a strategy suggested by Dube and Vargas (2009). The assumption here is that the previous period rough diamond export volume of these peaceful countries is correlated to current international polished diamond price, but not influenced by current violence in other diamond-abundant countries. The variables $\text{PRIM}_c \times \text{PRICE}_t$, $\text{SEC}_c \times \text{PRICE}_t$ and PRICE_t in regression (10) are treated as endogenous and instrumented for using $\text{PRIM}_c \times \text{EXP}_{kt-1}$, $\text{SEC}_c \times \text{EXP}_{kt-1}$ and EXP_{kt-1}, where EXP_{kt} is the export volume of rough diamonds in carats of large peaceful exporter k in period t taken from the Kimberly Process Statistics. Because these are only available quarterly for the period 2004-2009, I only estimate quarterly models and loose a considerable number of observations. Countries included are Australia, Botswana, Canada, Russia and South Africa. In case there is a worry that diamond export from Botswana and South Africa is not exogenous to violence in other African countries (one might for example suspect that diamonds from conflict countries are smuggled across the border and are exported as if they were mined in Botswana or South Africa), I also run some regressions including only the export volume of Australia, Canada and Russia in the instruments. Both combinations of instruments pass standard overidentification tests. Instruments give acceptable R^2's for the first stage (in the range 0.31 to 0.47) and F-statistics comfortably over 10 [6], giving confidence that the instruments indeed explain part of the variation in the endogenous variables and suggesting no weak instruments.

Table 4 reports the results of this exercise. Column (1) shows that instrumenting for diamond price does not meaningfully change the size and sign of the coefficients of interest: the interaction between primary diamond abundance and diamond price is still positively related to violence, whilst the sign of the coefficient on the interaction term including secondary diamond abundance is negative. Compared to the results in table 2 column (2) however, the former looses and the latter gains significance. Although I can offer no intuitive explanation for the changes in significance level, IV-regression does not provide convincing evidence to support the concern that the basic results are driven by reversed causality and in fact strengthens the result on secondary diamonds. The result that an increase in the price of diamonds leads to a decrease in violence in areas abundant in secondary diamonds again conforms to the predictions of Dal Bó and Dal Bó (2004).

When using different diamond prices, similar results are obtained using the value of diamonds taken from the Kimberley Process Statistics (column 3). However, using the diamond price index produces insignificant coefficients on the variables of interest and

[6] with the exception of the interaction between primary diamond abundance and diamond price in regression (2) of table 4

Table 4: Instrumenting for diamond price

VARIABLES	(1) Quarterly IV	(2) Quarterly IV	(3) Quarterly IV	(4) Quarterly IV	(5) Quarterly IV
Prim. diamonds *	0.0416			0.0592*	
diamond price	(0.0272)			(0.0334)	
Second. diamonds *	-0.0485*			-0.0800**	
diamond price	(0.0266)			(0.0320)	
Diamond price	0.349			0.117	
	(0.938)			(0.902)	
Prim. diamonds *		-0.270			
diamond price index		(0.255)			
Second. diamonds *		-0.0304			
diamond price index		(0.315)			
Diamond price index		4.137			
		(11.87)			
Prim. diamonds *			0.0339		0.0436*
KP export value p/crt			(0.0223)		(0.0253)
Second. diamonds *			-0.0400**		-0.0582**
KP export value p/crt			(0.0200)		(0.0233)
KP export value p/crt			0.237		0.128
			(0.842)		(0.808)
Instrument: lagged production	Aus. Botsw. Can. Rus. SA	Aus. Botsw. Can. Rus. SA	Aus. Botsw. Can. Rus. SA	Aus. Can. Rus.	Aus. Can. Rus.
Controls include GDP, population and XCR	YES	YES	YES	YES	YES
Observations	1001	1001	1001	1001	1001
# Countries	44	44	44	44	44

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

an unexpected sign on the interaction between primary diamond abundance and price (column 2).

In the final two columns of table 4, I use a different set of instruments as to only include the export of Australia, Canada and Russia. Doing so actually strengthens the results obtained earlier, with all coefficients of interest now significant and of the expected sign. This does not support the idea that conflict in African countries is somehow related to increased diamond exports of Botswana and South Africa. It may even be that violence in Africa decreases diamond exports of these countries, for example through damaging infrastructure or, more likely, because customers prefer to buy 'guaranteed conflict free' diamonds from elsewhere at times when violence in Africa increases public awareness of 'blood diamonds'. Although this is speculative, it would bias the coefficients in columns (1)-(3) downwards, explaining the 'jump' in significance in the last two columns.

In sum: instrumenting for diamond price does not provide convincing evidence that the basic results follow from endogeneity of the diamond price to conflict in diamond abundant areas.

5.2 Cyclical effects and other resources

Another potential concern may be that diamond prices and violence are prone to similar cyclical effects, biasing the results. It is known that over a quarter of all retail sales of diamonds take place in December. These spikes in demand may increase diamond price in specific periods of the year, although not necessarily, given efforts to smooth the diamond price by the Beers and competition amongst retailers (Yoeli, 2003). If violence in diamond abundant areas is during the same months (for example for reasons related to climate) this could possibly create a spurious correlation between violence and diamond price.

To control for this, I include a full set of month and quarter dummies respectively in the basic monthly and quarterly models. As can be seen in Table 5, columns (1) and (2), this does not affect the results.

The results may also be biased if the presence of diamonds is correlated to the presence of other resources and the prices of those resources and the diamond price co-vary. In this case, part of the increase in violent that has been ascribed to the increasing value of diamonds might in reality be due to other resources simultaneously becoming more valuable. This concern seems especially pressing for primary diamonds, as Clifford suggests that not only primary diamonds occurrence, but also the occurrence of numerous other resources is confined to areas that have been geologically stable for the past 1500 years (Archeons) (Clifford, 1966).

In order to control for this, I include indicators for the abundance of a country in other resources, interacted with diamond price. I distinguish four categories of other resources: oil, gas, minerals Clifford identifies as on-Archeon and those he considers off-Archeon. Data on proven oil and gas reserves in billions of barrels and cubic feet respectively are drawn from the Oil and Gas Journal. US Geological Survey provides a database of occur-

Table 5: Controlling for cycical effects and the presence of other resources

VARIABLES	(1) Monthly FE	(2) Quarterly FE	(3) Monthly FE	(4) Quarterly FE	(5) Yearly FE
Prim. diamonds * diamond price	0.0127**	0.0424**	0.00431	0.0155	0.0450
	(0.00560)	(0.0181)	(0.00345)	(0.0108)	(0.0537)
Second. diamonds * diamond price	-0.0208	-0.0746	-0.0178	-0.0645	-0.182
	(0.0169)	(0.0524)	(0.0145)	(0.0450)	(0.217)
Diamond price	-0.102	-0.402	-0.297	-0.906	-3.034
	(0.370)	(1.205)	(0.446)	(1.451)	(6.460)
On-Archeon minerals * diamond price			0.00801***	0.0267***	0.133***
			(0.00226)	(0.00734)	(0.0371)
Off-Archeon minerals * diamond price			0.00327	0.00817	0.0104
			(0.00497)	(0.0165)	(0.0766)
Oil reserves * diamond price			0.00183	0.00662	0.0243
			(0.00266)	(0.00912)	(0.0412)
Gas reserves * diamond price			0.00463	0.0141	0.0946
			(0.00572)	(0.0195)	(0.106)
Includes full set of month/quarter dummies	YES	YES	NO	NO	NO
Controls include GDP, population and XCR	YES	YES	YES	YES	YES
Observations	4193	1397	4193	1397	349
# Countries	44	44	44	44	44

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

rences of a wide range of minerals (Survey, 2005). The total number of deposits in a country classified as containing one of Clifford's on-Archeon minerals (gold, platinum, iron, asbestos or chromium) as 'major commodity' is taken to be an indicator for the on-Archeon mineral abundance. The total number of deposits coded as having some other mineral (excluding diamonds)[7] as 'major commodity' forms the indicator for off-Archeon mineral abundance. I do not distinguish according to development status of the deposit (occurrence only, prospect producer, producer, post producer), again because resource production may be endogenous to the model.

The last three columns of Table 5 include interaction terms between these four categories of resources and diamond price. As can be seen, there is evidence that the earlier results indeed partially captured the impact of price increases of other resources that occur in the same areas as diamonds (on-Archeon resources). The interaction term including on-Archeon minerals is highly significant in all three models and its inclusion causes the coefficient on primary diamond abundance times diamond price to lose significance and decrease considerably in size. The signs with which the interactions including primary and secondary diamonds enter the regression remain unchanged. The terms including the other minerals enter the regressions positively yet not significantly.

The earlier results are clearly not robust to controlling for the presence of other resources. If a rise in diamond price spurs conflict activity in diamond abundant areas, it seems to do so only as part of a price increase of numerous resources occurring in the same areas. This however does not necessarily invalidate the conclusion that the theoretical model by Dal Bó and Dal Bó fits the data better than that by Garfinkel et al. The production processes of gold, platinum, iron, asbestos and chromium can also be considered capital intensive and the former model would predict that an increase in the price of these resources is related to more violent activity. None of these resources seem characterized by particularly weak property rights. The evidence for the wage rate as the channel connecting resource price and violence still seems more convincing than weak property rights.

5.3 Mechanisms: wage rate versus the 'prize' of government

However, Besley and Persson (2008) offer an alternative explanation for the results obtained throughout this paper. An increase in the price of capital intensive resources with relatively strong property rights may not be connected to increased violence because it depresses the wage rate, but because it increases the exogenous revenue the government can spend at its own discretion, thereby raising the expected returns to fighting over government. In the case of diamonds, one would expect primary diamonds to provide a larger flow of government revenue than secondary diamonds; precisely because property rights over primary diamonds are better protected is it easier for the government to obtain a por-

[7] These minerals include: Aluminum, Antimony, Barium, Beryllium, Cobalt, Copper, Gemstone, Graphite, Lead, Manganese, Mercuty, Nickel, Silver, Tin, Titanium Uranium and Zinc. I exclude deposits containing only Clay, Limestone, Salt, Stone or Talc-soapstone as major commodity.

tion of the rents from extraction, whether through taxation, a concession for extraction or extraction by a state-owned enterprise. This would also explain the result that the diamond price is connected to increased violence in areas that are abundant in primary diamonds, but not in those with secondary diamonds. Similarly, we can also expect other capital intensive resources to provide substantial revenue flows to the government, again providing an alternative explanation for the results in the previous section.

The most straightforward way to test between these two competing mechanisms, wages versus the prize of obtaining government, would be to control for the wage rate. However, to the best of my knowledge, reliable data on the wage rate in African countries is not available. Therefore, I employ a different strategy. If the wage rate is the relevant mechanism, we would expect violence in resource abundant areas to increase as a result of an increase in the price of a capital-intensive resource; unless labour is fully mobile, the wage rate decreases most in areas where resource production takes place. On the other hand, if the prize of government is the relevant mechanism, we would expect violence in the capital, where the government sits, to increase most strongly.

To test this, I construct two new dependent variables: violence in diamond abundant provinces and violence in the capital. The former is the number of violent events in ACLED that according to the geographic coordinates took place in a province (or comparable administrative unit) that has at least one kimberlite or lamproite deposit that is estimated to be potentially diamondiferous. The latter is the number of violent events that ACLED codes as having taken place in the legislative capital of a country.

Table 6, columns (1) and (2) show the results of using these two dependent variables in the baseline regression. As can be seen, this provides no clear evidence on which mechanism is most strongly supported by the data, as the interaction term between primary diamond and diamond price enters both regressions insignificantly. If anything, it provides some weak support for the wage mechanism, as the coefficient on the interaction term between primary diamond abundance and diamond price has the expected sign in regression (1).

From the previous section, it is clear that the interaction term between primary diamond abundance and diamond price to a considerable extent captures the effect of price changes of other resources occurring in the same area. The impact of price change of other capital-intensive resources with relatively secure property right can equally be explained by both Dal Bó and Dal Bós and Besley and Persson's model. To distinguish between both explanations, I also include the four interaction terms between diamond price and abundance of other resources in the regression run in column (1) and (2) of table 6. The results in column (3) and (4) show that the interaction term including on Archeon minerals is significantly and positively related to violence in areas abundant in primary diamonds (and supposedly other on-Archeon minerals), but not significantly related to violence in the capital. The coefficient on this interaction term even carries a negative sign in regression (4). Although by no means conclusive, these results provide suggestive evidence in favour of the wage

Table 6: Mechanisms

VARIABLES	(1) Monthly FE	(2) Monthly FE	(3) Monthly FE	(4) Monthly FE
Prim. diamonds * diamond price	0.00174 (0.00104)	-2.00e-05 (0.000154)	-1.52e-05 (4.69e-05)	0.000101 (0.000221)
Second. diamonds * diamond price	-0.000216 (0.000458)	-0.000282 (0.000919)	-0.000264 (0.000298)	-0.000514 (0.000971)
Diamond price	-0.00941 (0.0106)	0.00809 (0.0370)	-0.00599 (0.00691)	-0.00514 (0.0465)
On-Archeon minerals * diamond price			0.00202*** (5.05e-05)	-0.000526 (0.000424)
Off-Archeon minerals * diamond price			-0.000187 (0.000128)	0.000981 (0.000861)
Oil reserves * diamond price			2.69e-05 (3.90e-05)	7.61e-05 (0.000214)
Gas reserves * diamond price			-0.000308 (0.000204)	-0.000481 (0.000675)
Dependent: violent events excl. protests in:	Diamond provinces	Capital	Diamond provinces	Capital
Controls include GDP, population and XCR	YES	YES	YES	YES
# Countries	44	44	44	44

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

rate mechanism, but no support for the prize of government mechanism.

6 Conclusion and policy implications

This paper has investigated whether an increase in diamond prices leads to more violent activity in African countries that are diamond abundant, and if so through which mechanism. Potentially, a rise in diamond price could increase conflict activity through changing the wage rate, thereby impacting the opportunity costs of conflict (Dal Bó and Dal Bó, 2004) and/or through weak property rights protection, increasing the expected revenue from conflict (Garfinkel et al., 2008). The two theoretical models formalizing these mechanisms make opposite predictions for primary diamonds (characterized by a capital intensive production process and relatively secure property rights) and secondary diamonds (labour intensive and relatively insecure property rights). Exploiting this, I interact both primary and secondary diamond abundance with diamond price and investigate whether these terms are related to violent activity. This research, based on explicit theoretical models, using an exogenous indicator for primary and secondary diamond abundance and employing a country-fixed effects model, intends to avoid some of the pitfalls of earlier work, hopefully arriving at more consistent and reliable results.

The findings suggest that a rise in diamond price is related to conflict in African countries that are abundant in primary diamonds, but is unrelated or even negatively related to violence in countries with secondary diamonds. These results are not driven by the choice of diamond price data or by the endogeneity of the diamond price to conflict. They are robust to controlling for cyclical effects, but not to controlling for the presence of other types of resources. Taken together, there is some evidence that the diamond price is related to violence in Africa. However, this effect is at least partly due to price increases of other resources present in the same areas. Overall, the data is most consistent with Dal Bó and Dal Bó's model, emphasizing the wage rate as a channel connecting resources and violence, and there is little evidence supporting the model by Garfinkel et al. A competing explanation for these results might be that resources increase the 'prize' of fighting over government (Besley and Persson, 2008). However, when distinguishing between violence in diamond abundant areas and violence in the capital, I find suggestive evidence in favour of the wage rate mechanism.

These results have implications for policies regarding natural resources attempting to limit conflict. Most importantly, results suggest that any diamond may be a 'conflict diamond'; also those mined legally. In fact, this paper suggests that primary diamonds, usually mined by international companies with the consent of the government, are more strongly related to conflict than secondary diamonds, usually suspected to be 'blood diamonds'. Furthermore, there appear to be no special characteristics of diamonds that make them 'guerilla's best friend'. Increases in the price of numerous resources with capital-intensive production processes (or creating a revenue flow for the government) may increase violence to an equal or even greater degree. These implications may warrant reconsidering the effectiveness of various policies.

The most prominent initiative regarding diamonds is the Kimberley Process Certification Scheme, attempting to limit trade in diamonds mined by rebels, mostly thought to be secondary diamonds. In terms of the models presented, it attempts to lower the price of diamonds obtained through expropriation, decreasing the returns to conflict. This paper finds no evidence supporting the weak property rights - increased returns to conflict channel, thereby suggesting that the potential effectiveness of the Kimberley Process is low (even abstracting from difficulties in the execution of the scheme). The apparent idea behind the Kimberley process, that easily 'lootable' diamonds provide direct returns to rebels, thereby increasing conflict activity, is not supported by the data in this paper. Within the Dal Bó and Dal Bó model, decreasing the price of expropriated diamonds would decrease the returns to the expropriation sector for as far has it targets the diamond industry. However, this policy would not have any effect on the main channel suggested by this model, the wage rate, again suggesting limited effectiveness. Finally, the Kimberley Process does not fit in well with the Besley and Persson model, because diamonds mined with the governments consent are never conflict diamonds by the definition of the Kimberley process.

More broadly, the specific attention to diamonds the Kimberley Process embodies may not be productive. If other capital intensive resources are similarly related to conflict, it may be worth considering policies that address the impact these resources and diamonds have on violence simultaneously.

One such alternative policy is suggested by Dal Bó and Dal Bó. They show that in the presence of an expropriation sector, a subsidy to productive labour paid for by a tax on capital or provision of (unproductive) public employment, can be Pareto improving. In the context of conflict and weak states, the latter policy seems most feasible. Intuitively, when a country experiences an increase in the price of a capital intensive good, it may absorb part of the labour made redundant by a shift to more capital intensive production in unproductive public employment, thereby mitigating the decrease in wages. Policies attempting to increase outside options for workers intending to limit the labour pool from which insurgents can draw recruits have been executed on a limited scale. Hanson et al. (2009) for example, investigate the impact of the US Commanders Emergency Response Program (CERP) in Iraq. Using exogenous variation in the rotation of US military units across Iraqi provinces, they conclude that the program has indeed decreased violent activity. In sum, this paper suggests that public employment merit consideration as an alternative to trade bans.

A final type of policy is exemplified by the Extractive Industries Transparency Initiative (EITI). This coalition of governments, companies and civil society attempts to promote transparency as to how much natural resource extracting companies pay to governments and what the proceeds from natural resources are spent on. If we believe that one of the channels connecting natural resource price with conflict is the 'prize' of government and that the initiative limits the extent to which the government can allocate natural resources money to its own group (improves the quality of institutions in terms of the Besley and Persson model), this policy could be effective. However, my tentative attempt to distinguish between the wage rate and the 'prize' of government as a channel provides suggestive evidence in favour of the former.

References

Bergenstock, D. J. and J. M. Maskulka (2001). The de beers story. are diamonds forever? *Business Horizons 44*(3), 37–44.

Besley, T. and T. Persson (2008). The incidence of civil war: theory and evidence.

Blattman, C. and E. Miquel (2009). Civil war. *NBER Working Paper Series no. 14801*.

Brunnschweiler, C. and E. H. Bulte (2009). Natural resources and violent conflict. resource abundance, dependence and the onset of civil wars. *Oxford Economic Papers 61*, 651–674.

Chorlton, L. (2007). Generalized geology of the world: Bedrock domains and major faults in gis format.

Clifford, T. N. (1966). Tectono-metallogenic units and metallogenic provinces of africa. *Earth and Planetary Science Letters 1*, 421–434.

Collier, P. and A. Hoeffler (1998). On economic causes of civil war. *Oxford Economic Papers 50*, 563–573.

Collier, P. and A. Hoeffler (2004). Greed and grievance in civil war. *Oxford Economic Papers 56*, 563–595.

Collier, P. and A. Hoeffler (2005). Resource rents, governance, and conflict. *Journal of Conflict Resolution 49*(4), 625–633.

Collier, P., A. Hoeffler, and D. Rohner (2009). Beyond greed and grievance: Feasibility and civil war. *Oxford Economic Papers 61*, 1–27.

Dal Bó, E. and P. Dal Bó (2004). Workers, warriors and criminals. social conflict in general equilibrium.

Dube, O. and J. Vargas (2009). Commodity price shocks and civil conflict. evidence from colombia. unpublished working paper.

Elbadawi, I. and N. Sambanis (2002). How much war will we see? explaining the prevalence of civil war. *Journal of Conflict Resolution 46*(3), 307–334.

Faure, S. (2006). World kimberlites consorem database version 2006-2. consortiom de recherche en exploration minérale consorem.

Fearon, J. and D. Laitin (2003). Ethnicity, insurgency and civil war. *American Political Science Review 97*(1), 75–90.

Garfinkel, M., S. Skaperdas, and C. Syropoulos (2008). Globalization and domestic conflict. *Journal of International Economics 76*, 269–308.

Global Runoff Data Centre (2007). Major rivers of the world.

Hanson, M., R. Iyengar, and J. Monten (2009). Building peace. the impact of reconstruction spending on the labor market for insurgents.

Hegre, H. and N. Sambanis (2006). Sensitivity analysis of emperical results on civil war onset. *Journal of Conflict Resolution 50*(4), 508–535.

Helmstaedt, H. and J. Gurney (1995). Geotectonic controls of primary diamond deposits: implications for area selection. *Journal of Geochemical Exploration 53*(1-3), 125–144.

Humphreys, M. (2005). Natural resources, conflict and conflict reslution. uncovering the mechanisms. *Journal of Conflict Resolution 49*(4), 508–537.

Janse, A. and P. A. Sheahan (1995). Catalogue of world wide diamond and kimberlite occurences: a selective and annotative approach. *Journal of Geochemical Exploration 53*, 75–111.

Lujala, P., N. P. Gleditsch, and E. Gilmore (2005). A diamond curse? civil war and a lootable resource. *Journal of Conflict Resolution 49*(4), 538–562.

Marshall, T. and R. Baxter-Brown (1995). Basic principles of alluvial diamond exploration. *Journal of Geochemical Exploration 53*, 277–292.

Raleigh, C. and H. Hegre (2005). Introducing acled: An armed conflict location and event dataset.

Rigterink, A. (2010). The wrong suspect. an enquire into the endogeneity of natural resources to civil war.

Ross, M. (2004). How do natural resources influence civil war. evidence from thirteen cases. *International Organization 58*(1), 35–67.

Ross, M. (2006). A closer look at oil, diamond and civil war. *Annual Review of Political Science 9*, 265–300.

Saldern, M. v. (1992). Forecasting rough diamond prices. a non-linear optimization model of dominant firm behaviour. *Resources Policy*, 45–58.

Spar, D. L. (2006). Continuity and change in the international diamond market. *Journal of Economic Perspectives 20*(3), 195–208.

Survey, U. G. (2005). *Mineral Resources Data System*. Reston, Virginia: US Geological Survey.

Sutherland, D. G. (1982). The transport and sorting of diamonds by fluvial and marine processes. *Economic Geology 77*(7), 1613–1620.

Yoeli, E. (2003). In december, diamonds are forever. empirical evidence of counter-cyclical pricing in a durable goods market.