

**The London School of Economics and
Political Science**

**ESSAYS ON VIOLENT CONFLICT
IN DEVELOPING COUNTRIES:
CAUSES AND CONSEQUENCES**

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Development of the London School of Economics and
Political Science for the degree of Doctor of Philosophy,
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Abstract

This thesis consists of three essays, on the causes and consequences of violent conflict. It focuses on two factors that are thought to play a role in violent conflict, natural resource abundance and the media.

The thesis exploits quasi-experimental variation to investigate whether natural resources and violent conflict are related, and if so, through which mechanism. It finds that evidence from cross-country studies indicating that natural resources (as a single category) cause violent conflict is not as robust as popularly believed. Proxies for natural resource abundance used are potentially endogenous to conflict, and addressing this issue changes the results obtained radically. Agricultural resources are found to be negatively related to civil war onset. In the case of diamonds specifically, evidence is found that primary diamonds, but not secondary diamonds, are related to violence. Both results provide support for *income* (or opportunity cost) as mechanism connecting natural resources and violent conflict.

Policy documents assert that media can play a state-building role in conflict situations. However, media could also induce anxiety, and there has been increasing interest in the role of anxiety in the formation of political attitudes. This thesis investigates the impact of intensity of exposure to radio broadcasts on fear of victimization and the impact of fear on political attitudes, in South Sudan. It concludes that individuals living in areas with better radio reception display a higher level of fear, and that anxious individuals are more likely to support a local militia and less likely to support the government army. The latter could be considered the opposite of state-building.

Table of contents

Acknowledgements	7
Introduction	9
CHAPTER 1	14
Natural Resources and Violent Conflict	14
Introduction	14
Cross-country empirical studies: are resources and civil war related?	16
Investigating endogeneity: is the relationship robust?	22
Measuring natural resources: natural and subsoil capital	22
Empirical strategy	31
Results	32
Theoretical models and mechanisms: the ‘how’ of this relationship	41
More empirics: which mechanism(s) do the data support?	43
The opportunity cost of conflict versus the returns to conflict mechanism	44
Quality of government mechanism	46
The credit constraint mechanism	48
Conclusion and Policy Implications	49
CHAPTER 2	52
Diamonds and violent activity in Africa	52
Uncovering relationships and mechanisms	52
Introduction	52
Theoretical models	56
Garfinkel, Skaperdas and Syropoulos: property rights and returns to conflict	56
Dal Bó and Dal Bó: wages and the opportunity cost of conflict	58
Besley and Persson: the ‘prize’ of government and the returns to conflict	60
The case of diamonds	61
Existing country case studies on diamond mining, wages and conflict	61
Data and methodology	64
Diamonds: some geology	64
An alternative measure of diamond abundance: diamond propensity	68
Methodology	73
Data	74
Results	75
Robustness	78
Endogeneity of diamond price	78
Cyclical effects and other resources	82
Mechanisms: wage rate versus the ‘prize’ of government	85
Conclusion and policy implications	87
CHAPTER 3	90
Information is liberating?	90
Results from a natural experiment on the impact of radio on anxiety, and anxiety on political attitudes	90

Introduction	90
Theory and Literature	92
Media information and anxiety	93
Anxiety and political attitudes	95
Media and state-building	96
Background and context	96
LRA and fear	97
Arrow Boys and other armed actors	97
Attitudes towards the central government and the SPLA	98
Media and Information	99
Data and methods	99
Data	99
Natural experiment: Yambio FM	101
Hypotheses and models estimated	109
Results	115
Yambio FM and fear of the LRA	115
Robustness: radio and fear	118
Mechanisms: Yambio FM and fear	123
Impact of anxiety: the Arrow Boys and the SPLA	127
Impact of anxiety: mechanisms	130
Conclusion and discussion	132
Conclusion	135
References	137
Appendix A	148
Appendix B	151

List of tables

Table 1: Summary of findings of various cross-country empirical studies.....	18
Table 2: Correlation between measures of resource abundance, over time.....	30
Table 3: Replacing natural resource abundance in Collier and Hoeffler (2004).....	33
Table 4: Using different years of measurement.....	34
Table 5: Instrumental variable models.....	36
Table 6: Cross-country models of natural resource abundance and violent conflict.....	37
Table 7: Replacing natural resource abundance in Collier, Hoeffler and Rohner (2009).....	39
Table 8: Opportunity cost of conflict mechanism.....	46
Table 9: Quality of government mechanism.....	48
Table 10: Diamond propensity versus diamond occurrence and production.....	70
Table 11: Correlation coefficients for various measures of diamond abundance.....	72
Table 12: Diamonds and violence. Baseline results.....	76
Table 13: Different diamond prices.....	77
Table 14: First stage IV model.....	80
Table 15: Instrumenting for diamond price.....	81
Table 16: Controlling for cyclical effects and the presence of other resources.....	84
Table 17: Diamonds and Violence. Mechanisms.....	86
Table 18: Correlation between residual radio reception and various boma, individual and household level characteristics.....	105
Table 19: Yambio FM and fear. Baseline results.....	116
Table 20: Controlling for LRA activity.....	119
Table 21: Controlling for presence of other armed forces.....	121
Table 22: Controlling for various other factors.....	122
Table 23: Yambio FM and fear. Mechanisms.....	124
Table 24: Fear and political authority.....	128
Table 25: Reception of Yambio FM and political authority.....	129

List of figures

Figure 1: World distribution of natural resources according to different measures.....	25
Figure 2: Primary diamond propensity.....	66
Figure 3: Secondary diamond propensity.....	67
Figure 4: Reception of Yambio FM.....	103

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All errors remain my own.

Introduction

This thesis consists of three essays, on the overarching theme of violent conflict and insecurity. It empirically investigates two factors that are thought to be related to violent conflict: natural resources and media. Specifically, this thesis explores the relationship between violent conflict and natural resources in general and diamonds in particular, and the role of the media in contributing to feelings of (in)security and in promoting state-building in conflict-affected situations.

Given the common theme of causes of violent conflict, this thesis contributes to a rapidly expanding literature in economics and political science. Blattman and Miguel (2009) give a comprehensive overview. According to these authors, the past ten years have seen an “explosion” in research on violent conflict, especially in economics, a field that until twenty years ago largely ignored the topic. They divide the existing literature in three categories - theoretical models of violent conflict, empirical research into its causes, and consequences of violent conflict - and provide recommendations for future research for each. The authors conclude for example that too little empirical work is informed by a formal theoretical model, that many works are subject to econometric identification problems - especially those that investigate the relationship between violent conflict and natural resources, social divisions and political grievances respectively - and that evidence is weakest on the effect of violent conflict on the institutions, technology, social norms and culture (Blattman and Miguel 2009).

This thesis contributes to the literature in Blattman and Miguel’s last two categories: empirical research into the causes and consequences of violent conflict. Following the recommendations for future research by these authors, this thesis places particular emphasis on econometric identification, exploiting various quasi-experimental sources of variation. Furthermore, when a relationship between violent conflict and a particular cause is identified, it investigates the *mechanism* underpinning this relationship, where possible employing a formal theoretical model. Lastly, the third chapter on media and violent conflict investigates the impact of fear of violence on specific social norms and institutions: trust in various forms of authority, and the authorities that people turn to in case of trouble. It thereby contributes to a topic that Blattman and Miguel identify as particularly under-researched.

This thesis consists of three chapters. The first chapter concerns the relationship between natural resources and violent conflict. The idea that natural resource abundance spurs civil war has gained a degree of acceptance within academic and policy circles, following a number of often-cited cross-country studies (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009). However, these studies have been criticized for their lack of an underlying theoretical model, and for failing to identify a *causal* relationship between natural resources and violent conflict (Besley and Persson 2008; Blattman and Miguel 2009; Brunnschweiler and Bulte 2009; Humphreys 2005; Ross 2006). Specifically, the proxy for natural resource abundance used in a number of studies, exports of natural resources over GDP, is plausibly endogenous to the models estimated. Exports of natural

resources as a percentage of GDP may increase in anticipation of conflict (if GDP declines more strongly than natural resource exports in anticipation of conflict), may increase as a result of conflict (various theoretical models suggest that conflict increases the pace of natural resource extraction), or may be correlated to a third factor related to conflict (natural resource extraction may be correlated to the government's discount rate). This may seriously impede the ability of studies using this measure to demonstrate a *causal* relationship between natural resource abundance and war.

The chapter investigates to what extent results of cross-country studies on natural resources and war are driven by endogeneity, by testing whether results from a number of these studies are robust to (a) replacing the original, arguably endogenous, proxy for natural resource abundance with two arguably more exogenous measures; and (b) instrumenting for the original proxy using the latter two measures. The exogenous measures used are *subsoil capital* and *natural capital*, measures of the net present value of the *stock* of natural resources in the economy. Chapter one replicates the results from two studies that find the strongest effect of natural resources on civil war (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009), and replaces the original proxy for natural resource abundance with natural and subsoil capital. Furthermore, it uses natural and subsoil capital as instruments for the original proxy. Since these studies find the strongest relationship initially, these constitute the 'toughest test' if one wants to prove that the results are spurious. The chapter concludes that results from these studies are not robust to changing the measure of natural resource abundance, nor to instrumenting for it: the relationship between natural resources and civil war onset disappears when doing either.

This, combined with results from other cross-country studies, leads the chapter to conclude that evidence that natural resources as a single category cause civil war onset is not as robust as is popularly believed, especially where it stems from cross-country studies.

Furthermore, the chapter reviews to what extent theoretical models on the relationship between natural resources and violent conflict have empirical support, by analysing the data from Collier and Hoeffler (2004) and critically assessing the wider literature. Theoretical models propose a number of mechanisms through which natural resources and conflict could be connected. The presence of natural resources may raise the *returns to conflict*, either by increasing the returns to holding territory, or by increasing the returns to forming the government and being in charge of revenue flows derived from resources (Besley and Persson 2008; Garfinkel, Skaperdas, and Syropoulos 2008). Furthermore, the presence of natural resources may decrease the *quality of government*, as the higher probability of being overthrown decreases the existing government's discount rate (Besley and Persson 2008). Lastly, to the extent that natural resources are characterized by a capital-intensive production process, they may depress the wage rate and thereby the *opportunity cost* of conflict (Dal Bó and Dal Bó 2004). The chapter concludes that the mechanism that has been investigated most empirically, and that is supported most strongly, has not been widely translated into policy.

The second chapter also investigates the relationship between natural resources and violent conflict, focussing on one specific resource: diamonds. Diamonds mined in conflict areas, sometimes dubbed 'blood diamonds', have received particular attention from activist campaigns, were the subject of a popular movie, and are the focus of the Kimberly Process Certification Scheme. Mirroring the previous chapter, chapter two is particularly concerned with identifying an exogenous source of variation in diamond abundance, and with the mechanism(s) connecting diamonds to violence.

The chapter focuses on two mechanisms introduced earlier, the returns to conflict mechanism (Garfinkel, Skaperdas, and Syropoulos 2008) and the opportunity cost of conflict mechanism (Dal Bó and Dal Bó 2004). These mechanisms make opposite predictions for two types of diamonds: primary and secondary diamonds. Primary diamonds are mined in capital-intensive mines for which property rights can be clearly established. Secondary diamonds are extracted from long stretches of river, making it difficult to establish property rights, and production requires little more capital than shovels, buckets etc. The returns to conflict mechanism would suggest that secondary diamonds, lacking clear property rights, would be connected to violent conflict. By contrast, the opportunity cost mechanism predicts that the capital-intensive primary diamonds would be related to violence. The chapter also considers a third theoretical model by Besley and Persson (2008).

All models suggest that natural resource production increases as a response to conflict. Hence, existing data on diamond production is potentially endogenous to conflict, and production data is likely unreliable, especially where it stems from conflict zones. Therefore, the chapter constructs an indicator for the geographic propensity of an area to hold diamonds, using geological factors. The occurrence of diamond follows a number of geological regularities. For example, primary diamonds are found in areas where the bedrock is a particular age, and secondary diamonds are transported away from this original source up to a known distance, through rivers.

Following Dube and Vargas (2009), the chapter investigates whether an increase in the international price of diamonds impacts violent activity in African countries that are estimated to be abundant in primary and secondary diamonds respectively (Dube and Vargas 2009). 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 provides support for the opportunity cost mechanism, but no support for the returns to conflict mechanism.

The international diamonds price is likely unrelated to conflict in diamond rich countries, as it is well documented that it is closely related to the market position of the near-monopolist market leader in diamond production, De Beers (Bergensstock and Maskulka 2001; Saldern 1992; Spar 2006). Despite this, the chapter instruments for international diamond price using the production volume of the largest diamond exporters (which have been peaceful over the entire research period). Results are substantially weakened. Results are robust to using different diamond

prices and controlling for cyclical effects. Similar results supporting the opportunity cost mechanism are found for other resources, notably primary and secondary gold.

Taking these results at face value, they could have implications for policy, especially for the Kimberley Process Certification Scheme (KPCS). This scheme attempts to exclude illegally mined diamonds from the market, essentially driving their price down to zero. Case studies of countries producing secondary diamonds indicate that the KPCS is most likely to affect informally mined secondary diamonds, because obtaining a licence to formalize diamond production is prohibitively expensive for artisanal miners. These case studies also suggest that diamonds mined using artisanal methods contribute to the livelihoods of individuals. The analysis in this thesis however, finds no support for a link between secondary diamonds and conflict. The opportunity cost mechanism even suggests that decreasing the price of a labour-intensive resource providing people with a wage may increase violence, although this supposition is not supported by the data analysed.

Natural resources are one factor though to play a role in violent conflict. Media is another. Policy documents assert that media, especially radio, contribute to peace building and state building. Establishing a national radio station appears to have become a standard component in UN peace missions (Orme 2010). Alternatively, it has been suggested that ‘hate speech’ spread by the media spurs violence (Straus 2007; Yanagizawa-Drott 2012). On the other hand, it has been suggested that exposure to media increases fear of victimization, although this literature is focussed on established democracies, and frequently fails to identify a causal relationship between media and fear (Dowler 2003; Eschholz 1997; Heath and Gilbert 1996). Furthermore, there has been increasing interest in the role of emotions, specifically fear or anxiety, in the formation of political attitudes (Neuman et al. 2007). The third chapter of this thesis investigates the impact of exposure to radio broadcasts on anxiety and the impact of anxiety on political preferences, using a natural experiment in South Sudan. This chapter is co-authored by Mareike Schomerus.

Specifically, this chapter investigates whether exogenous variation in signal strength of a particular radio station broadcasting about the Lord’s Resistance Army (LRA) affects individuals’ level of fear of being victimized by the LRA. Furthermore, it investigates the impact of increased anxiety on political attitudes. It concludes that people living in areas with better radio reception fear the LRA more and that fear of the LRA, as instrumented by radio reception, is positively related to support for a civilian protection militia, The Arrow Boys, and negatively related to support for the government army. This result is robust to controlling for actual LRA activity, presence of other armed forces, distance to the CAR or DRC border, phone coverage, displacement and date-of-enumeration.

The literature suggests various mechanisms through which exposure to media may lead to fear, and through which fear may influence political attitudes may be connected. Frequency of media coverage could be rationally taken as an indicator of risk, media coverage may increase the *availability* of fear-inducing occurrences, information from the media could *substitute* for personal experiences, *resonate* with personal experiences, or individuals may have *affinity* with the victims

portrayed by the media. Two main theories that describe the relationship between anxiety and political attitudes are *Affective Intelligence* and *Affect Transfer*. The chapter considers those mechanisms that provide testable implications, and finds suggestive evidence in favour of *availability* and *Affective Intelligence*.

Results imply that fear resulting from exposure to radio broadcasts about the LRA can influence social norms and institutions, specifically the actors that individuals trust and rely on in case of difficulty. Individuals predicted to be more anxious rely more strongly on the Arrow Boys, and less on the government army. If we believe that increasing support for an informal militia, and decreasing support for ‘formal’ state institutions is the opposite of state building, radio does decidedly not contribute to state building in this case.

CHAPTER 1

Natural Resources and Violent Conflict

Abstract

This chapter argues that evidence that natural resources cause civil war onset is not as robust as popularly believed, especially where it stems from cross-country studies. The idea that natural resources spur conflict has reached a certain degree of acceptance among scholars and policy makers with a number of influential cross-country studies finding a positive relationship between natural resource abundance and civil war. This chapter argues that the proxy for natural resources abundance used in a number of these studies is endogenous to the models estimated, seriously undermining the ability of these studies to demonstrate a causal relationship between resources and conflict. In this chapter, I adopt two plausibly more exogenous measures of natural resource abundance. When replicating those studies that find the strongest effect of natural resources on civil war (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009), using these more exogenous measures of resource abundance, no evidence is found that natural resource abundance leads to higher civil war risk. The chapter further assesses empirical support for theoretical models detailing the mechanisms connecting natural resources and violent conflict. The mechanism that has received the most empirical support, hypothesizing that the price of natural resources influences wages or income and thereby the opportunity cost of conflict, has not been widely translated into policy.

Introduction

Over the past twenty years, terms such as ‘natural resource curse’, ‘natural resource trap’ and ‘blood diamond’ have been added to our vocabulary, all illustrating that natural resources adversely affect countries that possess such ‘riches’ in large amounts. Natural resources are said to be associated with bad economic performance, undemocratic regime types and civil conflict (Collier and Hoeffler 2004; Sachs and Warner 2001; Helmstaedt and Gurney 1995). This chapter will explore this last relationship. Specifically, it investigates whether existing results from cross-country studies connecting natural resources and violent conflict are robust to replacing the potentially endogenous proxy for natural resource abundance with two plausibly more exogenous measures. It concludes that results are not robust to this. Furthermore, the chapter critically assesses empirical support for a number of theoretical models detailing the *mechanisms* that may connect natural resources and violent conflict.

The literature on this topic is extensive and ‘natural resources’ is potentially a wide category. Hence, setting some boundaries and definitions is in order. For the purpose of this chapter, the term ‘natural resources’ refers to tradable primary commodities, including agricultural products, timber, narcotics, fossil fuels, metals and gemstones. Natural resource abundance refers to the quantity of natural resources *present* in a country, and is conceptually distinct from natural resource production or export. This chapter does not engage with the effect of scarcity, degradation or depletion of stocks of renewable resources on violent conflict. A flourishing literature surrounding this topic exists (a good starting point for the interested reader is the theme number of *Political Geography*, volume 26 issue 6). The literature on scarcity seems, at least on the surface, at odds with literature on primary commodities and conflict: the former argues that *scarcity* of resources leads to violence, the latter that an *abundance* of resources leads to violence.

Furthermore, the chapter will focus almost exclusively on quantitative literature. This is not to say that this is the only field in which interesting research on natural resources and violent conflict is being done. However, quantitative research on resources and war has been very prominent in influencing policy makers and popular perceptions: the most-cited article on this topic (Collier and Hoeffler 2004) uses quantitative methods, an early version of which was published under auspices of the World Bank, whilst its popular translation, *the Bottom Billion*, made the bestseller lists in 2007. As the idea that natural resources and violence are connected has definitely conquered a place in the public consciousness, it is interesting to examine more closely how rigorous the analyses that form the foundation of this belief are.

This chapter will argue that the link between natural resources and civil war onset, as apparent from studies exploiting cross-country variation is not as strong as popularly believed. Over the recent years, evidence that these studies fail to identify a *causal* relationship between natural resources and violence has been piling up.

Two often-cited studies in the empirical literature are Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009). These studies find a strong relationship between natural resources and civil war onset (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009). Both studies use exports of natural resources as a percentage of GDP as a proxy for natural resource abundance. However, this measure may be endogenous to the model. A high rate of natural resource exports as a percentage of GDP can be a consequence of the anticipation of war. Alternatively, natural resource production as a percentage of GDP can be correlated to weak economic structures, low institutional quality or a government with a high discount rate, all factors that can plausibly be related to civil conflict. The argument that exports of natural resources as a percentage of GDP is endogenous has been made by numerous authors (e.g. Besley and Persson 2008; Blattman and Miguel 2009; Brunnschweiler and Bulte 2009; Humphreys 2005; Ross 2004)). However, the extent to which conclusions of studies using this measure are driven by endogeneity is a matter for empirical investigation. To investigate this, I use two measures of natural resource abundance that are deemed more exogenous to conflict, natural and subsoil capital (World Bank

2006). I then reproduce the exact models estimated by Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009), replacing the original proxy for natural resource abundance with the plausibly more exogenous measures. When doing this, the relationship between natural resources and conflict becomes insignificant or negative. Furthermore, I use natural and subsoil capital as instruments for natural resource exports, and oil production. Instrumental variable models also fail to find a positive relationship between civil conflict and predicted natural resource exports or oil production respectively.

The chapter then critically assesses empirical support for a number of theoretical models detailing potential *mechanisms* connecting natural resources and conflict. This question is important from a policy point of view, as some policies would seem effective if we have one mechanism in mind, but would be ineffectual, or even have adverse effect, from the perspective of another. This topic has been reviewed before (e.g. (Humphreys 2005; Ross 2004)). However, as this particular field has evolved rapidly over the last ten years, and numerous new theoretical models have been proposed and empirical studies done, an updated investigation of evidence regarding the mechanisms connecting natural resources and violent conflict appears to be in order. Furthermore, this chapter will investigate these mechanisms using data from Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009).

Although not all mechanisms have been tested empirically at the time of writing, the chapter concludes that the opportunity cost of conflict mechanism has received the most support, both from existing literature and from the analysis presented. However, this mechanism does not appear to have been translated widely into policy.

The remainder of this chapter is organized as follows. The first section reviews studies using cross-country variation, considers a number of reasons for why conclusions differ markedly between studies and relates some critiques of this particular research design. The second section investigates the robustness of the conclusions from Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009) to replacing, or instrumenting for, the original proxy of natural resources abundance. The third section provides the intuition behind several theoretical models on mechanisms connecting resources and conflict. The fourth section tests these theoretical models empirically, and reviews other studies investigating the same question. The final section concludes and highlights some policy implications.

Cross-country empirical studies: are resources and civil war related?

One way to try to establish whether natural resources and violent conflict are related is to investigate whether countries that have or produce more resources are more prone to civil war than countries with fewer resources. This set-up compares different countries to each other and therefore uses cross-country variation – as opposed to variation over time (does a particular

country or area experience more violence at a time when it has or produces more resources?). This section will focus on studies that rely at least partially on cross-country variation, which I will refer to as ‘cross-country studies’ for ease of reference. It should be noted that most studies discussed use panel data and base their conclusions on variation over time as well as comparisons between countries.

The basic set-up of cross-country studies is similar. They attempt to explain the onset of civil war, using a range of economic, social, political and geographical factors as explanatory variables, of which the production, rents, exports or stocks of natural resources is one. The period under study starts at either 1945 or 1960 and extends as far as data availability allows, and all the world’s countries for which data is available are included in the sample. Civil war onset measured as a one or a zero, where one means that a civil war started in a particular country in a particular year and zero means no such war started. For violence to constitute a civil war, it has to have some political motivation, the government needs to be party to it and it has to have resulted in at least 1000 ‘battle-related deaths’. In practice, the last criterion is usually the hardest to satisfy, so whether violence gets coded as a civil war depends heavily on the number of battle-related deaths recorded. In addition to natural resources, factors hypothesized to influence the chance of a civil war onset may include GDP, the size of the population, level of ethno-linguistic or religious fractionalization/polarization, levels of democracy and inequality, years since the last civil war, an indicator for how mountainous a country is and an indicator for non-contiguous territory.

Despite the similarities in set-up, conclusions from cross-country studies differ markedly, as Table 1 illustrates. The table shows how various studies measure natural resource abundance and whether the study finds a positive (+), negative (-) or no statistically significant relationship (0) between natural resources and civil war onset. From the top panel, we can see that there is no consensus on whether natural resources as a single category increase the chance of violent conflict, with roughly half of the studies finding a positive relationship between the two and the other half concluding that no relationship exists. Most studies that do find that natural resources increase war risk use primary commodity exports as a percentage of GDP as an independent variable, although Fearon and Laitin (2003) and Fearon (2005) do not support this conclusion even though they use the same measure. Studies using stocks of natural resources generally fail to find a connection between resources and violent conflict onset.

A more clear-cut picture emerges from investigations into oil or fossil fuels specifically: all studies conclude that oil is associated with civil war onset and results are similar for virtually all measures of oil abundance. The only notable exception is oil reserves, again a measure of resource stocks (Humphreys 2005).

Studies investigating the impact of diamonds on war risk, summarized in the bottom panel of Table 1, provide an inconclusive myriad of results. Many of these studies distinguish between primary diamonds, those that are mined in capital-intensive mines, and secondary diamonds, those

Table 1: Summary of findings of various cross-country empirical studies

Study	Measure Natural Resources	Relationship Resources - War
	----- Aggregated Natural Resources -----	
(Brunnschweiler and Bulte 2009)	Stock of all Natural Resources per capita	0
(Collier and Hoeffler 1998)	Primary Commodity Exports as % of GDP	+
(Collier and Hoeffler 2004)	Primary Commodity Exports as % of GDP	+
(Collier, Hoeffler, and Rohner 2009)	Primary Commodity Exports as % of GDP	+
(De Soysa 2002)‡	Stock of all Natural Resources per capita	0
	Stock of Mineral Resources per capita	+
(De Soysa and Neumayer 2007)	Mineral Rents as % of GNI	0
(Elbadawi and Sambanis 2002)	Primary Commodity Exports as % of GDP	+
(Fearon and Laitin 2003)	Primary Commodity Exports as % of GDP	0
(Fearon 2005)	Primary Commodity Exports as % of GDP	0
	----- Oil -----	
(De Soysa 2002)	Oil exporter dummy	+
(De Soysa and Neumayer 2007)	Energy Rents as % of GNI	+
(Fearon and Laitin 2003)	Oil exporter dummy	+
(Fearon 2005)	Fuel exports as % of GDP	+
(Humphreys 2005)	Proven oil reserves per capita	0
	Quantity of oil produced per capita	+
(Ross 2006)	Fuel rents per capita	+
	----- Diamonds -----	
(Humphreys 2005)	Total quantity of diamonds produced per capita	+
(Lujala, Gleditsch, and Gilmore 2005)	Dummy primary diamond production	0 (-)†
	Dummy secondary diamond production	0 (+)†
(Ross 2006)	Value of primary diamonds produced per capita	+
		0

‡ De Soysa (2002) investigates a considerably shorter period than the other studies in Table 1, 1989-1999, and uses a 25 battle-related deaths threshold as opposed to 1000 battle-related deaths. Results for Stock of Mineral Resources are insignificant when adding a dummy for oil exports to the model.

† Lujala, Gleditsch & Gilmore (2005) only find significant results when taking the onset/incidence of ethnic conflict as a dependent variable. Sign of these results in parentheses

that can be mined using artisanal techniques and are considered easily 'lootable'. Humphreys (2005) concludes total diamond production is positively related to civil war onset, whilst Lujala, Gleditch and Gilmore (2005) find that both primary and secondary diamond production are unrelated to war onset in general. The latter continue to conclude that primary diamonds are negatively, and secondary diamonds positively related to *ethnic* war onset, whilst Ross (2006) finds the exact opposite concluding that primary diamonds are positively, and secondary diamonds negatively related to both civil war onset in general and ethnic war onset. Given that results on the relationship between diamonds and violent conflict differ strongly between studies, diamonds as a specific natural resource merit further investigation. This will be the subject of the next chapter.

What explains this lack of agreement (with the exception of results on oil)? It is likely that many reasons exist, but a number have been systematically explored. Fearon (2005) investigates why Collier and Hoeffler (2004) and Fearon and Laitin (2003) do not come to the same conclusion, despite using the same measure of natural resource abundance. He concludes that Collier and Hoeffler's results are an artefact of how they split up the research period (in intervals of five, rather than one year), their decision to drop observations for which no data is available rather than to impute the missing data and keep them in the sample, and their specific set of control variables. When Fearon changes some combination of these relatively arbitrary decisions, he is no longer able to find a positive and significant relationship between natural resource exports as a percentage of GDP and civil war onset.

Another potential reason for the lack of consensus may be that various studies use different datasets on civil war onset (Sambanis 2004). Although these datasets have very similar definitions of war as noted above, Sambanis shows that seemingly minor differences in coding rules can have substantial consequences for how many wars are included and in what year the start of a war is recorded. Some examples of these differences are: is the 1000 battle-related deaths threshold cumulative over the entire duration of the conflict or per year? When is a conflict first recorded: in the year the first violence takes place or the first year the conflict crosses the deaths threshold? What to do with a conflict that slowly accumulates deaths over time until it exceeds the threshold, whilst we would intuitively not characterize it as a civil war? What to do when violence 'dips' below the casualty threshold for one or more years – when would we code this as a continuation of an old conflict and when would we code a new war start? Sambanis shows that very few variables that supposedly explain civil war onset consistently do so across all war databases. Even the dummy for oil exporters, a measure that has given consistent results across all studies in Table 1, is sometimes positively and sometimes unrelated to war, depending on the database chosen.

In another attempt to establish how sensitive conclusions are to reasonable changes in research set-up, Hegre and Sambanis (2006) investigate whether different combinations of explanatory variables consistently give the same results (Hegre and Sambanis 2006). They take 18 concepts that are supposedly related to civil conflict, of which natural resources is one, and identify 88 variables measuring these concepts. Then, they systematically try all possible combinations of

these 88 variables and look at the distribution of the coefficients for each variable. None of the five measures for natural resources, including two measuring oil exports, makes their cut-off for variables that are systematically related to civil war onset.¹

Does it matter that results are not the same across studies? It matters if we think that all studies are equally credible, and had they all come up with the same conclusions, we would have believed that natural resources cause civil war. It matters less if we think that not all of these studies credibly identified a causal relationship to begin with, so we would not trust their conclusions even if they had all drawn the same one, or if we are more inclined to believe certain studies over others.

Do cross-country empirical studies succeed in showing that natural resources *cause* civil war? A major problem in identifying a causal relationship is that natural resource exports or production may be *endogenous*. In other words: certain countries may export or produce a large amount of natural resources for a reason, and that reason may not be independent of violence. Natural resource exports as a percentage of GDP is most suspicious in this regard. This indicator does not measure resource abundance, but rather resource dependence (Brunnschweiler 2008). Countries that are resource dependent usually display a number of other characteristics, such as poverty, ‘bad’ governance and ‘bad’ institutions, any one of which can make a country more likely to experience a civil war. So if we observe a positive relationship between natural resource exports as a percentage of GDP and civil war start, it is impossible to tell whether this means that natural resources cause war or that any of these other characteristics cause both natural resource dependence and war risk. Expressing natural resource exports as a percentage of GDP is a further source of endogeneity. It is plausible that productive activity, and with that GDP, will decline *in anticipation of* civil war. Natural resource exports will likely not decline as steeply, as these industries are location-specific and hence harder to move out of the country. Thus, the ratio of natural resource exports as a percentage of GDP may increase in anticipation of civil war, rather than the civil war breaking out in response to natural resource exports (Ross 2004).

It has been argued that the production, rents (the value of production net of extraction costs) or exports of natural resources *per capita* are free of these endogeneity problems (Ross 2006). However, over the last years, numerous theoretical models have suggested that they are not. A main argument for this is that the pace at which a country extracts natural resources is a choice: a choice that is influenced by the country’s institutions and often made by its government. Chichilnisky (1993) originally modelled this in the case of renewable resources. Her model features two otherwise identical countries with a different level of property rights, and predicts that the country with the poorer property rights exploits resources at a higher pace and thereby *appears* more resource abundant (Chichilnisky 1993). One of the theoretical models presented in the third section of this chapter similarly predicts that countries in conflict export more natural resources if the property rights to that resource are insecure (Garfinkel, Skaperdas, and Syropoulos 2008). Hence,

¹ Although it should be noted that when using the lower death threshold of 25 battle related deaths, oil exports as a percentage of GDP does make the list of variables that are robustly related to violence.

we may observe that natural resource production or exports and violent conflict correlate not because they are causally related, but because they are both a *consequence* of a poor institutional environment.

A variation of this argument is that the pace of natural resource extraction may be an indicator of the government's discount rate, and that this in turn is related to conflict risk. The government's discount rate can be taken as given: a government that intrinsically cares more for the future will choose a slower pace of natural resource extraction and better overall policies, and will therefore be less at risk of civil war. Alternatively, the government's discount rate can be a function of the probability of it being overthrown: a government that chooses poor policies will be at higher risk of being ousted, either violently or otherwise, and therefore will care less about its country's future stock of resources and more about grabbing what it can now. Indeed, a theoretical model by Robinson, Torvik and Verdier predicts that governments will over-extract resources compared to the efficient extraction path, especially when their political position is insecure (Robinson, Torvik, and Verdier 2006). Relatedly, if the government foresees a violent conflict, it may speed up the pace of natural resource extraction to finance military expenditure, although this argument relies on the absence of other cost-effective ways of raising war finance.

Another theoretical model presented in the third section of this chapter predicts that the production of capital intensive natural resources increases with conflict (Dal Bó and Dal Bó 2004). Thus, the model expects exports and production of resources to increase in response to conflict *as well as* the other way around, and this two-way causation poses a further challenge for studies using export or production numbers.

From the measures of natural resource abundance in Table 1, the stocks of natural resources per capita are plausibly the least endogenous, as the amount of oil a country possesses is a geological fact. It is not entirely free from suspicion though, as the present stock of natural resources is a result of past extraction decisions and we may simply not have discovered natural resource deposits in the world's most unstable areas yet. However, it seems harder for a government to meaningfully influence future resource stocks than present resource extraction, and it seems doubtful that resources nobody knows about will affect politics at all. If we believe that resource stocks are more exogenous, we would put most faith in the conclusions of studies using stock measures. From Table 1, we can see that virtually all of these conclude that there is no causal relationship between natural resources and the onset of civil war.

In sum, cross-country studies do not provide a clear-cut result on the relationship between natural resources and civil war onset, with the possible exception of results on oil. This is partly due to relatively minor differences between studies that we would expect solid conclusions to be robust to. Additionally, there is increasing suspicion that positive associations between natural resources and civil war are a result of endogeneity, and cannot be interpreted causally.

Investigating endogeneity: is the relationship robust?

Although the argument that natural resource exports as a percentage of GDP is endogenous has been made by numerous authors (Besley and Persson 2008; Blattman and Miguel 2009; Brunnschweiler and Bulte 2009; Humphreys 2005; Ross 2006), the extent to which conclusions from studies using this measure are driven by endogeneity is a matter for empirical investigation. This section investigates this. To do so, I select the two studies that find the strongest relationship between natural resources and civil war, those by Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009). Because these studies find the strongest relationship initially, they provide the ‘toughest test’ when one wants to show that these results are in fact spurious. Both studies use natural resource exports as a percentage of GDP as a proxy for resource abundance. As the previous section has illustrated, this particular measure is subject to serious endogeneity problems. I replace this proxy for natural resource abundance with a number of plausibly more exogenous measures and assess to what extent this affects the results obtained. In addition, I use the arguably exogenous variables as instruments for potentially endogenous measures of natural resource abundance.

Within the framework of the ‘resource curse’ literature, it has been established that the measure of natural resource abundance used can have substantial impact on the conclusions drawn. The ‘resource curse’ literature attempts to establish whether there is a negative relationship between natural resource abundance and economic growth. Using natural resource exports as a percentage of GDP as a measure of natural resource abundance, one would arrive at this conclusion (Sachs and Warner 1995, 2001). However, Brunnschweiler (2008) argues that this is due to the endogeneity problems described above. When she uses natural and subsoil capital (measures of the value of the *stock* of natural resources *per capita* explained in more detail below), the observed relationship between natural resource abundance and growth becomes either insignificant or positive (Brunnschweiler 2008). It would thus be interesting to see if a similar radical change would result from using these measures in the context of conflict.

Measuring natural resources: natural and subsoil capital

The alternative measures of natural resource abundance used are natural and subsoil capital, two measures of the value of the *stock* of natural resources in the economy. Unlike resource dependence and resource production, the initial stock of natural resources in an economy is determined by geography, and is therefore arguably more exogenous to conflict. The World Bank provides two such stock measures: natural and subsoil capital for the years 1995, 2000 and 2005 (World Bank 1997, 2006, 2011).

Subsoil capital consists of the net present value (NPV) of the flow of rents from exploitation of stocks of four fossil fuels² and ten metals and minerals³, over an assumed lifespan. The World Bank constructs this measure as follows (World Bank 2006). It estimates for each country the size of the stock of each resource that can be economically extracted and the country-specific rents derived from a unit produced (the unit price minus extraction costs). It assumes that the stock of resources will be exploited within a time span of twenty years in each country. This roughly corresponds to the world average reserve-to-production ratio for most of the resources included in the measure. Furthermore, it assumes that extraction occurs along an optimal path, given a fixed growth rate of resources rents, and a fixed discount rate. The discount rate is set at four per cent, which is the upper bound of estimated social return on investment for industrialized countries.⁴

Note that the World Bank estimates of subsoil capital for 1995 and 2000 (World Bank 1997, 2006) artificially impose the same discount rate and time horizon for extraction on all countries in the sample. These are exactly the factors that we would like to hold constant because they are a potential source of endogeneity.

To arrive at a measure of natural capital, the World Bank adds the NPV of the flow of income derived from cropland, timber, non-timber forest resources, pastureland and protected areas to the value of subsoil capital for each country. To calculate the NPV of rents from *cropland*, ten representative crops are identified.⁵ For each of these crops and each country, the NPV of cropland is the product of the total area of cropland, country-specific yield per acre, world price and a fixed rental rate (one minus the ratio of costs to revenue per acre, assuming the product is sold at world prices), over an assumed lifespan of 25 years, discounted using a fixed four per cent discount rate. Yields are assumed to increase at a fixed rate, which is different for developing and developed countries.⁶ A similar method is used to determine the NPV of *pastureland*. The representative products in this case are beef, lamb, wool and milk. The NPV of standing *timber* is calculated using a similar method to subsoil capital, where the area of forest within 50 kilometres of infrastructure equals the stock of timber. The assumed lifespan of extraction is 25 years, or the estimated time to exhaustion of timber resources given current country-specific production and timber growth, whichever is smaller.⁷ The NPV of *non-timber forest resources* is 0.1 times the size of forested areas (the share of forests assumed accessible) multiplied by an assumed revenue per acre, which is different for developing and developed countries, over a 25 year life span, discounted. Finally, *protected areas* are a natural resource in the sense that they can bring income from tourism. Its

² Oil, natural gas, hard coal and lignite (soft coal)

³ Bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin and zinc

⁴ Later estimates of subsoil capital (World Bank 2011) are calculated using an extraction time-span of 25 years, a zero growth rate of resource rents and a country-specific discount rate based on the annual growth rate of per capita consumption.

⁵ Maize, rice, wheat, bananas, grapes, apples oranges, soybeans coffee and a residual category which includes roots and pulses.

⁶ Later estimates use a rental rate of 0.3 for all crops, are based on production data from a different source and use a country-specific discount rate.

⁷ (World Bank 2011) assumes zero growth of rents for both categories of countries.

NPV per acre is set at a rate lower than the country-specific NPV of crop and pastureland (reflecting the opportunity cost of designating some land as a protected area). The life span is 25 years and the discount rate is four per cent (World Bank 2006).

As is clear from the above, when calculating the value of natural capital for 1995 and 2005, the World Bank also imposes the same discount rate on all countries. However, unlike subsoil capital, the way in which natural capital is measured introduces other potential sources of endogeneity. Cropping patterns, patterns in the use of pastureland and yields per acre are likely partially determined by a country's political and economic conditions. Furthermore, the World Bank assumes different parameters for developed and developing countries when calculating the NPV of non-timber forest resources and the growth rate of rents to cropland and pastureland. Lastly, the life span of standing timber is potentially dependent on the pace of extraction. For these reasons, natural capital is not the preferred measure of natural resources in this chapter. However, in aggregating all natural resources, including agricultural products, into a single measure, it is conceptually most similar to the original measure employed by Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009). When we wish to examine the impact of natural resources as a single category on conflict, natural capital is the best alternative measure available.

Figure 1 gives a sense of the global distribution of natural resources according to various measures. It displays countries with missing data (-999) in grey, countries without resources in white, and classifies the remaining countries according to quartile.⁸ Panel A compares natural capital, natural resource exports as a percentage of GDP and natural resource exports per capita. The latter is constructed by multiplying Collier and Hoeffler's (2004) original measure by total GDP at current prices and dividing this by the size of the population.⁹ When focussing on natural resource exports as a percentage of GDP, countries rich in natural resources are predominantly found in Africa and the Middle-East, and to a lesser extent in Middle-America. However, weighting natural resource exports by population rather than GDP shows an extremely different picture: Africa appears particularly resource-poor according to this metric, and Europe, North America and South America appear particularly rich in resources. Natural capital has considerable overlap with resource exports per capita: Europe, North America and South America also appear resource-rich by this measure, and variation within Africa is similar, to the extent that data on Africa is not missing.¹⁰ Natural capital has little visual overlap with natural resource exports as a percentage of GDP. This illustrates the argument that natural resource exports as a percentage of GDP reflect resource dependency rather than the presence of resources: both natural capital and the reweighted measure

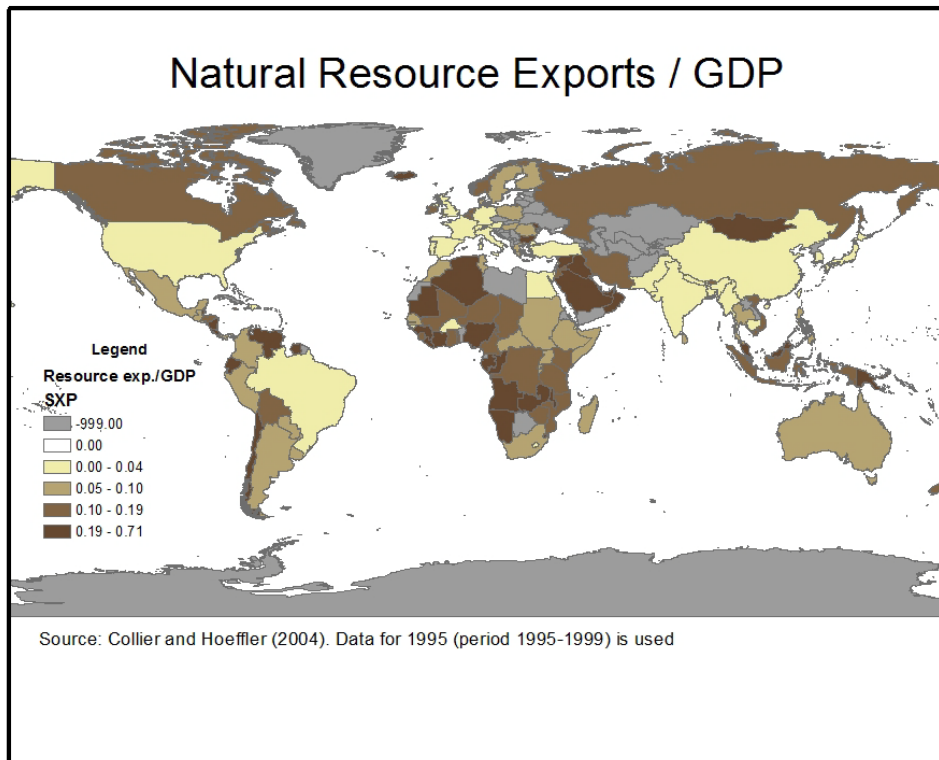
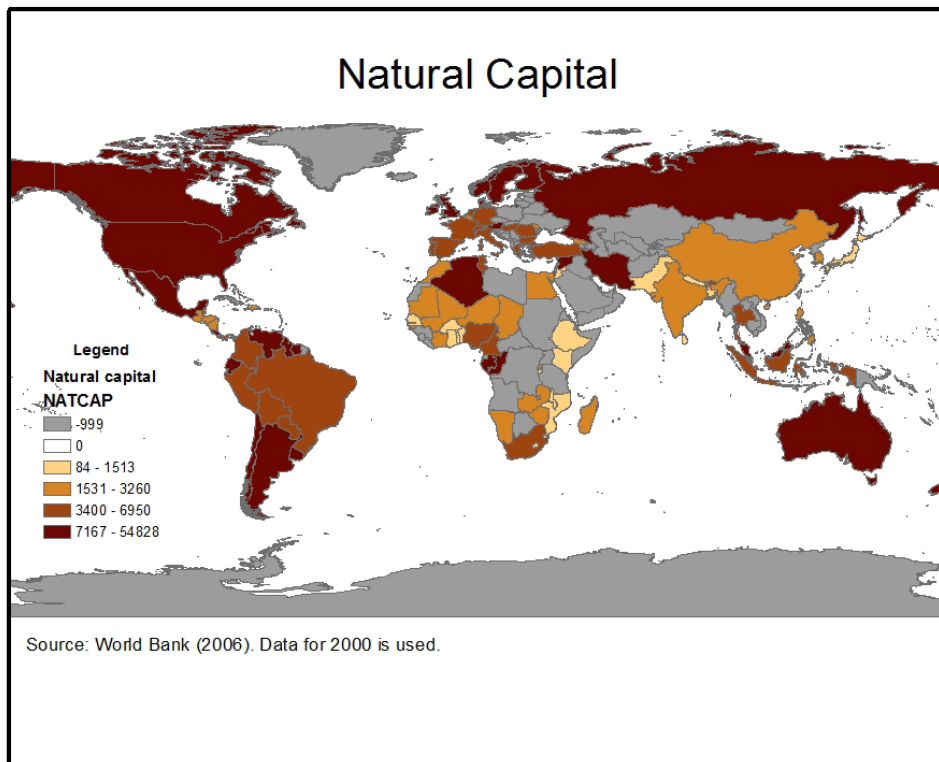
⁸ For oil reserves per capita, the quartile ranges are calculated excluding Saudi Arabia and the United Arab Emirates. These countries have extremely large oil reserves and including them would mean that only these two countries fall in the fourth quartile.

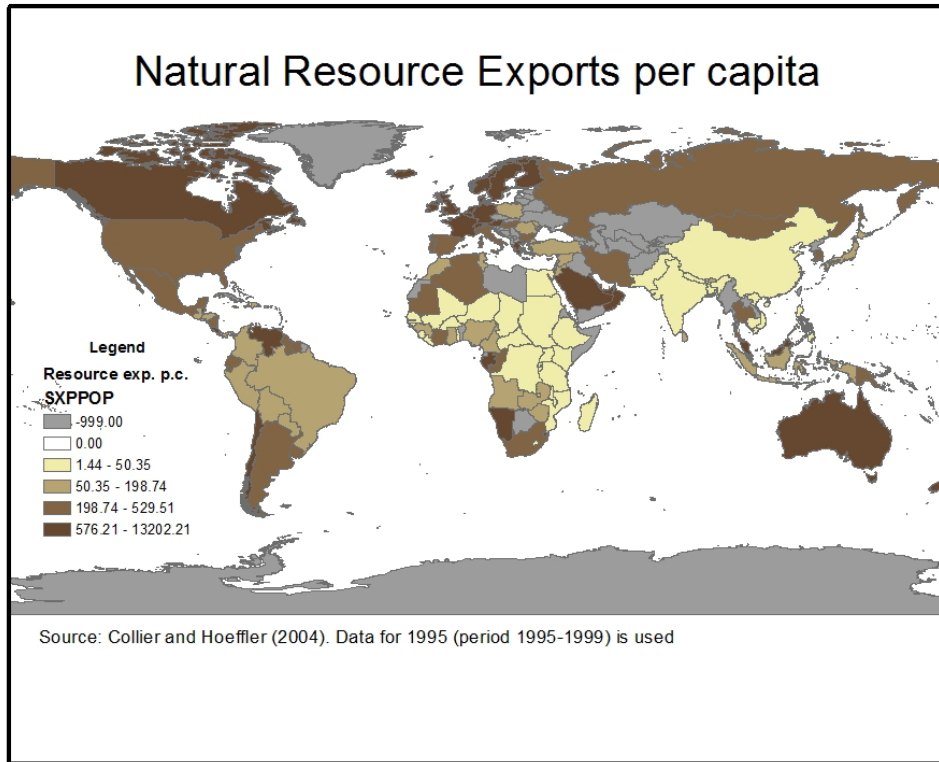
⁹ Both additional variables are obtained from the World Bank World Development Indicators

¹⁰ Although it would appear that missing data on Africa is a downside of the natural capital measure, many African countries are excluded from Collier and Hoeffler's final analysis because they miss data on other variables – using natural capital leads to a loss of only 29 (out of 459) observations. See Table 2.

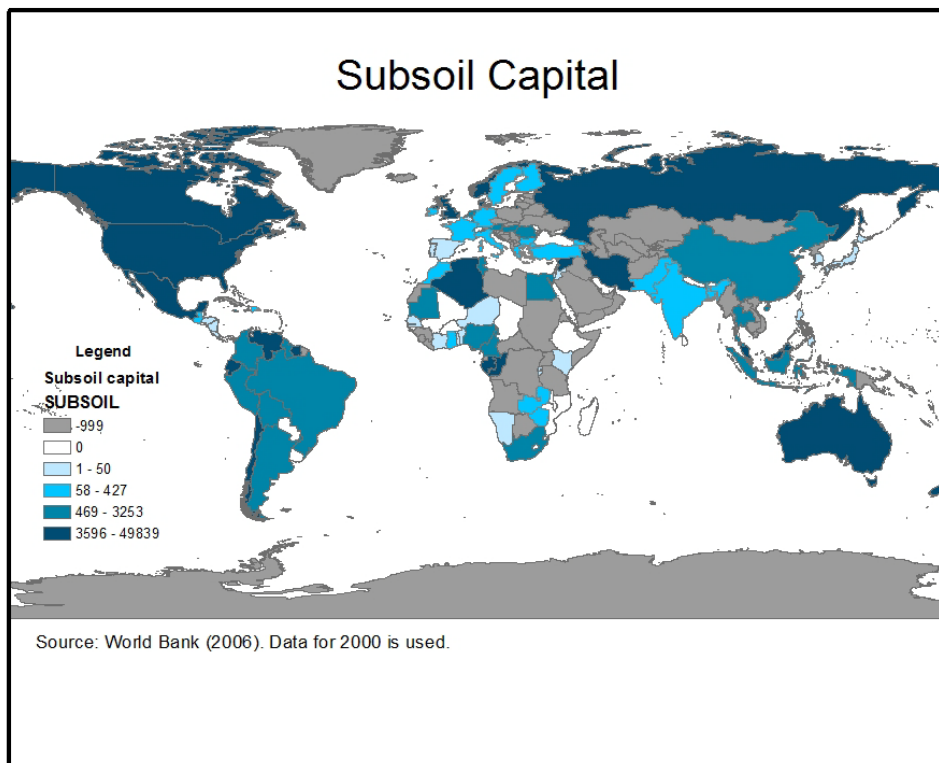
Figure 1: World distribution of natural resources according to different measures

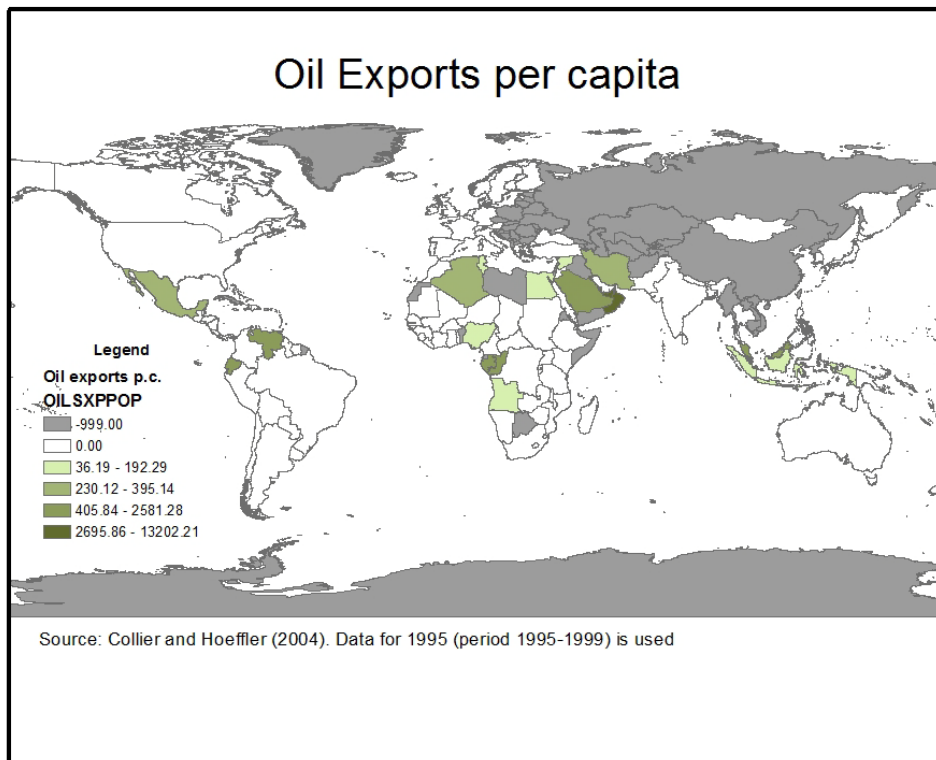
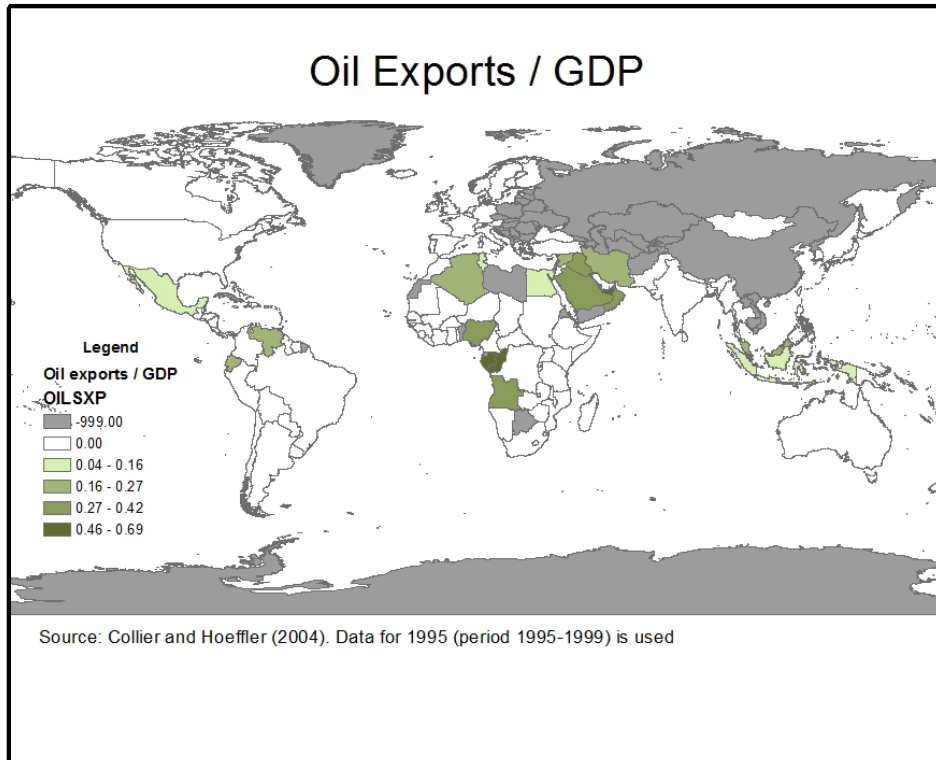
Panel A

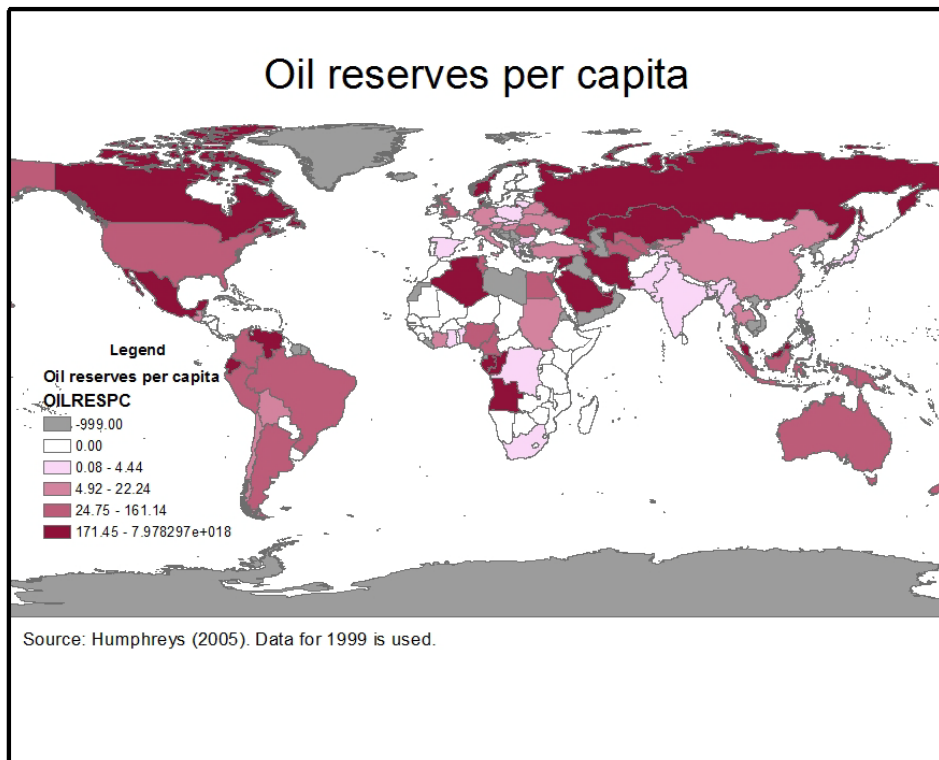
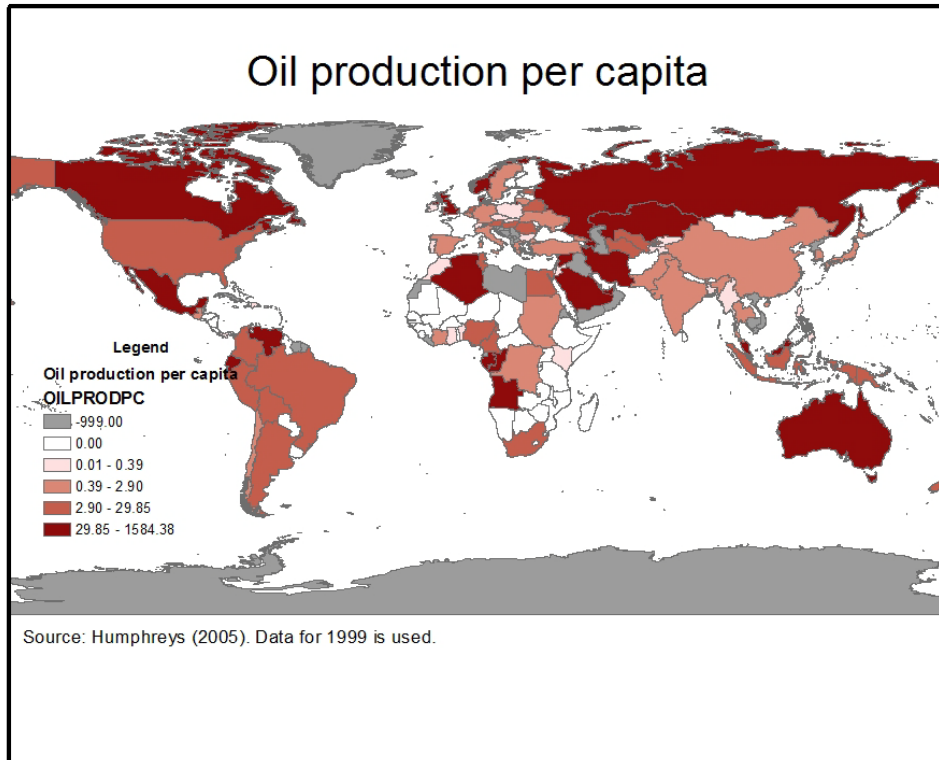




Panel B







suggest that it may not be the case that the more developed areas of the world have fewer resources, but rather that they are less dependent on them.

Panel B of Figure 1 compares subsoil capital, Collier and Hoeffler's oil exports as percentage of GDP¹¹, this measure reweighted by population, and Humphreys (2005) indicators for oil production and oil reserves. A somewhat similar, but less pronounced picture emerges. Oil exports over GDP depict Africa as most oil-rich, whereas oil exports per capita indicate that the Middle East has most oil. Subsoil capital visually overlaps more with the latter than the former, although it includes more types of exhaustible resources and hence has fewer countries with zero resources. The global distribution of resources looks broadly similar when taking either oil reserves or oil production per capita taken from Humphreys (2005) as a measure. Subsoil capital visually overlaps with both these measures.

Natural and subsoil capital measure *stocks* of natural resources, but not initial stocks, rather stocks in 1995, 2000 and 2005. The main analysis uses data from 2000, because the 1995 measures are only available for a reduced sample of countries, and the 2005 data is calculated using country-specific discount rates. Using natural and subsoil capital implies explaining past conflict (going back to 1960) using stocks of natural capital in 2000 (or predicting past resource exports using stocks of natural resources in 2000 - when using natural and subsoil capital as instruments). For this to be meaningful, natural and subsoil capital should capture a country's underlying predisposition to possess natural resources, and thus be correlated to natural resource exports and production throughout the time period under research.

Table 2 displays the correlation between natural and subsoil capital respectively, and alternative measures of natural resource abundance. As expected from observing Figure 1, the correlation between natural resource exports as a percentage of GDP and natural and subsoil capital respectively, is very low. Correlation coefficients do not exceed 0.3 and are insignificant in a number of cases. The correlation between subsoil capital and oil exports as a percentage of GDP is much stronger; coefficients range from 0.46 to 0.55. Correlation coefficients increase in size substantially when weighting natural resource exports by population rather than GDP; coefficients obtained for natural capital and natural resource exports per capita, and subsoil capital and oil exports per capita are of respectable size, ranging from 0.53 to 0.65. Correlations do not appear to become meaningfully stronger over time. In fact the correlation coefficient for 1995 is the lowest in both sets. This mitigates the concern that natural and subsoil capital in 2000 are poor predictors of past natural resource exports.

Subsoil capital is also significantly correlated to Humphreys' (2005) measures of oil production and oil reserves. All coefficients are significant at the 1 per cent level. However, the size of the correlation coefficient fluctuates quite strongly over time, peaking between 1985 and 1990. I can offer no reasonable explanation for this. However, these series provide no strong evidence that

¹¹ They construct this by multiplying natural resources as percentage of GDP by a dummy for oil-producing countries.

Table 2: Correlation between measures of resource abundance, over time**Panel A: correlation coefficient between natural capital (2000) and...**

YEAR	1960	1965	1970	1975	1980	1985	1990	1995
Resource exports / GDP	0.1021	0.1047	0.1157	0.1148	0.2279 *	0.1848 *	0.2289 **	0.2371 **
Resource exports p.c.	0.6470 ***	0.6418 ***	0.5838 ***	0.5655 ***	0.6232 ***	0.6079 ***	0.5383 ***	0.5330 ***

Panel B: correlation coefficient between subsoil capital (2000) and...

YEAR	1960	1965	1970	1975	1980	1985	1990	1995	1999
Resource exports / GDP	0.1730 *	0.1750 *	0.1682 *	0.1798 *	0.2963 **	0.2252 **	0.2722 ***	0.2637 ***	-
Resource exports p.c.	0.4677 ***	0.5027 ***	0.4554 ***	0.5596 ***	0.6419 ***	0.5934 ***	0.5158 ***	0.4673 ***	-
Resource exports/ GDP * oil dummy	0.5514 ***	0.5519 ***	0.5425 ***	0.5629 ***	0.5184 ***	0.4602 ***	0.4699 ***	0.4643 ***	-
Resource exports p.c. * oil dummy	0.5713 ***	0.6030 ***	0.6085 ***	0.6048 ***	0.6008 ***	0.5874 ***	0.5512 ***	0.5350 ***	-
Oil production	0.3506 ***	0.4720 ***	0.5762 ***	0.6193 ***	0.7888 ***	0.9399 ***	0.9317 ***	0.8735 ***	0.6762 ***
Oil reserves	-	0.3703 ***	0.3802 ***	0.3857 ***	0.3836 ***	0.8244 ***	0.6137 ***	0.5716 ***	0.2928 ***

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

natural and subsoil capital in 2000 better predict later oil production or reserves: the coefficient on oil reserves for 1999 is the lowest in the series, and the size of the coefficient on oil production for 1999 is roughly similar to that for 1975.

Another concern is that the year of measurement of natural and subsoil capital is a source of endogeneity. One could argue that present stocks of natural resources reflect past exploitation rates. Furthermore, natural and subsoil capital are constructed using *known* stocks, and resource discovery might be endogenous to conflict. World Bank (2011) investigates the changes in natural and subsoil capital from 1995 to 2005. It concludes that variation is mainly due to changes in world prices of resources (which are the same for all countries in a given year). Where stocks have changed, they have increased most strongly in Sub-Saharan Africa and the Middle East and North Africa. These are two regions we would most strongly associate with violent conflict. Extrapolating this backwards, 2000 levels of natural and subsoil capital are thus likely to overestimate past levels of natural resource abundance in conflict-prone regions, biasing the relationship between natural

resource and conflict upward. This would make it more, not less challenging to prove that earlier obtained results are due to endogeneity.

Empirical strategy

This section will investigate to what extent results obtained by Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009) are driven by endogeneity, by replacing the proxy for natural resource abundance, with subsoil capital and natural capital. Furthermore, it will use natural and subsoil capital as instruments for natural resources exports as a percentage of GDP, natural resource exports per capita and oil production.

It is important to keep in mind which question(s) these analyses address. We may want to know whether countries that are rich or abundant in natural resources are more likely to experience civil conflict. Collier and Hoeffler (2004) and Collier, Hoeffler and Rohner (2009) appear to want to address this question, when they state that natural resources exports as a percentage of GDP is a proxy for natural resource *abundance* (see (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009), Appendix A and Appendix B). Conceptually, this question calls for a cross-country set-up and a measure of the amount of natural resources present. Stocks appear to be an adequate measure of this. Replacing the original proxy for natural resource abundance with natural and subsoil capital, and converting this to a cross-country set-up aims to provide an answer this question.

Alternatively, we may be interested in whether resource production, exports, or resource-dependence increases the likelihood of civil war. This question calls for a time-series or panel data analysis, and is subject to problems of endogeneity described above. Instrumenting for natural resource production, exports and dependence with natural and subsoil capital is one strategy to mitigate these endogeneity problems and arrive at a credible *causal* answer to this question.

To my knowledge, natural and subsoil capital are rarely used in the context of civil conflict, the exceptions being De Soysa (2002) and Brunnschweiler and Bulte (2009). However, neither of these articles are a direct test of whether earlier results are driven by endogeneity. These studies do not only replace the measure of natural resource abundance, but also differ from previous studies in a number of other ways. For instance, they use a different set of explanatory variables, a different time span, a different dependent variable, or a different econometric estimation technique compared to Collier and Hoeffler (2004) or Collier, Hoeffler and Rohner (2009). As results from cross-country studies have been shown to be sensitive to such changes (Fearon 2005; Hegre and Sambanis 2006; Sambanis 2004), we cannot be sure whether the changes in results De Soysa (2002) and Brunnschweiler and Bulte (2009) observe are due to elimination of endogeneity or to different changes to the specification. Furthermore, Brunnschweiler and Bulte (2009) use an instrumental variable model, using natural and subsoil capital as two of a number of other instruments for natural resource exports as percentage of GDP. This is problematic, because their additional instruments likely violate the exclusion restriction. These are latitude (known to be correlated to

institutions (Rodrik, Subramanian, and Trebbi 2004)), percentage of land area in the tropics (potentially correlated to malaria risk and long-term economic development (McArthur and Sachs 2001)) and distance to the nearest coast or navigable river (potentially correlated to economic development). Hence, these instruments are plausibly correlated to violent conflict via a mechanism other than natural resource abundance.

Results

Table 3 presents the model employed by Collier and Hoeffler (2004). Column (1) replicates the logit regression presented in Collier and Hoeffler (2004) Table 5 column 3. A detailed description of the control variables and data sources is provided by Collier and Hoeffler (2004) and reproduced in Appendix A of this thesis. The only difference between the original analysis and the one presented here is that I use robust standard errors, taking into account possible heteroscedasticity and/or autocorrelation within panel data. As we can see from column (1), natural resource exports as percentage of GDP and its square are significant at 1 per cent in the original analysis, suggesting an inverse U-shaped relationship between natural resources and war.

In column (2), the original measures of natural resource abundance are replaced with natural capital and its squared term. The relationship observed earlier loses its significance, and the coefficient now carries a negative sign. Entering subsoil capital as a measure of natural resource abundance similarly shows no significant relationship between resource and war onset (column (3)). Using the natural logarithm of either two variables equally gives similar results (not shown).

Although replacing the original variable only results in a marginal loss of observations, one might be concerned that this loss of significance is an artefact of a different sample composition. Therefore, I run the original regression on the same sample as used in columns (2) and (3). As shown in column (4), this does not cause the coefficient on natural resource exports as a percentage of GDP to lose significance. In fact, the size of its coefficient increases somewhat. Sample composition does not seem to drive the loss of significance. Experimenting with dropping various control variables or step-wise deletion of insignificant controls equally does not cause either subsoil or natural capital to become significant at any conventional level.

Table 3 shows us that using an arguably more exogenous measure of natural resource abundance can have large consequences for the relationship observed. Using either exogenous measure, no evidence can be found for a positive significant relationship between natural resource abundance and civil conflict. The original results, concluding that this relationship does exist, appear to have been driven by endogeneity.

Table 3: Replacing natural resource abundance in Collier and Hoeffler (2004)

	(1)	(2)	(3)	(4)
<hr/>				
CIVIL WAR ONSET				
Natural resource exports / GDP	37.0716*** (10.565)			42.6033*** (11.093)
Natural resource exports /GDP ²	-69.2696*** (22.323)			-78.0838*** (23.576)
Natural capital		-0.3480 (1.057)		
Natural capital ²		-0.0334 (0.288)		
Subsoil capital			0.4971 (1.327)	
Subsoil capital ²			-0.3262 (0.534)	
Post cold war dummy	-0.8730 (0.822)	-0.9217 (0.759)	-0.8860 (0.749)	-1.2948 (0.951)
Male secondary schooling	-0.2878** (0.136)	-0.0862 (0.166)	-0.1324 (0.164)	-0.2286 (0.168)
GDP growth (t-1)	-0.0455 (0.053)	-0.0390 (0.064)	-0.0396 (0.062)	-0.0192 (0.064)
Peace duration	-0.3446 (1.328)	-2.3094* (1.326)	-2.1904 (1.357)	-0.3577 (1.516)
Mountainous terrain	0.5436 (1.044)	0.4086 (1.035)	0.3272 (1.047)	1.1019 (1.183)
Geographic dispersion	-4.0317*** (1.450)	-2.7158* (1.423)	-2.8384** (1.375)	-4.9182*** (1.544)
ln Population	0.9272*** (0.256)	0.4013*** (0.144)	0.3993*** (0.150)	1.1295*** (0.254)
Social fractionalization	-0.8450** (0.341)	-0.1008 (0.355)	-0.1242 (0.346)	-0.8121** (0.377)
Ethnic fractionalization	0.0412** (0.019)	0.0170 (0.017)	0.0172 (0.017)	0.0397* (0.022)
Religious fractionalization	0.1479 (0.185)	-0.1886 (0.208)	-0.1541 (0.200)	0.0515 (0.214)
Polarization	-25.2763 (15.855)	-0.6202 (13.487)	-1.9408 (13.928)	-27.5817 (17.779)
Ethnic dominance	2.0202* (1.125)	0.2982 (0.914)	0.4458 (0.942)	2.3759* (1.281)
Democracy	-1.7692 (6.041)	-2.5802 (7.318)	-1.4184 (7.478)	0.0723 (6.478)
Income inequality	0.0252 (0.029)	0.0397 (0.027)	0.0362 (0.027)	0.0397 (0.034)
Observations	479	450	450	450

Robust standard errors in parentheses.

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

Table 4: Using different years of measurement

CIVIL WAR ONSET	(1)	(2)	(3)	(4)	(5)	(6)
Natural capital 1995	4.489 (2.741)					
Natural capital ² 1995	-3.080* (1.857)					
Subsoil capital 1995		0.997 (1.618)				
Subsoil capital ² 1995		-0.830 (0.772)				
Natural capital 2000			1.689 (1.320)			
Natural capital ² 2000			-0.939* (0.494)			
Subsoil capital 2000				1.142 (1.549)		
Subsoil capital ² 2000				-0.840 (0.767)		
Natural capital 2005					1.474 (1.270)	
Natural capital ² 2005					-0.629 (0.462)	
Subsoil capital 2005						0.778 (1.006)
Subsoil capital ² 2005						-0.350 (0.348)
Observations	440	440	458	458	459	459

Robust standard errors in parentheses

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

One may be concerned that these results are sensitive to the year of measurement of natural and subsoil capital, even though these measures have been shown to correlate systematically to past resource exports in an earlier section. Therefore, Table 4 shows the results of replicating the regressions in columns (2) and (3) of Table 3 using data on natural and subsoil capital for different years, published by the World Bank in 2011. As highlighted earlier, these measurements are slightly suspect, since they use a country-specific discount rate. Coefficients on the control variables are omitted for brevity. For none of the alternative years of measurement, does natural or subsoil capital enter the regression significantly. No significant relationship between natural resource abundance and conflict is found for any of the years of measurement. The coefficient on natural capital squared is significant at the ten per cent level in two instances (columns (1) and (3)), but this result is difficult to interpret given the lack of significance of the main variable. Table 4, thus provides no evidence that results are sensitive to the year of measurement.

With Table 5, I turn to the question whether natural resource dependence, natural resource exports, and oil production are related to violent civil conflict. In this case, I use subsoil capital, natural capital, or the combination of both as instruments. Instrumental variable models are estimated by

IV probit, since IV logit does not exist. In the IV models, I drop the quadratic term, both because its use has been sharply criticized (see for example (Fearon 2005)) and because keeping the quadratic endogenous variable and instrument introduces multicollinearity, which causes the IV probit model to fail to achieve convergence. For comparison, logit and probit models omitting the quadratic terms are also given. In all models, the same control variables as in Table 3 are included, but coefficients are omitted from the table.

Panel A of Table 5 again reproduces the original model from Collier and Hoeffler (2004) (column (1)), and shows that the relationship between natural resource dependence and civil war is robust to omitting the quadratic term and to shifting the method of estimation to probit (columns (2) and (3)). It is not, however, robust to instrumenting for natural resource exports over GDP using any combination of instruments. All coefficients in the IV models carry a negative sign, and the coefficient in column (6), using only natural capital as instrument, is even significant at the ten per cent level. Again, the relationship between natural resources and conflict, more specifically the relationship between natural resource dependence and civil war onset, turns insignificant when addressing potential endogeneity.

In Panel B, natural resource exports weighted by population rather than GDP is used as the independent variable of interest. Resulting coefficients in column (1) of panel B still carry similar signs to those in panel A, but they are no longer significant. Instrumenting for natural resource exports per capita again results in coefficients that are insignificant, of smaller size, and in two cases negative. However, as columns (2) and (3) show, this may also be due to dropping the quadratic term, or change in estimation method respectively.

Finally, panel C uses Humphreys (2000) measure of oil production. This is positively, yet not significantly related to civil war onset in columns (1), (2) and (3). However, when instrumenting for oil production using subsoil capital, the coefficient on oil production is negative, though again insignificant.

In sum, results on natural resource dependence are similar to the ones obtained earlier this section. I generally fail to find a significant positive relationship between civil war onset, and natural resource exports and oil production respectively, using data from Collier and Hoeffler (2004). Results obtained provide some suggestive evidence that addressing endogeneity problems can change the size and sign of the coefficients, and thus the relationship observed, for these variables.

Let us now return to the relationship between natural resource *abundance* and civil war. It was observed earlier that this is conceptually a cross-sectional question. Furthermore, since natural capital and subsoil capital are time-invariant, as are many of the control variables, the time dimension seems to add little to the new analysis. Therefore, I convert the data into cross-sectional data. As a rule, this involves taking the average of the available data for each variable, by country. The only exceptions are social and religious fractionalization: since these variables only change at one point in time, the 1960 value is used, analogous to ethnic fractionalization. The dummy for the post-Cold War period and the peace duration variable (days since the last war) are dropped. Lastly,

Table 5: Instrumental variable models

Panel A: Resource dependence						
CIVIL WAR ONSET	(1) logit	(2) logit	(3) probit	(4) IVprobit	(5) IVprobit	(6) IVprobit
Natural resource exports / GDP	37.07*** (10.56)	3.921** (1.736)	1.853** (0.892)	-4.094 (4.871)	-3.235 (4.958)	-6.711** (3.329)
Natural resource exports / GDP ²	-69.27*** (22.32)					
Instruments:				Natural and subsoil capital	Subsoil capital	Natural capital
Observations	479	463	479	450	450	450
Panel B: Resource exports						
CIVIL WAR ONSET	(1) logit	(2) logit	(3) probit	(4) IVprobit	(5) IVprobit	(6) IVprobit
Natural resource exports p.c.	45.87 (39.14)	0.158 (6.726)	-0.0356 (3.491)	-0.289 (5.278)	0.425 (4.886)	-4.213 (6.384)
Natural resource exports p.c. ²	-548.9 (457.6)					
Instruments:				Natural and subsoil capital	Subsoil capital	Natural capital
Observations	479	463	479	450	450	450
Panel C: Oil production						
CIVIL WAR ONSET	(1) logit	(2) logit	(3) probit	(4) IVprobit		
Oil production p.c.	118.2 (78.41)	27.32 (21.08)	12.79 (11.07)	-28.79 (50.54)		
Oil production p.c.	-2900 (2270)					
Instruments:				Subsoil capital		
Observations	467	467	467	437		

Robust standard errors in parentheses

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

income inequality was dropped, allowing more countries in the sample. Including it would lead to a radical loss of observations, while not changing the coefficients of interest meaningfully.

An advantage of the cross-section analysis is that I can construct multiple dependent variables. This allows me to investigate the effect of natural resource abundance on various indicators for civil war. One possible dependent variable is a dummy indicating whether a war started in a given country at any time between 1960 and 1999. Alternatively, the number of wars occurring in the same period could be used. I construct both variables twice, once using the list of

Table 6: Cross-country models of natural resource abundance and violent conflict

DEPENDENT	War dummv (1)	War dummv (2)	# Wars (3)	# Wars (4)	War duration (5)	Ave duration (6)	Casualties (7)	Ave casualties (8)
PANEL A								
Natural resource exports / GDP	8.4355 (-7.4263)	9.5083 (-7.5884)	4.3789* (-2.5089)	4.4297** (-2.1033)	3,506.67 (-5,989.33)	1,127.13 (-3,388.24)	51,485.53 (-232,463.31)	28,196.25 (-114,593.99)
Natural resource exports /GDP ²	-21.551 (-15.6865)	-23.7569 (-16.1745)	-8.7144* (-4.6496)	-8.7516** (-3.8978)	-8,742.20 (-11,104.34)	-4,570.22 (-6,310.20)	9,318.43 (-430,963.01)	-39,227.09 (-213,397.63)
Observations	118	118	118	118	108	115	109	116
R-squared			0.258	0.282	0.198	0.188	0.164	0.163
PANEL B								
Natural capital	-0.621	-1.109	0.0344	0.1866	-1,321.4112*	-903.3774**	-11,738.55	-9,049.04
Natural capital ²	-1.261	-1.247	-0.31	-0.263	-774.327	-417.109	-30,118.58	-11,996.98
Observations	97	97	97	97	90	94	91	95
R-squared			0.263	0.279	0.232	0.22	0.214	0.192
PANEL C								
Subsoil capital	1.57	0.7885	0.2716	0.42	-969.628	-676.615	-16,746.48	-9,067.97
Subsoil capital ²	-1.951	-1.935	-0.334	-0.281	-858.124	-458.52	-32,892.87	-12,947.07
Observations	97	97	97	97	90	94	91	95
R-squared			0.269	0.294	0.215	0.194	0.215	0.191

Standard errors in parentheses. Dependent variables: (a) war occurrence 1960-1999 (Sarkkees 2000) (b) war occurrence 1960-1999 (Collier and Hoeffler 2004) (c) number of wars 1960-1999 (Sarkkees 2000) (d) number of wars 1960-1999 (Collier and Hoeffler 2004) (e) total number of days at war 1960-1999 (f) average number of days per war (g) total number of war casualties 1960-1999 (h) average number casualties per war. Controls for male secondary schooling, GDP growth, mountainous terrain, geographic dispersion, ln population, social, ethnic and religious fractionalization, polarization, ethnic dominance and democracy are included. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

wars printed in Collier and Hoeffler's article and once using an updated version of the Singer and Small dataset they use (Sarkees 2000). The variables differ considerably, both because the set-up of the dataset has been changed (see Sarkees 2000 for details) and because Collier and Hoeffler seem to have made additions to the original dataset (Elbadawi and Sambanis 2002). Using the updated Singer and Small dataset, I can also obtain the number of days a country was at war between 1960-1999, the average number of days per war, the total number of casualties and the average number of casualties per war. As most of these dependent variables are no longer dichotomous I use linear regression instead of logit regression, except in the case of both dummy variables corresponding to war starts.

Table 6 summarizes the results from running a similar specification as in Table 3 on the thus created cross-sectional data. Subsoil capital is not significantly related to any of the eight dependent variables (panel C). Natural capital is equally unrelated to all aspects of civil war, except the total and average number of days at war. It is significant and *negatively* related to the latter two variables (panel B). This suggests that natural resource abundance actually shortens civil war duration, a result that has been obtained before by Humphreys (2005). He argues that natural resource abundance can facilitate military victory if the benefits accrue to the strongest party to a conflict. However, the same pattern cannot be found using subsoil capital, so this result is not robust. The coefficients on both squared terms are consistently insignificant, providing little evidence that a quadratic relationship exists. The strong relationship between natural resources as a percentage of GDP and civil war only partly survives the conversion to cross-section: it is only significant (at the ten per cent level) using the number of wars as a dependent variable (panel A).

This exercise shows that within this cross-section dataset, no positive significant relationship can be found between natural and subsoil capital and any aspect of civil war.

Addressing endogeneity causes the conclusions found by Collier and Hoeffler (2004) to change quite dramatically. However, Collier and Hoeffler have published a new version of their analysis in 2009 together with Dominique Rohner, one they state is an improvement over their 2004 one. Therefore, it is interesting to see if using natural and subsoil capital in this new analysis has a similar impact.

Table 7 presents the results using this new specification. Column (1) replicates the result obtained by Collier, Hoeffler and Rohner (again the only difference being the use of robust standard errors). Description of the control variables and data sources reproduced from Collier, Hoeffler and Rohner (2009) can be found in Appendix B. Natural resource exports as a percentage of GDP and its square are significantly related to conflict, though at a considerably lower level than in the previous analysis (10 per cent).

Column (2) and (3) show the same models, replacing the original measure of natural resource abundance. Results are very similar to those obtained for the Collier and Hoeffler (2004) study. Again, replacing the original proxies for natural resource abundance with natural and subsoil

Table 7: Replacing natural resource abundance in Collier, Hoeffler and Rohner (2009)

CIVIL WAR ONSET	(1) logit	(2) logit	(3) logit	(4) logit	(5) probit	(6) ivprobit	(7) ivprobit
Natural resource /exports / GDP	7.1495* (3.9831)			4.7999 (5.0865)	-0.1011 -0.54	-1.1046 -2.426	-4.0282* -2.165
Natural resource Exports / GDP ²	-14.5810* (7.7718)			-9.4272 (11.6577)			
Natural capital		0.4188 (0.951)					
Natural capital ²		-0.2957 (0.278)					
Subsoil capital			1.3613 (1.085)				
Subsoil capital ²			-0.7700* (0.465)				
ln GDP	-0.2323* (0.1206)	-0.3445* (0.1924)	-0.4437** (0.1801)	-0.3607** (0.1462)	-0.1399** -0.056	-0.1804** -0.073	-0.1572** -0.07
GDP growth	-0.1477*** (0.0346)	-0.0969* (0.0558)	-0.0915* (0.0535)	-0.1205*** (0.0442)	-0.0816*** -0.017	-0.0676*** -0.022	-0.0594*** -0.022
Post cold war dummy	-0.1349 (0.3710)	-0.2139 (0.4364)	-0.2096 (0.4273)	-0.0342 (0.4459)	-0.1054 -0.196	-0.0215 -0.233	-0.0738 -0.214
Previous war dummy	-0.0818 (0.4879)	0.0355 (0.5125)	0.0666 (0.5103)	-0.1376 (0.5671)	0.0694 -0.221	-0.045 -0.249	-0.0181 -0.228
Years since previous war	-0.0579*** (0.0154)	-0.0441*** (0.0165)	-0.0420** (0.0168)	-0.0540*** (0.0176)	-0.0268*** -0.007	-0.0263*** -0.008	-0.0227*** -0.008
Former French African colony	-1.2032** (0.6046)	-0.7685 (0.6246)	-0.7162 (0.6326)	-0.8593 (0.6898)	-0.6285** -0.306	-0.4758 -0.333	-0.4383 -0.309
Social fractionalization	2.1734*** (0.7820)	1.9105** (0.9291)	1.7676* (0.9351)	1.8951** (0.9662)	1.1782*** -0.397	1.1034** -0.558	1.3450*** -0.454
Proportion of young men Population	12.4933 (7.9723)	18.2281** (8.2574)	18.4066** (8.2181)	18.1814** (8.4871)	5.1783 -3.486	9.8109** -4.578	11.3898*** -3.863
	0.2764*** (0.0856)	0.1810** (0.0743)	0.1566** (0.0765)	0.2097** (0.1063)	0.1278*** -0.039	0.0676 -0.074	-0.011 -0.075
Mountaneous terrain	0.0110 (0.0074)	0.0188*** (0.0072)	0.0185** (0.0075)	0.0190** (0.0082)	0.0046 -0.004	0.0073 -0.005	0.0035 -0.005
Democracy	0.0123 (0.0452)	0.0888 (0.0567)	0.0976* (0.0582)	0.0800 (0.0586)	0.0057 -0.022	0.0255 -0.031	0.0063 -0.029
Instrument						Subsoil capital	Natural capital
Observations	1063	863	863	828	1063	828	828

Robust standard errors in parentheses.

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

capital causes the relationship observed by Collier, Hoeffler and Rohner (2009) to disappear: it results in insignificant coefficients that are small in size. The only difference is that subsoil capital squared is significant at 10 per cent level, but with subsoil capital itself being insignificant, this result seems hard to interpret

In this analysis, considerably more observations are lost when replacing natural resource production as a percentage of GDP with natural and subsoil capital. Running the original analysis on exactly the same reduced sample is not possible in this case, as the original variable is not available for 35 observations that do have values for natural and subsoil capital. The results obtained by also omitting these 35 observations are presented in column (4). The fact that natural resource production as a percentage of GDP and its square enter this regression insignificantly indicates that we cannot exclude the possibility that (part of) the loss of significance is due to changes in sample composition. As noted before, results from cross-country studies have been shown to be fragile to relatively minor changes in specification.

Column (5) reinforces this impression: the coefficient on natural resource exports as a percentage of GDP loses significance and decreases in size when omitting the quadratic term and switching to a probit model. This is due to the former change: a probit model including the quadratic term gives results qualitatively similar to those in column (1). Columns (6) and (7) show the results obtained when instrumenting for natural resource exports using natural and subsoil capital. As before, this decreases the size of the coefficients of interest considerably. Natural resource exports as instrumented by natural capital even enters the regression negative and significant, at the ten per cent level, see column (7).

As with the Collier and Hoeffler 2004 analysis, I subsequently converted the data into a cross-sectional model. The results mirror the ones obtained before. No evidence consistent with a positive relationship between natural or subsoil capital and war can be found in a cross-section analysis.

The conclusion of this section is that the relationship between natural resource abundance and conflict observed by the two articles under study is driven to a large extent by endogeneity. Replacing the potentially endogenous proxy for natural resource abundance with two arguably more exogenous measures, or using the latter as instruments for the former, changes the conclusion of the analysis radically. The relationship between natural resource abundance and conflict onset disappears. This, combined with the critiques on cross-country studies found in the literature, leads me to conclude that the *causal* relationship between natural resources and conflict, as evident from cross-country studies, is not as strong as popularly believed.

Theoretical models and mechanisms: the ‘how’ of this relationship

The previous sections dealt with *whether* there is a connection between natural resources and war. An equally interesting question is *how* this relationship exactly works, because different *mechanisms* through which natural resources may lead to violence suggest different solutions to the problem. For example: if we believe that natural resources with poorly protected property rights incite more violence because they are easily ‘lootable’ we may suggest giving the state more control over the resources. However, if we believe that the rents flowing from natural resources result in poor quality government, this may well be the last thing we want to do.

A (further) criticism directed at cross-country studies is that they lack a theoretical model (Besley and Persson 2008), although they suggest numerous mechanisms connecting resources and war. Having a theoretical model is useful because some mechanisms that sound reasonable at first glance are actually incomplete, require unrealistic assumptions or make unrealistic predictions. For example, the best known mechanisms supposedly connecting resources and war is ‘greed’ (Collier and Hoeffler 2004). A layman’s interpretation of ‘greed’ could be something similar to “if there is lootable wealth lying around in the form of resources, there will always be people willing to fight over it”. However, some lootable asset is likely present that at all times and all places (if not natural resources, then land, tools, cash, bicycles or smartphones), so this way of thinking unrealistically predicts that people will always be fighting everywhere (if anything, more in rich countries as they have more assets). This ‘model’ lacks some sense of the cost of conflict. Another example is that the existence of insurgent groups financed by the proceeds of natural resource sales is sometimes regarded as ‘smoking gun’ evidence that natural resources cause conflict. However, how can we be sure that these insurgent groups would not have found some other source of funding in absence of natural resources (such as abduction for ransom, funding from a rival state or extortion)? And how do we explain countries without insurgency, despite sufficient funding? This ‘model’ requires information on why it was deemed advantageous to start an insurgency in the first place and on whether funding is a constraining factor.

Several theoretical mechanisms connecting natural resources to violent conflict have been proposed. It is possible that natural resources affect the *returns to conflict*. This comes in two variations: resources may either increase the returns to holding territory or the ‘prize’ of obtaining government power. Secondly, resources may affect the *opportunity cost of conflict*, through impacting the wage rate. A third possible mechanism suggests that natural resources impact the *quality of government*, meaning the government invests less in productive policies or strengthening of institutions, and more in clientelistic hand-outs and/or oppression of the opposition. Finally, proceeds of natural resources may finance conflict, and thereby *relieve a credit constraint*. This section will outline the intuition behind various theoretical models, deferring the question of whether they adequately describe reality to the next section.

Focussing on the returns to holding territory, Garfinkel, Skaperdas and Syropoulos (2008) construct a model of a country in which two groups can decide to allocate labour to fighting over some contested amount of oil-producing land. If the price of oil increases, the contested land becomes more valuable (returns to conflict go up) and the groups allocate more labour to conflict in order to obtain it. Hence, the model predicts that an increase in the price of a resource with insecure property rights leads to an increase in violent conflict.

An alternative model by Dal Bó and Dal Bó (2004) also assumes that labour is the main input to conflict, yet focuses on the opportunity cost of violence. It features a country with two productive sectors (one capital-intensive and one labour-intensive) and one expropriation sector violently stealing a fraction of total production. Individuals face the decision whether to use their labour to produce or to expropriate; the opportunity cost of allocating labour to violent expropriation is the wage this labour could have earned in the productive sectors. Wages, and thereby the opportunity cost of violence, decrease as the price of a capital-intensive good increases, for the following reason. As the price of a capital-intensive good increases, the capital-intensive sector expands and the labour-intensive sector contracts. The contracting labour-intensive sector releases more labour onto the market than the capital-intensive sector can absorb at the going wage rate, hence wages decrease. In real world terms, the model predicts that an increase in the price of a natural resource with a capital-intensive production process depresses wages and encourages violence. Conversely, violence decreases with the price of a labour-intensive natural resource.

Janus (2012) combines both the opportunity cost and returns to conflict mechanisms in one model, and adds a third, natural resources as relieving a credit constraint. In contrast to other models, it allows for a resource stock that is exhaustible and for capital to be an input to violence, in addition to labour. In the model, two groups possess a fixed amount of labour that can be allocated to producing agricultural goods, to producing natural resources or to fighting over the remaining stock of natural resources. Earnings from natural resources can be used to purchase a capital input to fighting (such as weapons). It is possible that natural resource earnings are not sufficient to buy as much 'fighting capital' as a group would optimally want, in which case the group faces a binding credit constraint. Janus shows that whether his model supports the opportunity cost mechanism (a decrease in agricultural productivity leads to increased fighting) or the returns to conflict mechanism (an increase in the stock or price of natural resources leads to increased fighting) depends on whether this credit constraint is binding. In addition, he shows that an increase in the price of the capital input to conflict (the aim of an arms embargo) could have adverse effects if the credit constraint does not bind (Janus 2012). Although pointing to important omissions of other models, these results may depend on a number of contestable assumptions for which Janus offers few justifications, such as the assumed production functions for the three sectors, the assumption that earnings from agriculture cannot be used to purchase 'fighting capital' and the premise that the amount of natural resources extracted is large enough relative to the remaining stock to meaningfully influence the returns to fighting.

What is perhaps most notably absent from all the above models is a policy-making government. Yet, numerous arguments exist that the proceeds from natural resources (mainly oil revenues) impact the behaviour of governments, creating so-called ‘petro-states’ combining strong dependence on oil revenue, extensive rent-seeking, unsuccessful development policies and political instability (Karl 1997). Kaldor, Karl and Said (2007) formulate this as an ‘oil rent-seeking cycle’, in the later stages of which governments need to rely increasingly on rent-seeking and repression to remain in power, eroding state institutions, leading to ‘new oil wars’ and eventual state failure. A variation on this argument is that natural resource wealth attracts corrupt politicians garnering support through identity politics, which makes war along real or imagined ethnic lines more likely (Kaldor, Karl, and Said 2007).

Besley and Persson (2010) construct a model explaining why extensive natural resource extraction, low income, low state capacity and violent conflict so often go together. In the model, the government receives natural resources and tax revenue, which it can use to fund army wages, public goods, investments in state capacity and/or *de facto* transfers to its own group. An opposing group can raise an army to replace the government. If natural resource rents increase, the ‘prize’ attached to obtaining government power increases, as this means more revenue that the government can potentially redistribute to its own group. This gives both the opposition and the government a greater incentive to arm. Furthermore, when there is violent conflict, the government has a smaller interest in investing in state capacity, as supporting economic development increases wages and thereby the government’s costs of raising an army (Besley and Persson 2008). Hence, natural resource rents raise the returns to conflict *and* decreases the opportunity cost of conflict through low quality government. Employing a similar reasoning, Caselli (2006) presents a model in which a government of a natural resource rich country faces a greater chance of being displaced and therefore invests less in long-term economic growth (Caselli 2006).

However, not all theoretical models predict that natural resources are an economic as well as a political curse. In a model by Tsui (2010), natural resource rents actually induce governments to choose more optimal economic policies. This follows from the assumption that taxing the natural resource sector is subject to lower dead-weight transaction costs than taxing other productive activity and that the incumbent can gain political support by increasing citizens’ income. Tsui further expands on the possibility that increasing natural resource rents may not necessarily lead to outright civil war but to more government repression discouraging the opposition from engaging in violence (Tsui 2010).

More empirics: which mechanism(s) do the data support?

The previous section has identified four potential theoretical mechanisms through which natural resources can lead to violent conflict: returns to conflict (either the returns to holding territory or the ‘prize’ of obtaining government), opportunity cost of conflict, quality of government and

relieving a credit constraint. However, the fact that a theory is coherently formulated and internally consistent does not necessarily make the theory ‘true’, in the sense that it successfully describes reality. Therefore, this section returns to empirics, asking which of the four theoretical mechanisms are supported by real-world information.

The opportunity cost of conflict versus the returns to conflict mechanism

First, consider the opportunity cost of conflict mechanism. A number of studies take GDP as an indicator for income or wage, and investigate whether the price of natural resources affects GDP and thereby conflict risk (using the same definition of civil conflict as cross-country studies). Studies of this type essentially attempt to find evidence that as the price of a particular natural resource decreases, GDP decreases and conflict risk increases more in countries possessing this particular resource than in countries without this resource. Aggregating all types of resources, Brückner and Ciccone (2010) conclude that this is the case, supporting the opportunity cost mechanism (Brückner and Ciccone 2010), while Bazzi and Blattmann (2011) find no evidence for this supposition (Bazzi and Blattman 2011). However, this seems like rather a rough test of the opportunity cost of conflict mechanism: GDP does not translate directly into individuals’ incomes and depending on whether a resource is labour or capital intensive, shocks to its price may have opposite effects on wages (Dal Bó and Dal Bó 2004). It seems therefore useful to distinguish different types of resources. When doing so, Bazzi and Blattmann find some evidence that an increase in the price of certain agricultural resources is associated with decreased violent conflict and conclude that the opportunity cost mechanism is the only mechanism supported by their data, although weakly.

Dube and Vargas (2009) provide a direct test of the theory put forward by Dal Bó and Dal Bó. They compare the impact of changes in the price of a capital-intensive resource (oil) on areas in Columbia abundant in this resource, to the impact of changes in price of a labour-intensive resource (coffee) in areas of Columbia suited to coffee production. The Dal Bó and Dal Bó model would predict that an increase in the price of the oil would lead to an increase in violence in areas possessing this resource, whilst an increase in the price of coffee would lead to a *decrease* in violence. This is indeed what the study finds (Dube and Vargas 2009). Chapter two of this thesis will provide another test of the opportunity cost mechanism. It compares the impact of an increase in the international diamond price in areas with a geological propensity for primary diamonds, secondary diamonds and no diamond propensity respectively. As primary diamonds are characterized by a capital-intensive production process and secondary diamonds by a labour-intensive one, the Dal Bó and Dal Bó model predicts that former are positively, and the latter negatively related to violence. Chapter two will show that this is indeed the case.

The critical reader may remark that a positive relationship between the price of a capital-intensive resource (like oil or primary diamonds) and violence could also be considered evidence in

favour of the returns to conflict mechanism. Proceeds from capital-intensive resources commonly accrue directly to the government, potentially contributing to the 'prize' of capturing it.

One way to distinguish between the opportunity cost of conflict mechanism and the returns to conflict mechanism is to consider the location where the violence takes place: if wage rates were the true mechanism, we would expect violence to go up in the region the resource is produced, whilst the returns to conflict mechanism would predict that violence would increase in the capital, where the government is located. Dube and Vargas (2009) and chapter two of this thesis find increasing violence in resource-producing regions, but not in the capital, failing to support the returns to conflict mechanism. Furthermore, the latter finds that secondary diamonds, one of the archetypically 'lootable' resources with poorly protected property rights, are unrelated or even negatively related to violence, providing an additional argument against the returns to conflict mechanism suggested by the Garfinkel, Skaperdas and Syropoulos (2008). Other studies equally fail to find evidence in support of the returns to conflict mechanism. Bazzi and Blatmann (2011) conclude that an increase in the price of so-called 'extractive' resources does not increase conflict risk. Cotet and Tsui (2010) find that the chance of experiencing a coup or irregular leader transition does not increase after an oil discovery. In sum, there has been very little empirical support for the returns to conflict mechanism.

In contrast to the above works, Angrist and Kugler (2008) fail to find any evidence supporting the opportunity cost mechanism in the case of coca. They investigate the impact of a military campaign cutting off the supply of raw coca to Colombia, dramatically increasing domestic production. This could potentially have a positive effect on livelihoods in coca-growing regions. However, the military campaign is concluded to be unrelated to local livelihoods and to have *increased* rather than decreased violent deaths in coca growing regions (Angrist and Kugler 2008).

Overall then, there has been a reasonable amount of research on the opportunity cost mechanism, most of it providing support for it. Studies generally fail to find evidence in favour of the returns to conflict mechanism. However, the case of illegal drugs is an exception.

The analysis in the previous section occasionally provides some support for the opportunity cost mechanism as well, but no support for the returns to conflict mechanism. Note that natural capital includes agricultural resources that could be characterized as labour-intensive, as it includes rents derived from cropland and pastureland. Subsoil capital, including fossil fuels and minerals, includes natural resources commonly considered capital-intensive. Subsoil capital is not significantly related to civil war onset in any of the regressions presented in the previous section. When using natural capital, we observe a significant negative relationship between natural resources and violent conflict in some cases. Natural capital appears to be negatively related to war duration (Table 6, columns (5) and (6)) and instrumenting for natural resource exports using natural capital results in a negative relationship between natural resources and war onset (Table 5, column (6), Table 7, column (7)). The relationship between natural capital and civil war is not significant in any other regressions.

However, natural capital is an *aggregation* of subsoil capital and various types of natural resources that could be considered labour-intensive. This could weaken the results. To investigate this, I subtract subsoil capital from natural capital, so that the resulting measure only includes rents derived from cropland, pastureland, forests and protected areas. I call this measure agricultural capital. I enter this variable in the models by Collier and Hoeffler (2004), Collier, Hoeffler and Rohner (2009) and in the cross-sectional models presented in the previous section. The quadratic term is dropped, because there is no theoretical reason to believe that the relationship between agricultural capital and civil war is U-shaped. All models include the same set of control variables as before.

Table 8: Opportunity cost of conflict mechanism

Model	Coefficient on agricultural capital	Robust standard error on agricultural capital
Collier and Hoeffler (2004)	-0.4138**	(1.7934)
Collier, Hoeffler and Rohner (2009)	-2.3161**	(1.0788)
Cross-section:		
War occurrence (Sarkees 2000)	-5.7410**	(2.556)
War occurrence (Collier and Hoeffler 2004)	-6.3396**	(2.642)
Number of wars (Sarkees 2000)	-0.1438	(0.234)
Number of wars (Collier and Hoeffler 2004)	-0.1074	(0.199)
War duration	-553.8688	(569.925)
Average war duration	-353.1364	(321.901)
Total war casualties	3,390.9326	(21,902.872)
Average war casualties per war	-870.0355	(9,090.698)

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

Table 8 presents the coefficients on agricultural capital in the various models. In all four models of war occurrence, agricultural capital is negatively related to civil war onset. All coefficients are significant at the five per cent level. Countries abundant in agricultural capital appear to be significantly *less* likely to enter into a civil war. Agricultural capital appears to be unrelated to the number of wars, war duration or war intensity in the cross-section models however. The previously observed negative relationship between natural capital and war duration is not replicated for agricultural capital.

The results presented in Table 8 thus present evidence in favour of the opportunity cost mechanism in the case of civil war onset, in line with most of the existing literature.

Quality of government mechanism

A number of studies investigate the impact of natural resources on government quality, with mixed results. Some research suggests that natural resources increase the level of repression or autocracy in non-democratic countries. For example, Caselli and Tesei (2011) find that an increase in the price of a countries' principal export commodity is associated with a decrease in polity score for non-democratic countries (Caselli and Tesei 2011). Similarly, Cotet and Tsui (2010) conclude that

military spending as a percentage of GDP increases in non-democratic countries following an oil discovery, suggesting that governments increase the level of repression. However, Brückner, Ciccone and Tesei (2012) find that a positive shock to oil prices is related to an increase in GDP and an *improvement* in democracy, as measured by various indicators, in countries that possess oil (Brückner, Ciccone, and Tesei 2012).

The quality of government mechanism also suggests that there is a link between government quality and civil war risk. Only Cotet and Tsui (2010) attempt to investigate this. They find no increase in the probability of civil war, coups or irregular leader transitions after oil discoveries. In general, polity score does not consistently explain civil war (Sambanis 2004). This does not necessarily mean that the quality of government mechanism is not valid. Government quality is multifaceted and extremely difficult to measure and the process from resource discovery to government behaviour to political violence may take a long time, making it difficult to identify such a relationship.

The model by Besley and Persson (2008) suggests that when institutions are of high-quality (i.e. if they do not allow preferential distribution of proceeds from natural resources to the ruler's own group), the presence of natural resources need not increase war risk. I investigate this in the cross-section. In this model, I include an interaction term between subsoil capital and institutional quality. Subsoil, rather than natural capital is included because proceeds from subsoil capital are most likely to accrue to the national government. Four measures of institutional quality are used: average protection against expropriation (Acemoglu, Johnson, and Robinson 2001), the legal structure and security of property rights (Fraser Institute 2008), government effectiveness (Kaufmann, Kraay, and Mastruzzi 2008) and overall institutional quality (Mehlum, Moene, and Torvik 2006), henceforth called MMT IQ. All measures score institutional quality on some scale, with a higher value indicating better institutions. When appropriate, I compute the average of the available scores over the relevant period (1960-2000). Since institutions can be assumed to be endogenous to civil war, I instrument for institutional quality and for the interaction between institutional quality and subsoil capital using the inverse of the colonial settler mortality rate (Acemoglu, Johnson, and Robinson 2001) and the interaction between the inverse of the settler mortality rate and subsoil capital. Because this instrument is only available for a subsample of ex-colonies, a considerable number of observations are lost. The dependent variable is the number of wars over the period according to Sarkees (2000).

Table 9 shows the results. The signs of the coefficients are consistent with the quality of government mechanism as modelled by Besley and Persson (2008), but results are rarely significant. The coefficients on the subsoil capital are consistently positive, which is expected if natural resources increase the number of civil wars in countries with poor institutional quality. The interaction term enters all regressions with a negative sign, which is again expected if natural resources do not increase the number of civil wars in countries with good institutions. With the exception of column (2), the signs of the coefficients on institutional quality are negative, consistent

with the idea that countries with good institutions experience civil war less often. However, given that only the interaction term in column (1) enters the regression significantly, this cannot be considered strong evidence in favour of the quality of government mechanism.

Table 9: Quality of government mechanism

NUMBER OF CIVIL WARS	(1)	(2)	(3)	(4)
Subsoil capital	0.0952 (0.0715)	0.0134 (0.102)	0.199 (0.300)	0.107 (0.110)
IQ MMT	-1.310 (2.641)			
Government effectiveness		1.383 (4.351)		
Property rights			-2.571 (4.682)	
Average protection against expropriation				-0.131 (0.288)
Interaction	-0.179* (0.106)	-0.0539 (0.0942)	-0.0539 (0.0525)	-0.0179 (0.0145)
Observations	52	55	51	55

Robust standard errors in parentheses.

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

The credit constraint mechanism

The final mechanism suggests that proceeds from natural resources relieve some credit constraint for individuals intending to fight. I am not aware of a study directly testing this mechanism. Possibly, this is because it is difficult to establish whether potentially violent groups are credit constrained. Angrist and Kugler (2008) do suggest that coca production provides funding for violent groups in Colombia, as explanation for their result that coca production and violence are linked. However, they do not provide information suggesting that funding was prohibitively scarce before coca production soared. Few ways to test for this mechanism using cross-country data readily present themselves.

In conclusion, the results in this section are in line with the current state of research on which mechanisms connects natural resources and violence. It provides evidence in favour of the opportunity cost mechanism and no evidence in favour of the returns to conflict mechanism. Results on the quality of government mechanism are extremely weak and the credit constraint mechanism remains untested. With regard to the former, a promising future avenue for research would be to investigate the relationship between political repression, or otherwise unproductive government policies that could arise from revenue flows from natural resources to the government, and violent conflict. To do so, it appears necessary to find more disaggregated indicators of

repression or government policy, as catch-all indicators such as polity score or military spending have been investigated reasonably extensively already, without clear-cut results. With regard to the credit constraint mechanism: a first priority for research would be to operationalize the degree to which violent groups are ‘credit constraint’ empirically.

Conclusion and Policy Implications

This chapter has concluded that evidence from cross-country studies that natural resources cause civil war onset is weak. Results from cross-country studies vary widely, even though studies employ similar specifications, with a possible exception in the case of oil. Results on diamonds, the subject of the next chapter of this thesis, are especially inconclusive. Serious doubts exist as to whether these studies, especially those studies using natural resource exports as a percentage of GDP as a measure of natural resource abundance, convincingly show a *causal* relationship between natural resources and conflict. This chapter has investigated empirically to what extent conclusions from these studies are driven by endogeneity, by replicating two studies finding a strong relationship between natural resources and conflict (Collier and Hoeffler 2004; Collier, Hoeffler, and Rohner 2009) and replacing the original proxy for natural resource abundance by two plausibly more exogenous measures. The chapter shows that results are not robust to this change. They are equally sensitive to instrumenting for natural resources as a percentage of GDP using any combination of natural and subsoil capital.

The chapter then critically reviewed empirical support for various theoretical mechanisms potentially connecting natural resources and conflict. Mechanisms are important, because which mechanism we think connects natural resources and violent conflict determines to a large extent which policy we deem effective. Various mechanisms have been proposed, not all of which are equally well supported by empirical studies. Overall, the chapter finds that there is little evidence for the returns to conflict mechanism, but substantial evidence for the opportunity cost of conflict mechanism, and suggests that further study is needed with regard to the quality of government and credit constraint mechanisms.

What are the implications of these conclusions for research and policy? In the case of research, this chapter shows that endogeneity is a very real concern if one wants to establish what effect natural resource abundance has on civil war risk. However, endogeneity is not always addressed. Hegre and Sambanis (2006) for example state: “Since very few of the papers in the literature on civil war deal with the issue of endogeneity, we also ignore it [...]”. This chapter shows that, in order to draw sensible conclusions on the causes of civil war, possible endogeneity has to be taken into account, as not doing so could lead to a spurious correlation between natural resource abundance and civil war onset. Since this type of research has drawn a great deal of attention from policy makers and a

number of policy initiatives is based on the proposition that natural resource abundance is related to war risk, this seems especially undesirable.

In the case of policy, consider two well-known policies intending to break the link between natural resources and conflict: a ban on the export of natural resources from conflict zones and initiatives to improve the transparency of revenue flows associated with resources. Interestingly, if we look at these policies from the perspective of the opportunity cost mechanism, the one most strongly supported by empirical work, we may expect them to be ineffective, or even to have adverse effects, although empirical work investigating these policies directly is necessarily to establish this more firmly.

Trade bans can take the form of a blanket ban on the export of a particular natural resource (commonly oil) or a selective ban on the trade in illegally obtained resources that may finance conflict. An example of the latter is the Kimberley Process Certification Scheme (KPCS), which forbids signatory countries to import or export diamonds that do not carry a certificate stating they were legally mined. Campaigns that incite consumers not to buy so-called ‘conflict resources’ could be considered as an informal selective trade ban.

Proponents of trade bans often appear to have some variation of the returns to holding territory mechanism or credit constraint mechanism in mind. The reasoning seems to be that if we take trade in illegally obtained resources away, this would decrease the incentive to fight over territory and/or insurgents would lack the capital to continue violence. However, these mechanisms have received little empirical support. Trade bans do not necessarily decrease the incentive for violence if we think obtaining government is the ‘prize’ of conflict, especially if selective trade bans consider all government-traded resources legal (in fact, in case of the KPCS it is the government that issues the certificates of ‘clean health’ for diamonds). Furthermore, blanket bans are often lifted after one party has obtained some decisive victory and forms a recognized government, so this may still be a high-return goal to strive for. Executed in this manner, there does not appear to be a theoretical reason why trade bans would address the quality of government mechanism. If trade bans do not decrease the incentive to fight over government, they are unlikely to decrease the existing government’s discount rate.

Whether the opportunity cost mechanism predicts a trade ban to be effective depends on whether the ban hits a capital or a labour intensive resource. In the former case, it gives cause for high hopes, but in the latter, the opportunity cost mechanism would suggest that a trade ban can have the adverse effect of decreasing wages and thereby *increasing* violence. The KPCS, which almost exclusively hits ‘lootable’, labour-intensive secondary diamonds, is a possible example of this. This will be investigated further in chapter two. Lastly, the opportunity cost mechanism suggests that any capital-intensive resource may be related to violence via the wage rate, regardless of whether the proceeds are spent on weapons or used for perfectly legal ends. Taking this at face value, campaigns that expose dealings of resource extraction companies with armed groups, though

laudable in the sense that they inform consumers, may not be the most effective way to curb violence.

A second policy attempts to improve the transparency of revenue flows, with the intention of inciting governments to use proceeds from natural resources for socially beneficial goals such as education. An example of this is the Extractive Industries Transparency Initiative (EITI). This policy appears to be inspired by the quality of government and/or the government as 'prize' mechanism, attempting to either directly improve governance or to prevent natural resource proceeds to be distributed as rents. However, there is no strong empirical evidence in favour of either mechanism. As this policy restricts governments and the dealings of companies with governments, there is little reason to expect it to be effective from the perspective of the returns to territory mechanism or the credit constraint mechanism. Equally, the opportunity cost mechanism appears to predict success for transparency initiatives only if and when better governance leads to meaningful increases in the wage rate. This is possible, though likely to be a time-consuming process.

In sum, it can be argued that policies exist based on some variation of all but one mechanism connecting natural resources and violent conflict. Interestingly, the possible exception is the opportunity cost mechanism, the mechanism garnering most empirical support. What policies would this mechanism suggest? One suggestion that comes to mind is to directly support the wage rate, by labour-intensive (reconstruction) spending. In theory, this could decrease the probability of conflict and thereby benefit society as a whole, even if the labour hired through such a scheme is completely unproductive (Dal Bó and Dal Bó 2004). In practice, labour-intensive reconstruction spending by the US military has proven to be successful in decreasing violence in Iraq (Iyengar, Monten, and Hanson 2011), suggesting it may be an effective short-term policy. Despite initial success, the execution of such a policy seems key: if these schemes would become another source of rents to be distributed by the government they could even have adverse effects.

Diamonds and violent activity in Africa

Uncovering relationships and mechanisms

Abstract

This chapter investigates whether an increase in the international price of diamonds increases violent activity in African countries that are likely to have diamonds and if so, through which mechanism(s). Currently used measures for diamond production are potentially endogenous to conflict, and arguably subject to concerns about their reliability. Therefore, I propose a new indicator – Diamond Propensity Index – for the geological propensity of an area to hold primary and secondary diamonds respectively. The chapter concludes, for the period 2002-2010, that an increase in the diamond price is positively related to violence in countries with a propensity to hold primary diamonds, but unrelated to violence in countries with a propensity towards 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 cost of conflict. The findings support the latter, but not the former. Results are robust to using different diamond prices and controlling for cyclical effects, although they are weakened when instrumenting for diamond price and controlling for the presence of other resources. However, results on other resources, notably gold, similarly support the wage rate rather than the property rights mechanism.

Introduction

“For every hand taken in marriage, another hand is taken away”¹²: this slogan accompanies an internet advertisement featuring a black hand, cut off at the wrist, wearing a diamond ring¹². 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’ defined as rough diamonds used by rebel movements to finance conflict against legitimate governments. This chapter aims to examine the proposed link between diamonds and violent conflict, by investigating whether variation in the international price

¹² Copyright by Michael Griffith; www.mgadvertisingdesign.blogspot.com

of diamonds is related to violent activity in areas likely to have diamonds and by considering the mechanism(s) through which international price of diamonds affects violent activity.

Research on diamonds and conflict is part of a larger literature on resources and civil war, which was reviewed extensively in chapter one of this thesis. This chapter introduced three studies specifically investigating diamonds, which are of particular relevance to the current chapter (Humphreys 2005; Lujala, Gleditsch, and Gilmore 2005; Ross 2006). These three studies all estimate a logit regression, with a dummy variable for conflict onset or occurrence by country-year as the dependent variable. All of the above-mentioned studies also use a set of control variables introduced by Fearon and Laitin (2003), which has become somewhat of an industry standard.

Lujala et al. (2005) construct a database, DIADATA, which includes known instances of diamond occurrence, date of discovery and date of first production. The data distinguishes between ‘un-lootable’ diamonds (extracted using technologically advanced methods – generally primary diamonds) and ‘lootable’ diamonds (secondary diamonds that 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 the value in US dollars using the country-specific diamond price, extrapolated back using a diamond price index he constructs. Ross multiplies these values with the Lujala et al. (2005) 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 found to be unrelated to violence, except to separatist conflict, and both types of diamonds are unrelated to conflict duration.

As is clear from the above, existing studies do not provide a common, clear-cut answer to the question whether primary and secondary diamonds respectively are related to violent conflict. In addition, chapter one has highlighted two critiques of the cross-country literature on natural resources and violent conflict: natural resource production may be *endogenous* to violent conflict, and these studies lack an explicit *theoretical model* of the relationship between natural resources and violence (Besley and Persson 2008; Blattman and Miguel 2009). Briefly repeating the points made in chapter one, the pace of natural resource extraction in a country and its risk of violent conflict may be jointly determined by the country’s institutional environment or the discount rate of its

government. In addition, the pace of natural resource extraction may increase *in response to* increased conflict risk. These concerns apply to the three studies of diamonds and violence described above as these use diamond production data.

Another difficulty specific to diamonds is the reliability of production and export data. As diamonds have a very high value-to-weight ratio, producing and exporting them illegally (and unrecorded by official statistics) is relatively easy. For example, a report by the World Bank on the Central African Republic estimates that 30 per cent of diamond production is kept ‘off the books’ and that 50 per cent of total production in the country is exported illegally (World Bank 2010). In particular, production of secondary diamonds, which often takes place in the informal sector, often goes unregistered (see for example (Hilson and Bockstael 2012; Hilson and Clifford 2010; Vetter 2007). Cases have been recorded of diamonds from conflict zones being ‘laundered’ by smuggling them into a different country, and then exporting them ‘on the books’ as diamonds produced in the latter country.¹³ This suggests that official data may substantially underestimate diamond production in and export from conflict zones, and overestimate diamond production in zones unaffected by conflict. Furthermore, the origin of a diamond may be falsely declared to avoid import taxes: it has been argued that a considerable number of ‘Liberian’ diamonds imported to Belgium were in fact of Russian origin (Bockstael and Vlassenroot 2011).

This chapter takes up the challenges outlined above. It proposes a measure for the geological propensity of an area to contain primary and secondary diamonds. A number of geological regularities as to where diamonds can be found exist: primary diamonds are found where two rock types, kimberlite and lamproite, occur in an area where the bedrock is of a particular age. Secondary diamonds originate in places with the same geological conditions, but they are transported away from their original location through erosion by rivers. Again, geology suggests that the distance between these rivers and the original source of secondary diamonds follows certain regularities. Because the proposed measure of diamond propensity is based on geology, it is arguably less subject to concerns regarding endogeneity and data reliability compared to diamond production data. Furthermore, the chapter employs a difference-in-difference approach, explained below, and country-fixed effects. To my knowledge, the relationship between diamonds and violent conflict has not been investigated using a difference-in-difference approach, or by exploiting only within-country variation.

Addressing the second challenge, this chapter is explicitly informed by a number of theoretical models. The intuition behind these was set out in the previous chapter, but they are introduced more formally here. One (Garfinkel, Skaperdas, and Syropoulos 2008) formalizes the idea that natural resources increase the returns to violence, as they can be 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

¹³ See for example: Conflict diamonds. Smuggling is Easy. *The Economist*. 14 March 2002.

and Dal Bó 2004) arrives at a similar prediction, but through a different mechanism. It poses that natural resources may decrease the opportunity cost 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 cost 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. This, in addition to their prominence in the international policy scene, justifies focusing on diamonds as a particular resource. Although chemically identical, primary diamonds are associated with a capital-intensive production process and relatively secure property rights, while the property rights of secondary diamonds can be more easily contested and production is labour-intensive. Therefore, the model by Garfinkel, Skaperdas and Syropoulos (2008) predicts that secondary diamonds are more strongly related to conflict than primary diamonds, while the model by Dal Bó and Dal Bó (2004) asserts that increases in the international diamond price increase violent activity in areas with primary diamonds, but decrease violence in areas with secondary diamonds. Although secondary diamonds have gained a reputation as ‘conflict diamonds’, evidence from case studies suggests both mechanisms merit investigation: about one million people derive income from informal mining, whereas the contribution of primary diamond mining to employment is relatively small (Hazleton 2002; Smillie 2005). By investigating the effect of variation in the international diamond price on violent activity in areas with a propensity to hold primary and secondary diamonds respectively, we can get a sense of the mechanism connecting diamonds and conflict: weak property rights increasing the returns to conflict or low wages decreasing the opportunity cost of violent conflict.

Empirically, this chapter employs a difference-in-difference approach, where changes in the international diamond price can be considered the ‘treatment’ and where the propensity of a country to hold primary or secondary diamonds determines whether it is in the ‘treatment’ or ‘control group’. It covers African countries for the period 2002-2010. Results indicate that an increase in the international diamond price is related to an increase in violent activity in countries that have a propensity to hold primary diamonds, but unrelated to violence in countries with a propensity towards secondary diamonds. This lends support to the Dal Bó and Dal Bó model, which emphasizes the opportunity cost of conflict in terms of wages as a mechanism that connects resources and conflict. This model describes how an increase in the international price of a capital-intensive resource may decrease wages, and thereby the opportunity cost of conflict. Results are robust to changing the measure of diamond price used and controlling for seasonal effects. Instrumenting for diamond price using the production volume of the largest, peaceful diamond producers and controlling for the presence of other resources weakens this result. However, investigating other resources in more detail, especially gold which also occurs in primary and secondary deposits, also provides evidence in support of the wage rate mechanism.

The conclusion that an increase in the diamond price is related to an increase in violent activity in countries likely to have primary diamonds, but unrelated to violence in countries likely to have secondary diamonds, has implications for policy, specifically for the Kimberley Process Certification Scheme (KPCS). Note that the KPCS is attempting to ban illegally mined diamonds from the market, essentially driving their price down to zero. Evidence from case studies presented in this chapter suggests that it is especially challenging to get informally produced secondary diamonds certified under the KPCS (Hilson and Bockstael 2012; Hilson and Clifford 2010; Vetter 2007). The absence of a relationship between diamond price and violence in countries with secondary diamonds may indicate that the KPCS, which was in force during all but one year of the research period, has been successful in ‘breaking’ the link between secondary diamonds and conflict. However, this does not explain the existence of a relationship between primary diamonds and conflict. If the model by Dal Bó and Dal Bó indeed explains the relationship between the value of diamonds and violent conflict, primary diamonds mined legally under the KPCS (as well as other legally mined primary resources) may indirectly contribute to violent conflict.

The remainder of this chapter is organized as follows: section two introduces the theoretical models, section three reviews evidence from case studies relevant to the theoretical models introduced, section four describes the methodology, the proposed measure of diamond propensity and other data used, section five presents the main results and section six will go into the robustness of the results. Section seven concludes and derives a number of policy implications.

Theoretical models

Garfinkel, Skaperdas and Syropoulos: property rights and returns to conflict

Garfinkel, Skaperdas and Syropoulos (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:

$$U_i(O_i, B_i) = (O_i)^\alpha (B_i)^\beta \quad (2.1)$$

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

Timing in this model is as follows: (a) groups allocate their labour to butter and gun production, taking other groups' gun choices as given; (b) 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 $T + T_0$; (c) production, trade and consumption takes place.

Solving by backward induction gives the following: given \tilde{T}_i each group maximizes (2.1) 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:

$$W_i(G, p) = \mu(p)(p(T + \pi_i T_0) + L - G_i) \quad (2.2)$$

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

Differentiating (2.2) with respect to G_i gives the optimal gun production (which is the same for all groups because they are *a priori* identical):

$$G_i^* = \frac{(N-1)pT_0}{N^2} \quad (2.3)$$

The result from (2.3) 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 value of the contested resource increases, the expected returns to investing in guns increase. Gun production also increases in amount area of contested land.

Garfinkel, Skaperdas and Syropoulos (2008) further show that the excess demand for the contested resource is decreasing in the degree of property rights insecurity (not shown in this chapter). This implies that a country would export more (import less) of the contested resource

under conflict compared to a non-conflict benchmark. This suggests we cannot treat a country's resource exports as exogenous to conflict.

Dal Bó and Dal Bó: wages and the opportunity 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, while an increase in the price of a labour-intensive resource decreases conflict in a producing country. This arises because a rising price decreases the returns to labour in the case of a capital-intensive resource (increases returns to labour in the case of a labour-intensive resource) and thereby the decreases (increases) opportunity cost 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:

$$\frac{a_{2K}}{a_{2L}} < \frac{a_{1K}}{a_{1L}} \quad (2.4)$$

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:

$$ra_{1K} + wa_{1L} = p \quad (2.5)$$

$$ra_{2K} + wa_{2L} = 1 \quad (2.6)$$

Furthermore, the markets for production factors clear:

$$q_1 a_{1K} + q_2 a_{2K} = \bar{K} \quad (2.7)$$

$$q_1 a_{1L} + q_2 a_{2L} = \bar{L} - L_A \quad (2.8)$$

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:

$$\frac{A(L_A)}{L_A}(r\bar{K} + w(L - L_A)) = (1 - A(L_A))w \quad (2.9)$$

In absence of full specialization, the implications of this model are as follows. Using (2.5) and (2.6), we can write r and w as a function of p . Differentiating with respect to p and bearing in mind (2.4), the authors show 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. This suggests that 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 therefore the 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), (2.9) can be written as:

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

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 , the authors obtain:

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

which can be shown to be positive, as $\frac{d(\frac{r}{w})}{dp} > 0$ and A is a concave function. 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 cost of allocating labour to the expropriation sector compared to the total value of production that can potentially be expropriated.

Using (2.7) and (2.8) 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, while production in the labour-intensive sector decreases in L_A . This implies that production volume of the capital intensive good is both a cause and a consequence of the size of the expropriation

sectors. Dal Bó and Dal Bó (2004) therefore remark that: “This two-way causation poses a challenge to empirical work trying to estimate the impact of natural resource availability on conflict”.

This model is tested in the context of Colombia by Dube and Vargas (2009) using an empirical set-up similar to the one employed in this chapter. 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 Colombia. 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 (Dube and Vargas 2009).

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. (a) The value of natural resource rents that the incumbent group will receive at the end of the period is exogenously determined. (b) Both groups choose the size of their army. The 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. (c) The incumbent group stays in power with some probability. This probability decreases in the size of the opposition army and increases in the size of the incumbent army. (d) The winning group determines policies: how natural resource rents are spent. The advantage of being the incumbent (henceforth called ‘incumbent advantage’) 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. (e) Payoffs are realized.

When choosing a level of armament, groups maximize their own-group expected payoff. Intuitively, groups choose to arm when the ‘incumbent advantage’ 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, reduces 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 in the way predicted. 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.

The case of diamonds

In light of the previous sections, diamonds are an interesting resource to investigate. 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, Skaperdas and Syropoulos (2008) as their models make opposite predictions on whether primary or secondary diamonds are positively related to conflict. As will be further illustrated in the next section, primary diamonds are mined through a capital-intensive process and property rights to primary diamonds can be protected relatively easily. Secondary diamonds, by contrast, are extracted using a labour-intensive production process and property rights to them are difficult to protect. Hence, the model by Dal Bó and Dal Bó predicts that primary diamonds are positively, and secondary diamonds negatively related to violent conflict, while the model by Garfinkel, Skaperdas and Syropoulos predicts that secondary diamonds are positively related to conflict and primary diamonds less so.

Existing country case studies on diamond mining, wages and conflict

Before moving to the analysis, it is useful to review existing case studies of countries producing diamonds for two reasons. First, these case studies do not provide unequivocal evidence that one type of diamond is related to conflict whilst the other is not. The question whether primary or secondary diamonds are related to violent conflict is thus still open for investigation. Second, case studies illustrate that it is *possible* that a decrease in wages in the secondary diamond sector leads to a loss of individual livelihoods at a scale that can result in unrest, and that an expansion of the primary diamond sector depresses employment or the wage rate. This justifies investigating the wage rate mechanism.

It has become common to associate violent conflict in Angola, Democratic Republic of Congo (DRC), Liberia and Sierra Leone with the presence of secondary diamonds and to regard primary diamonds, associated mainly with Botswana, Namibia¹⁴ and South Africa, as ‘clean’ (Taylor and Mokhawa 2003). However, a more detailed look at countries with diamond deposits complicates the simple picture that countries endowed with secondary diamond experience violent conflict, while countries with primary diamonds are peaceful. First, Angola, DRC, Liberia and Sierra Leone all also have primary diamond deposits, according to DIADATA (Lujala, Gleditsch, and Gilmore 2005). Primary diamond deposits were especially important during the civil war in Angola, where rebel control over primary diamond mines, and the virtual impossibility of controlling secondary diamond extraction (which is spread throughout hundreds of square miles) has been noted (Vetter 2007). Second, Namibia and South Africa also have ‘lootable’ diamond deposits (Lujala, Gleditsch, and Gilmore 2005; Hazleton 2002). In South Africa, for example, secondary diamonds make up approximately ten per cent of total production. In addition to formal production, small-scale licenced secondary diamond diggers alone produced an estimated 400 thousand carats of diamonds in 2000 (Hazleton 2002), which is two-thirds of the total reported production in Sierra Leone, and more than seven times the total reported production of Liberia in 2013¹⁵. Third, categorizing secondary diamonds as ‘blood diamonds’ and primary diamonds as ‘clean diamonds’ ignores a number of countries with secondary diamond mining that are largely considered peaceful. Ghana for example, has exclusively secondary diamond deposits (Lujala, Gleditsch, and Gilmore 2005), active artisanal diamond mining communities (Hilson and Clifford 2010) and is possibly a bigger diamond producer than Liberia (Bockstael and Vlassenroot 2011). Secondary diamond mining also takes place in Tanzania (Fisher et al. 2009), Cameroon (Schure et al. 2011) and Guinea (Smillie 2005).

Finally, primary deposits in Namibia and South Africa have been associated with violent conflict in the past. In Namibia, SWAPO, the now ruling party and past rebel movement fighting for Namibian independence from South Africa, emerged from a contract workers’ organisation and miners were “at the forefront of resistance to South African colonial administration” (Kempton and Preez 1997). Miners’ struggle for higher wages and SWAPO’s struggle for independence appear closely related in Namibia. The town of Kimberley in South Africa, home to the world’s quintessential primary diamond mine, was a scene of heavy fighting during the Boer War in 1899-1890. Memoirs from the time detail how a large number of mine workers employed by DeBeers and weapons bought with funds provided by this diamond company contributed to the defence of the town (Harris 1931). Hence, case study evidence does not unequivocally relate a single type of diamond to conflict.

¹⁴ Namibia’s diamond deposits are not technically primary, in the sense that they are found in the host rock. Instead, they are marine deposits found on the beach, or near the beach in the sea. These off-shore deposits are considered ‘not lootable’ (Lujala et al. 2005) and can only be mined using high-capital production techniques (i.e. boats) and thus share many characteristics of primary diamonds.

¹⁵ https://kimberleyprocessstatistics.org/static/pdfs/public_statistics/2013/2013GlobalSummary.pdf, accessed 17 September 2014.

Secondary diamonds have gained a reputation as ‘blood diamonds’ and are not usually associated with individuals or households making a living. Despite this reputation, there is a very extensive literature on diamond Artisanal and Small Scale Mining (ASM) as a livelihood strategy. The magnitude of the ASM diamond sector and the extent of its linkages to the local economy make it possible that diminishing livelihoods opportunities in this sector lead to unrest.

It is estimated that there are one million secondary diamond miners in the ASM sector in Africa (Smillie 2005). This contrasts with the small number of people employed in the primary diamond sector: in South Africa, Namibia and Botswana combined, the primary diamond sector employed an estimated 27,000 people in 2000 (Hazleton 2002). Although working conditions in the diamond ASM sector are poor, numerous studies describe secondary diamond mining as an important livelihood option in situations where few others are available. Hilson and Van Bockstael (2012) conducted interviews with household heads in rural Liberia, and describe how households supplement income from agriculture with proceeds from secondary diamonds mining because the former is not sufficient to pay for school fees, fuel or livestock. Secondary diamond mining, the authors show, has strong linkages to local rice cultivation (Hilson and Bockstael 2012). Diamond miners and diggers in Sierra Leone also consider mining as the only option to supplement their livelihoods, and consider mining as providing more financial security compared to other options (Levin 2005). A survey of the general population in two diamond mining areas in the same country shows that between 36 and 40 per cent of people in these areas feel they benefit personally from artisanal mining (Maconachie and Binns 2007). These authors also find links between mining and the rural economy: prices of foodstuffs are significantly higher in mining areas compared to other areas in Sierra Leone. In Tanzania, mining is perceived as an avenue to pursue a better life, and a survey in artisanal diamond and gold mining communities shows that households in which at least one member works in a mine, or provides services to miners, are less likely to be poor according to a number of definitions (Fisher et al. 2009).

An example from Ghana illustrates how fluctuations in the local diamond price can have a strong impact on livelihoods in diamond mining communities. In late 2006, Ghana temporarily suspended exports of rough diamonds after a visit from a Kimberley Process inspection team, amidst allegations that it was ‘laundering’ conflict diamonds from neighbouring Ivory Coast, which were later disproven. Hilson and Clifford (2010) investigate the effects of this ban in the mining region around Akwatia. In this region, around 3,700 people were registered to mine secondary diamonds, in addition to “thousands” of unregistered miners. The authors note a dramatic drop in diamond prices in the local market following the ban and observe how a large proportion of diamond miners were forced to leave to look for other work. Even one to two years after the end of the ban, the local economy in Akwatia—which previously boasted markets for staple foods, hotels, a transport hub and shops selling luxury goods such as phones and other electronics—had “collapsed outright”. A casual observation of ACLED data (introduced further in the next section) on violence in Ghana indicates that in the three regions of Ghana producing diamonds there were

only two violent events in the four years before the ban, and eight violent events in the four years after, a 300 per cent increase compared to a 18.5 per cent increase in areas of Ghana without diamond production over the same period.

It difficult to assess the impact of primary diamond mining on the overall wage rate using case study evidence, but the sector's record with regard to employment is not positive. Although it is clear that the primary diamond sector can provide very substantial revenues for the state, the sector employs relatively few people and has few links to the local economy (Taylor and Mokhawa 2003). Only 3 per cent of the total labour force in Botswana, and 0.1 per cent of the labour force in South Africa are employed in primary diamond mining (Hazleton 2002). In Namibia, furthermore, employment in the primary diamond sector has declined radically, from 6,731 people in 1990 to 2,190 in 2010 according to the Chamber of Mines of Namibia, as the sector employs increasingly capital-intensive production methods. Accounts of the history of the Kimberley mine in South Africa note the emergence of a "poor white" workers community following the introduction of steam engines and systematic underground mining (Meredith 2007). Taken together, the case study evidence above justifies investigating the wage rate as a potential mechanism connecting diamond mining and violent conflict.

A number of case studies investigate the relationship between artisanal secondary diamond mining and the KPCS. In theory, ASM diamonds can be legally exported under the KPCS. However, this requires licencing of miners and records of the production and sales of diamonds (Vetter 2007). In practice, it has proven extremely hard for artisanal secondary diamond miners to obtain a formal licence. Difficulties are noted in the cases of Angola (Vetter 2007), Cameroon (Schure et al. 2011), Ghana (Hilson and Clifford 2010), Liberia (Bockstael and Vlassenroot 2011; Hilson and Bockstael 2012), Sierra Leone (Levin 2005) and Tanzania (Fisher et al. 2009). To illustrate: obtaining a class C mining licence in Sierra Leone costs approximately \$600, including transportation costs and bribes (Bockstael and Vlassenroot 2011). Thus, the origins of secondary diamonds produced by ASM can often not be adequately traced so as to be certified as 'conflict-free' under the KPCS.

Data and methodology

Diamonds: some geology

Diamonds are found according to geological regularities, making it possible to use geological data to construct an exogenous measure of diamond propensity and to distinguish between the two competing theoretical mechanisms: wage rate and property rights. Some geology of diamonds will illustrate this.

Diamonds were formed deep beneath the earth's surface in the early phases of earth formation, over 1,500 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. Diamonds have survived only in geological areas that have been stable for the last 1,500 million years (Archons), a regularity that has become known as 'Clifford's rule' (Clifford 1966), validity of which has been confirmed more recently (Janse 1994). Movable primary diamond deposits are thus likely to occur where Archons and a transport medium (kimberlite or lamproite host rock) coincide (Helmstaedt and Gurney 1995). Other minerals are also likely to be found on-Archon (but are not associated with kimberlite or lamproite), most notably gold. 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 is considered capital-intensive (Hazleton 2002; Kempton and Preez 1997; Taylor and Mokhawa 2003).

Kimberlite and lamproite occur in pipes with a relatively small diameter (a few hundred meters to a kilometre) (Janse and Sheahan 1995). For example, the Kimberley mine in South Africa was reportedly only 220 yards by 180 yards in size at the start of mining (Meredith 2007) and primary diamond mines in Angola are reported to be "fenced in" (Vetter 2007). Hence, property rights over primary diamonds are relatively easy to protect.

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 miles from the original source (Sutherland 1982). Although it may seem intuitive, it is not the case that deposits closer to the source are necessarily the most valuable 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 of secondary diamonds are found off-Archon (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 (e.g. shovels, buckets) and artisanal production methods. This involves manually digging up or diving for gravel and manually 'washing' the gravel to sort 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, Skaperdas and Syropoulos (2008), who emphasize the ‘contestedness’ of resources as a mechanism, secondary diamonds would be related to conflict intensity, but primary diamonds 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 diamonds are positively related to the intensity of violence, while secondary diamonds are negatively related. This provides a clear way to distinguish between the mechanisms both models identify.

Figure 2: Primary diamond propensity

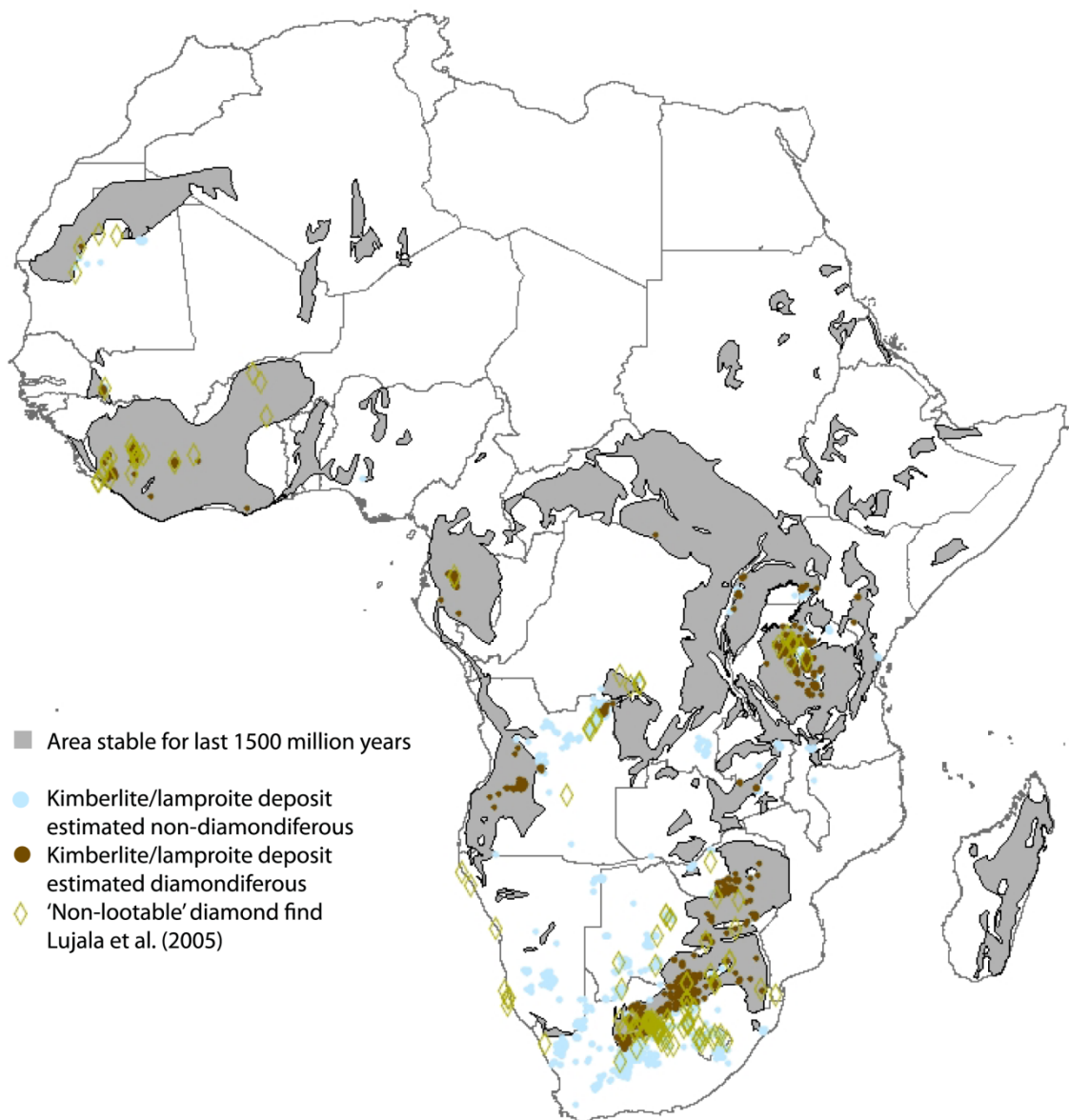
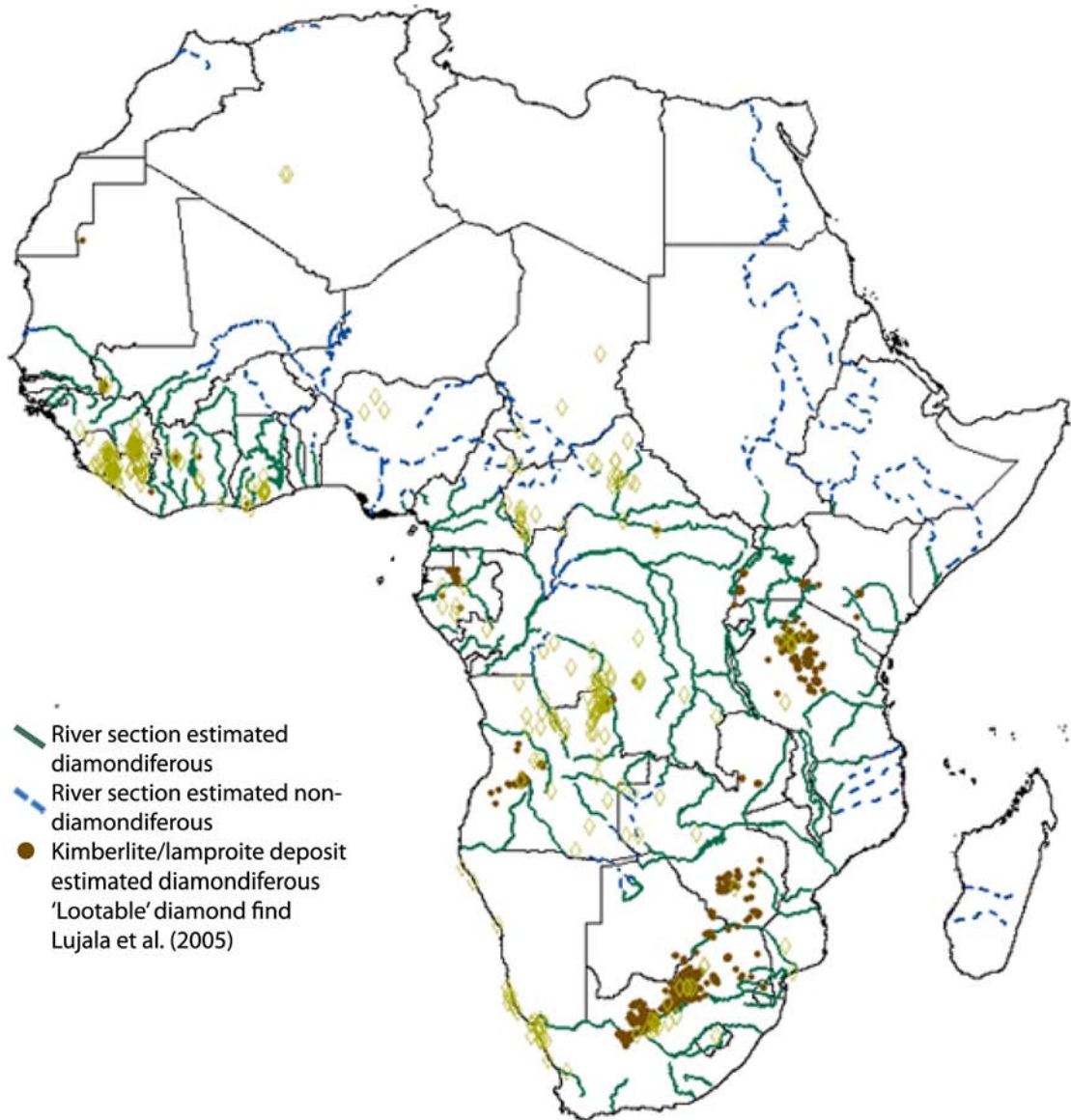


Figure 3: Secondary diamond propensity



An alternative measure of diamond abundance: diamond propensity

Measuring diamond production, abundance or presence is fraught with difficulty. As explained in the introduction, a large proportion of world diamond production may be unreported, smuggled across boundaries, or its country of origin may be misreported to avoid taxation. These processes are likely endogenous to conflict. Also, the theoretical models of resources and conflict presented consider resource production and exports as endogenous to violence. Another problem is that the main existing measure of diamond occurrence, from DIADATA (Lujala et al. 2005), is dichotomous. Classifying an entire country as either diamondiferous or not likely does not make use of important variation in the *extent* of diamond abundance. Other diamond export or production data (such as data used by Humpreys (2005)) is continuous, but does not distinguish between primary and secondary diamonds. Ross (2006) creates a continuous measure of diamond exports by multiplying the value of exports with the DIADATA production dummies, but this strategy looks doubtful at best. Under Ross's procedure, if a country has both primary and secondary diamond production (even a single instance of one type) the value of its exports is essentially doubled.

The geological regularities in where diamonds are found can be used to construct an exogenous and continuous measure of diamond abundance: diamond propensity. This will use Clifford's rule stating that primary diamonds are found when kimberlite and lamproite intersect with Archon regions, and the regularity that diamonds are transported by rivers up to 600 miles away from these points of origin.

To construct diamond propensity, I use the CONSOREM database of all known 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 years¹⁶, as suggested by Clifford and 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 propensity. Kimberlite and lamproite deposits thus estimated to be diamondiferous, non-diamondiferous deposits and Lujala et al's (2005) locations of 'non-lootable' diamond occurrences are illustrated by Figure 2. Visually, there is considerable overlap between both measures of diamond abundance.

By its design, this measure of primary diamond propensity is unlikely to 'miss' important primary diamond deposits, but likely to overestimate its number in areas on-Archeon. Primary diamond deposits found off-Archon are considered to be a geological irregularity, but it is well known in geology that not all on-Archon kimberlite and lamproite deposits carry diamonds (Janse and Sheahan 1995).

¹⁶ Areas classified by GSC as of an age between eo-Archean and Pealeo-Mesoproterozoic

To measure secondary diamond abundance, one would ideally want to have information on erosion channels since the formation of kimberlite and lamproite. Unfortunately, data on erosion channels 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 it has been established in geology that meaningful deposits of secondary diamonds are found up to 600 miles from the source kimberlite or lamproite, that rivers closer to the original source are not necessarily more diamondiferous than rivers further removed, 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 an on-Archon kimberlite or lamproite deposit. The total length of all these river segments in a given country in miles is the measure of secondary diamond propensity employed.

Figure 3 illustrates river segments estimated to be (non)diamondiferous and on-Archon kimberlite and lamproite deposits, as well as Lujala et al's measure of secondary diamonds. Again, there is considerable overlap visually.

More so than primary diamond propensity, this measure of secondary diamond propensity is likely to overestimate diamond abundance in a country, compared to actual mining data. In the case of secondary diamond propensity, there are two sources of uncertainty: whether the source kimberlite or lamproite indeed carries diamonds, and how far and in which direction(s) diamonds have been transported from this source. With regard to the latter point: viable secondary diamond deposits can be found in rivers within a 600 mile radius from the source but not uniformly, and it is very difficult to impossible to predict how they have spread. The measure of diamond propensity errs on the side of estimating both the kimberlite or lamproite deposit and all river sections within the 600 mile radius as diamondiferous, likely overestimating secondary diamond abundance.

Table 10 explores the differences between the diamond propensity measure, occurrence of 'lootable' and 'non-lootable' diamonds according to Lujala et al. (2005) and official mining activities listed in Janse and Sheahan (1995), on a country level. Note however that while the latter two measures of diamond abundance are dichotomous, diamond propensity is a continuous measure. The table also lists possible 'false positives', when diamond propensity predicts a country to have diamonds while the other measures do not, and 'false negatives', where diamond propensity fails to predict a country to be diamondiferous. Whether these are truly false positives or false negatives depends on the reliability of the alternative measures.

At the country level, the measure of primary diamond propensity overlaps reasonably with other indicators of diamond abundance: it has 14 out of 22 countries in common with at least one other source. There are four 'false positives'. In these cases the value of the primary diamond propensity measure is low: 1, 2, 7 and 8 kimberlite or lamproite deposits are estimated diamondiferous for Ghana, Kenya, Uganda and Zambia respectively.

Table 10: Diamond propensity versus diamond occurrence and production

Primary diamond propensity	'Unlootable diamond' occurrence (Lujala et al. 2005)	Primary diamond mining / prospective area (Janse and Sheahan)
Angola, Botswana, Cote d'Ivoire, DRC, Gabon, Ghana, Guinea, Kenya, Liberia, Mali, Mauritania, Sierra Leone, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe	Angola, Botswana, Burkina Faso, Cote d'Ivoire, DRC, Gabon, Guinea, Lesotho, Liberia, Mali, Mauritania, Mozambique, Namibia, Sierra Leone, South Africa, Swaziland, Tanzania, Zimbabwe	Angola, Botswana, Cote d'Ivoire, DRC, Guinea, Liberia, Lesotho, Mali, Sierra Leone, South Africa, Swaziland, Tanzania, Zimbabwe
Possible 'false positives': Ghana, Kenya, Uganda, Zambia		
Possible 'false negatives': Burkina Faso, Lesotho, Namibia†, Mozambique		
Secondary diamond propensity	'Lootable diamond' occurrence (Lujala et al. 2005)	Secondary diamond mining / prospective area (Janse and Sheahan)
Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, CAR, Cote d'Ivoire, DRC, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Malawi, Mali, Mauritania, Mozambique, Namibia, Nigeria, Republic of Congo, Rwanda, Senegal, Sierra Leone‡, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe	Algeria, Angola, Cameroon, CAR, Chad, Cote d'Ivoire, DRC, Gabon, Ghana, Guinea, Lesotho, Liberia, Mali, Mozambique, Namibia, Nigeria, Republic of Congo, Sierra Leone, South Africa, Zambia, Zimbabwe	Algeria, Angola, CAR, Cote d'Ivoire, DRC, Ghana, Guinea, Liberia, Mali, Namibia, Sierra Leone, South Africa
Possible 'false positives': Benin, Botswana, Burkina Faso, Burundi, Equatorial Guinea, Ethiopia, Gambia, Guinea-Bissau, Kenya, Malawi, Mauritania, Rwanda, Senegal, Somalia, Sudan, Swaziland, Togo, Uganda		
Possible 'false negatives': Algeria, Chad		

† Lujala et al. (2005) consider Namibia's off-shore marine diamond deposits as 'unlootable'. However, geologically, these diamonds are secondary diamonds as they are not found in the host rock.

‡ Global Run-Off Datacentre (2007) does not contain data on Sierra Leone. As Sierra Leone is an important country with regard to diamonds, I impute this data. The entire territory of Sierra Leone lies within a 600 mile radius from a potential kimberlite or lamproite deposit. Hence, the total length of its principal rivers is taken as the measure of secondary diamond propensity of Sierra Leone. Information on Sierra Leone's rivers was taken from the FAO: <http://www.fao.org/docrep/005/t0360e/t0360e10.htm>, accessed 18 September 2014.

Given such a low number of deposits, it is not surprising in the geological sense that none of these in reality carry diamonds (Janse and Sheahan 1995). Primary diamond propensity fails to predict the presence of diamonds in four cases: Namibia, Burkina Faso, Mozambique and Lesotho. Diamonds in Namibia are found in marine deposits and these deposits may be ‘unlootable’ according to Lujala et al., but not primary in the geological sense; as the list by Janse and Sheahan confirms. Primary diamond mining in Burkina Faso (Hinde 2009) and Mozambique¹⁷ appears to be in an exploratory phase and the extent and nature of diamond deposits appear as yet unclear. The failure of the primary diamond propensity measure to classify Lesotho as having primary diamonds is the only aberration from existing data that is difficult to explain.

As expected, the measure of secondary diamond propensity substantially overestimates the number of countries with secondary diamonds. Table 10 shows a large number of ‘false positives’: 18 countries. In a small number of cases, secondary diamond propensity appears to have correctly predicted the presence of secondary diamonds where the other measures have failed to do so: Artisanal diamond mining is reported in Botswana (Mallo 2012) and Equatorial Guinea (Vlassenroot and Bockstael 2008), and the nature of diamond deposits in Burkina Faso is unclear (Hinde 2009). A number of other ‘false positive’ countries, notably Guinea-Bissau, Swaziland and Togo, are small and share long stretches of border with neighbours that *do* have recognized secondary diamond deposits. It is thus not impossible that these countries have some secondary diamonds that official sources do not recognize. On the whole however, a large number of ‘false positives’ appear due to the tendency of the secondary diamonds propensity measure to err on the side of the predicting diamonds. The false positives appear to correlate with countries that have alluvial gold deposits: references to ASM gold mining can be found for 15 of the 18 false positives (Veiga and Baker 2004). As gold is an on-Archon resource, this correlation is not entirely unexpected. Alluvial gold mining and secondary diamond mining display many of the same characteristics, so the relationship between both resources and violence will be explored later in this chapter. Secondary diamond propensity fails to predict two ‘false negatives’, Algeria and Chad.

Table 11 shows the correlation between primary and secondary diamond propensity and alternative measures of diamond abundance in 1999 - the last year for which the Lujala et al. (2005) data is available. Primary diamond propensity correlates reasonably strongly with Lujala et al.’s indicators for primary diamond presence and production, especially when taking into account that the former is a continuous, and the latter a dichotomous variable. Correlation coefficients are larger in magnitude than 0.4 and significant at the 1 per cent level. Note that this correlation is of a similar magnitude as the correlation between the Lujala et al. (2005) and Humphreys (2005) data. Primary diamond propensity is not significantly related correlated to the latter measure of diamond abundance. This fact is not easily explained, especially since Lujala et al.’s indicators *are* correlated to

¹⁷ See <http://www.mining.com/mozambique-wants-angolas-help-with-diamond-mining-38672/>, accessed 18 September 2014.

Table 11: Correlation coefficients for various measures of diamond abundance

	Primary diamond propensity	Lujala et al. primary diamond presence	Lujala et al. primary diamond production	Humphreys diamond production
Primary diamond propensity	1.0000			
Lujala et al. primary diamond presence	0.4277*** (0.0027)	1.0000		
Lujala et al. primary diamond production	0.4882*** (0.0005)	0.8074*** (0.0000)	1.0000	
Humphreys diamond production	-0.2072 (0.1825)	0.4063*** (0.0069)	0.4800*** (0.0011)	1.0000

	Second. diamond propensity	Lujala et al. second. diamond presence	Lujala et al. second. diamond production	Humphreys diamond production
Second. diamond propensity	1.0000			
Lujala et al. second. diamond presence	0.2708* (0.0656)	1.0000		
Lujala et al. second. diamond production	0.2980** 0.0419	0.9095*** (0.0000)	1.0000	
Humphreys diamond production	0.0634 (0.6865)	0.1897 (0.2230)	0.2240 (0.1488)	1.0000

p-values in parentheses

**** $p < 0.01$, ** $p < 0.05$, 8 $p < 0.1$

both. Secondary diamond propensity is correlated to indicators for presence and production of secondary diamonds as well, but the size of the correlation coefficients is smaller and they are significant at a lower level. This likely reflects the tendency of the secondary diamond propensity measure to overestimate diamond abundance. However, the correlation between secondary diamond propensity and Lujala et al.'s indicator is stronger than that between the latter measure and the Humphreys data. The low levels of correlation between data on secondary diamonds from different sources likely reflect uncertainty on the locations where secondary diamonds can be found, and inaccuracies in diamond production data.

To sum up, geological regularities enable me to create a measure of an area's propensity towards primary and secondary diamonds. This measure is the number of kimerlite or lamproite deposits coinciding with a bedrock older than 15 million years (primary diamonds) and the total length of all stretches of river within a 600 mile radius of a predicted primary diamond deposit (secondary

diamonds). There is evidence that the measures constructed indeed capture primary and secondary diamond abundance, although by its construction, it tends to overestimate secondary diamond abundance. These measures will be used to test the different predictions of the models by Dal Bó and Dal Bó (2004) and Garfinkel, Skaperdas and Syropoulos (2008) described.

Methodology

I estimate the following model:

$$VIOLENCE_{ct} = \beta_1 PRIM_c \times PRICE_t + \beta_2 SEC_c \times PRICE_t + \beta_3 PRICE_t + \beta_4 X_{ct} + \alpha_c + \epsilon_{ct} \quad (2.10)$$

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 propensity towards primary and secondary diamond abundance of country c as described above, $PRICE_t$ 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 dollar. The latter two are included because the same nominal price of diamonds in dollars may provide a stronger incentive for conflict 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 the previous section. The model by Garfinkel, Skaperdas and Syropoulos (2008) 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.

Instead of entering it in the model directly, geological diamond propensity could be used as an instrument for actual diamond production. Unfortunately, the data required for this are not available. Data on diamond production or exports, such as those used by Humphreys (2005) or statistics provided by the Kimberley Process, do not distinguish between primary and secondary diamonds. This is unsurprising, as primary and secondary diamonds are chemically the same product. However, the distinction between the two is key to this chapter. The indicator for diamond production used by Lujala et al. (2005) does distinguish between primary and secondary diamonds, but this measure is only available until 1999. This does not overlap with the period for which data on diamond price are available.

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. Furthermore, it should be noted the diamond price in a given period is the same for all countries, and that it is therefore collinear with a set of dummies for time t . Empirically, this means

that estimating equation (2.10) excluding $PRICE_t$ and including time-fixed effects gives results extremely similar to the ones presented in this chapter. This 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).

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 conflict events in the period January 1997–July 2010, including the date of occurrence and geographic location and distinguishes between eight types of events: (a) violence against civilians; (b) battle, no change of territory; (c) battle, government regains territory; (d) battle, rebels overtake territory; (e) riots/protests; (f) non-violent activity by a conflict actor; (g) headquarters or base established; (h) non-violent transfer of territory. My default indicator of the intensity of violence is the number of events of the first four types; events (f) through (h) are 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 per cent of the market for rough diamonds and sales take place during non-public ‘sightings’ rather than through the open market, a rather secretive process (Saldern 1992; Spar 2006; Yoeli 2003). 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 per cent 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', and the prices for one carat clear diamonds and half carat clear diamonds, also obtained through Datastream. As it is unclear through what method Datastream arrived at the diamond price 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 have been taken from the World Development Indicators, which is recorded on a yearly basis. Consumer Price Index (CPI) and exchange rate of the local currency to the US dollar 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.

Results

Table 12 displays the results of running regression (2.10) 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 propensity and diamond price is consistently significant and positive. The increase in the size of this coefficient when moving from the monthly to the quarterly, and the quarterly to the yearly model, is roughly commensurate to the increase in the length of the period taken as the unit of analysis (e.g. the size of the coefficient in the quarterly model is roughly three times that of the coefficient in the monthly model). The interaction term including secondary diamond propensity is not significantly related to conflict activity in any of the models. This would indicate that an increase in diamond price leads to an increase in violence in countries that have a propensity towards primary diamonds, but does not affect conflict activity in countries likely to have 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 opportunity cost of conflict. This result is consistent with those obtained by Dube and Vargas (2009). The prediction that the price of labour-intensive secondary diamonds is negatively related to conflict is not supported.

Table 12: Diamonds and violence. Baseline results

	(1)	(2)	(3)	(4)	(5)
VIOLENT EVENTS	Monthly FE	Quarterly FE	Yearly FE	Monthly FE	Monthly FE
Prim. Diamonds	9.606**	31.53**	132.6*	11.26**	10.41**
* diamond price	(4.585)	(14.87)	(68.26)	(5.256)	(4.528)
Second. Diamonds	0.246	0.493	1.617	0.183	-0.179
* diamond price	(0.645)	(2.194)	(8.876)	(0.630)	(1.418)
Diamond price	-3.636	-12.28	-39.16	-3.080	-2.943
	(3.685)	(12.21)	(52.28)	(3.966)	(3.816)
GDP	1.070	3.436	10.68	1.010	0.982
	(1.304)	(4.098)	(15.85)	(1.389)	(1.398)
Population	-1.462	-4.191	-20.18	-1.396	-1.610
	(2.144)	(6.378)	(26.95)	(1.984)	(2.184)
Exchange rate	0.240	1.907	-4.583	0.167	
	(6.167)	(19.13)	(78.26)	(7.767)	
CPI					-6.890***
					(0.0480)
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

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

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 from previous work (Hegre and Sambanis 2006)), but the coefficients are insignificant.

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.

Table 13: Different diamond prices

VIOLENT EVENTS	(1) Monthly FE	(2) Monthly FE	(3) Monthly FE	(4) Quarterly FE	(5) Quarterly FE	(6) Quarterly FE	(7) Quarterly FE
Prim. Diamonds *	4.113**			13.05**			
diamond price index	(1.741)			(5.308)			
Second. Diamonds *	0.151			0.310			
diamond price index	(0.491)			(1.587)			
Diamond price index	-3.915			-13.05			
	(3.668)			(11.38)			
Prim. Diamonds *							15.29
KP export value p/crt							(13.39)
Second. Diamonds *							0.0759
KP export value p/crt							(0.604)
KP export value p/crt							-0.205
							(6.023)
Prim. Diamonds *		0.850**			3.438**		
price 1 carat c diamond		(0.353)			(1.322)		
Second. Diamonds *		0.0483			-0.0133		
price 1 carat c diamond		(0.0918)			(0.428)		
price 1 carat c diamond		-0.475			-2.009		
		(0.585)			(2.207)		
Prim. Diamonds *			0.534*			37.10**	
price 0.5 carat c diamond			(0.296)			(18.26)	
Second. Diamonds *			0.00747			-7.119	
price 0.5 carat c diamond			(0.0296)			(6.618)	
price 0.5 carat c diamond			-0.152			-24.34	
			(0.163)			(50.69)	
Controls include GDP, population and XCR	YES	YES	YES	YES	YES	YES	YES
Observations	4193	4193	4193	1397	1397	1397	1045
# countries	44	44	44	44	44	44	44

Robust standard errors in parentheses

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

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 (not shown).

In Table 13, I experiment with different diamond prices: the Datastream diamond price index, the price of one carat clear diamonds and the price of one half carat clear diamonds (available on a monthly, quarterly and yearly basis) and the value per carat of the exports of signatories to the Kimberley Process (KP), only available quarterly. Results are robust to using the price of one or a

half carat diamonds, and using the Datastream diamond price index instead of the diamond price factor. The coefficients on the interaction terms between primary diamond propensity and these indicators of diamond price have a positive sign, and are significant at various conventional levels (columns (1)-(6)). Similar results are obtained in the yearly model (not shown). No significant results are obtained when using the KP value per carat of exports, although the coefficients on the interaction term between primary diamonds and diamond price carries the expected signs (column (7)). Considering this, and the argument that the value of exports per carat is at best a rough indicator for international diamond price, the results presented in Table 13 are reasonably similar to the baseline results. Overall, an increase in diamond price is positively related to conflict activity in countries with primary diamonds, but is unrelated to violence in areas abundant in secondary diamonds. This provides support for the Dal Bó and Dal Bó model, and no support for the Garfinkel et al. model. The results do not seem to be driven solely by the choice of the indicator for diamond price.

Robustness

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. Four out of the world's five largest diamond producers, both by volume¹⁸ and by value¹⁹ 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). Research suggests that supply conditions impact the diamond price less than the strength of the market position of De Beers (which has recently been threatened by diamond extracting companies in Russia, Australia and Canada operating increasingly independently) (Bergensstock and Maskulka 2001; Spar 2006; Yoeli 2003).

Despite these arguments the reader may not be convinced, and believe that supply conditions do influence diamond price. Dube and Vargas (2009) suggest instrumenting for the price of a resource using the lagged production volume of other exporting countries. This strategy seems possible in the case of diamonds using the export volume of the largest peaceful diamond producing countries: Australia, Botswana, Canada, Russia and South Africa. The assumption is that the previous period

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

¹⁹ Largest producers by value (% of world production): Botswana (26%), Russia (18%), Canada (15%), South Africa (11%), Angola (10%).

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.

To estimate this IV model with fixed effects, the within estimator is used. The variables $\Delta (PRIM_c \times PRICE_t)$, $\Delta (SEC_c \times PRICE_t)$ and $\Delta PRICE_t$, indicating the quarter-on-quarter change by country in the variables $PRIM_c \times PRICE_t$, $SEC_c \times PRICE_t$ and $PRICE_t$, as defined in (2.10), are treated as endogenous. Instruments are $\Delta (PRIM_c \times EXP_{kt-1})$, $\Delta (SEC_c \times EXP_{kt-1})$ and ΔEXP_{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 $PRIM_c$ and SEC_c are time invariant, all quarter-on-quarter variation in the interaction terms used stems from diamond price or its instrument, and all instruments are uncorrelated to $PRIM_c$ and SEC_c . Hence, there is no worry that the instruments are positively correlated to the first part of the interaction term, and negatively correlated to the second. Because Kimberley process data are only available quarterly for the period 2004-2009, I only estimate quarterly models and lose a considerable number of observations. Taking differences is another source of a loss of observations.

Countries included in k 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 zones are smuggled to Botswana or South Africa, artificially increasing their export), 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.

Table 14 displays the results of the first stage, using different indicators of diamond price and different combinations of instruments. Changes in the export volume of all five countries are strongly correlated to changes in the diamond price, and the R^2 of the first stage ranges from 0.36 to 0.44 when using all five countries, and from 0.31 to 0.35 when using only countries outside Africa. However, the signs of the coefficients reveal the peculiar nature of the diamond market. The export volume of Australia and South Africa is consistently negatively related to diamond price, whilst exports of Russia, Canada and Botswana are positively related to price. This could be explained if we consider that some companies in the diamond sector – most notably DeBeers – could be price setters in the sense that an increase in their production depresses the diamond price, whereas smaller companies act as price-takers and increase production when the diamond price is high. This explanation is consistent with the negative sign on the coefficients for South African exports, South Africa being a traditional DeBeers stronghold. However, DeBeers is also active in Botswana and this country's exports are positively related to diamond price. Furthermore, Australian export volume carries a negative sign, whilst the main mining company in this country, Rio Tinto, is a relatively small player in the diamond market (about 7% of total production) and

Table 14: First stage IV model

ENDOGENOUS VARIABLE	(1) Diamond price	(2) Diamond price index	(3) KP export value p/crt	(4) Diamond price	(5) Diamond price
Interaction primary diamonds					
Primary diamonds * export Australia	-102.4*** (0.466)	4.353*** (0.492)	-105.2*** (1.050)	-116.3*** (0.714)	-120.0*** (1.499)
Primary diamonds * export Russia	22.81*** (0.316)	70.89*** (0.387)	10.73*** (0.549)	15.34*** (0.590)	2.479** (0.985)
Primary diamonds * export Canada	234.8*** (2.082)	285.8*** (1.982)	389.8*** (3.926)	298.5*** (1.909)	455.5*** (3.304)
Primary diamonds * export South Africa	-137.7*** (1.363)	-29.00*** (1.394)	-144.8*** (2.683)		
Primary diamonds * export Botswana	54.40*** (0.702)	69.74*** (0.614)	55.89*** (1.371)		
Interaction secondary diamonds					
Secondary diamonds * export Australia	-102.3*** (0.919)	4.491*** (0.923)	-104.1*** (2.778)	-116.6*** (0.896)	-119.7*** (2.796)
Secondary diamonds * export Russia	23.33*** (0.358)	71.48*** (0.366)	11.99*** (1.061)	15.54*** (0.355)	3.008*** (1.117)
Secondary diamonds * export Canada	237.4*** (0.803)	288.9*** (0.792)	395.9*** (2.140)	300.7*** (0.788)	460.7*** (2.181)
Secondary diamonds * export South Africa	-139.4*** (0.176)	-30.80*** (0.165)	-148.4*** (0.465)		
Secondary diamonds * export Botswana	54.03*** (0.0978)	69.35*** (0.0958)	54.98*** (0.300)		
Diamond price					
Export Australia	-93.33*** (1.552)	11.84*** (1.871)	-87.36*** (3.051)	-102.3*** (2.126)	-92.74*** (4.025)
Export Russia	21.05*** (0.657)	68.92*** (0.768)	8.551*** (0.988)	18.30*** (1.470)	11.36*** (2.090)
Export Canada	205.8*** (6.411)	256.1*** (5.198)	325.6*** (11.26)	276.8*** (5.562)	410.6*** (8.675)
Export South Africa	-116.9*** (3.505)	-10.20*** (3.387)	-99.49*** (6.888)		
Export Botswana	62.30*** (1.934)	77.20*** (1.764)	75.12*** (3.631)		
Observations	1,001	1,001	1,001	1,001	1,001
R ² first stage	0.443	0.444	0.363	0.353	0.313
R ² second stage	0.475	0.459	0.427	0.390	0.379

Standard errors in parentheses

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

thus unlikely to be a price-setter (Bain & Company 2013). This illustrates the difficulties in predicting the diamond price using export volumes and the lack of market conditions in the diamonds sector. Unexplained results in the first to a certain extent undermine confidence in the IV strategy.

Table 15 reports the results of the second stage. Column (1) shows that instrumenting for diamond price does not meaningfully change the size and sign of the coefficient on the interaction term between primary diamond propensity and diamond price. In fact, it increases slightly in size compared to results displayed Table 11 column (2). However, the standard error is larger, and the coefficient is no longer statistically significant at conventional levels. This is possibly due to the loss of observations (close to 400 observations are lost due to differencing and using the Kimberley Process data), and uncertainty introduced by using IV regression. Similar results are obtained when

Table 15: Instrumenting for diamond price

	(1)	(2)	(3)	(4)	(5)
VIOLENT EVENTS	Quarterly IV	Quarterly IV	Quarterly IV	Quarterly IV	Quarterly IV
Prim. Diamonds *	34.52			47.29	
diamond price	(25.69)			(31.35)	
Second. Diamonds *	-0.163			2.024	
diamond price	(1.668)			(2.202)	
Diamond price	-1.407			-7.742	
	(10.70)			(11.31)	
Prim. Diamonds *		-27.10			
diamond price index		(24.53)			
Second. Diamonds *		-3.115*			
diamond price index		(1.651)			
Diamond price index		4.714			
		(11.50)			
Prim. Diamonds *			28.09		34.96
KP export value p/crt			(20.88)		(23.62)
Second. Diamonds *			-0.131		1.191
KP export value p/crt			(1.381)		(1.654)
KP export value p/crt			-1.556		-5.067
			(9.700)		(9.813)
Instrument: lagged	Aus. Botsw.	Aus. Botsw.	Aus. Botsw.	Aus. Can.	Aus. Can.
production	Can. Rus. SA	Can. Rus. SA	Can. Rus. SA	Rus.	Rus.
Controls include GDP,	YES	YES	YES	YES	YES
population and XCR					
Observations	1001	1001	1001	1001	1001
# countries	44	44	44	44	44

Robust standard errors in parentheses

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

using KP export value as an indicator of diamond price, and when instrumenting for diamond price using only the production volume of Australia, Canada and Russia. The coefficient on the interaction term between primary diamond propensity and diamond price carries a positive sign in regression (3), (4) and (5), the size of the coefficients in these columns is comparable to those in Table 12 and Table 13, but coefficients are not statistically significant. The result in column (2) of Table 15 is aberrant, with the interaction between primary diamonds and price entering the regression negatively.

The coefficient on the interaction term between secondary diamond propensity and diamond prices carries a negative sign in columns (1)-(3), in contrast to results obtained earlier. It is significant at the 10% level in column (2). This provides some, albeit considerably weak support for the model by Dal Bó and Dal Bó (2004), which predicts that an increase in the price of diamonds leads to a *decrease* in violent activity in areas with secondary diamonds.

In sum: instrumenting for diamond price weakens the earlier results considerably, with the interaction term including primary diamond propensity generally entering the regressions insignificantly. This may be (partly) due to the considerable loss of observations and/or by the uncertainty introduced by the IV strategy. However, size and sign of the coefficient is generally unaffected by instrumenting for diamond price using production volume of the five largest peaceful diamond exporters.

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 high 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 16, 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. If this is the case, part of the increase in violence that has been ascribed to the increasing value of diamonds might in reality be due to other resources that occur in the same locations and simultaneously become 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 1,500 years (Archons) (Clifford

1966). The price of diamonds and the prices of a number of on-Archon resources, specifically gold, platinum and iron ore are indeed correlated: correlation coefficients range from 0.72 to 0.81 and are significant at the 1% level. Among on-Archon resources, gold requires special attention because of its similarities to diamonds: it also occurs in primary and secondary deposits, and is associated with ASM livelihoods. In addition, the indicator for secondary diamond propensity might partially be capturing secondary gold deposits.

Therefore, 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-Archon and those he considers off-Archon. 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 occurrences of a wide range of minerals (U.S. Geological Survey 2005). The total number of deposits in a country classified as containing one of Clifford's on-Archon minerals (gold, platinum, iron, asbestos or chromium) as 'major commodity' is taken to be an indicator for the on-Archon mineral abundance. The total number of deposits coded as containing some other mineral (excluding diamonds)²⁰ as 'major commodity' forms the indicator for off-Archon 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. For gold, I distinguish between primary and secondary gold deposits, the former consisting of deposits classified as "underground" or "off-shore" and the latter of deposits classified as "placer" or "surface". Deposits classified as "surface-underground" are considered as both primary and secondary deposits. Deposits classified as 'unknown' are ignored. Datastream provides data on gold, platinum and iron ore price.

Column (3) of Table 16 includes interaction terms between these four categories of resources and diamond price in the yearly model. Similar results are obtained for the quarterly and yearly model (not shown). 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. The interaction term including on-Archon minerals is highly significant and its inclusion causes the coefficient on the interaction term between propensity towards primary diamonds and diamond price to lose significance and decrease considerably in size. The terms including the other minerals enter the regressions positively yet not significantly. The loss of significance of the variable of interest appears exclusively due to the interaction term including on-Archon minerals; including the other three interaction terms only does not affect the results on the variables of interest qualitatively (column (4)).

The earlier results are found to not be robust to controlling for the presence of on-Archon resources. If a rise in diamond price spurs conflict activity in diamond abundant areas, it seems to do so as part of a price increase of others resources occurring in the same areas. This however does

²⁰ These minerals include: Aluminum, Antimony, Barium, Beryllium, Cobalt, Copper, Gemstone, Graphite, Lead, Manganese, Mercury, Nickel, Silver, Tin, Titanium, Uranium and Zinc. I exclude deposits containing only Clay, Limestone, Salt, Stone or Talc-soapstone as major commodity.

Table 16: Controlling for cyclical effects and the presence of other resources

VIOLENT EVENTS	(1) Monthly FE	(2) Quarterly FE	(3) Monthly FE	(4) Monthly FE	(5) Monthly FE
Prim. Diamonds *	9.630**	31.57**	1.980	6.768**	-0.574
diamond price	(4.583)	(14.87)	(2.746)	(2.684)	(2.722)
Second. Diamonds *	0.235	0.478	0.452	0.540	0.299
diamond price	(0.646)	(2.197)	(0.648)	(0.654)	(0.658)
Diamond price	-3.156	-11.52	-4.665	-5.999	-2.193
	(3.952)	(12.92)	(4.664)	(4.545)	(3.446)
On-Archon minerals *			8.764***		
diamond price			(2.576)		
Off-Archon minerals *			1.133	9.138**	
diamond price			(4.961)	(4.208)	
Oil reserves *			1.453	2.572	
diamond price			(2.394)	(2.768)	
Gas reserves *			8.154	4.441	
diamond price			(5.909)	(7.063)	
Primary Gold * gold price					6.313***
					(1.908)
Second. Gold * gold price					-2.346
					(14.55)
Gold price					-10.92
					(24.41)
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	4193	4,193
# countries	44	44	44	44	44

Robust standard errors in parentheses

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

not necessarily invalidate the conclusion that the theoretical model by Dal Bó and Dal Bó fits the data better than that by Garfinkel, Skaperdas and Syropoulos (2008) 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.

I investigate this further for the case of gold, as this also occurs in primary and secondary deposits. Column (5) of Table 16 includes an interaction term between primary gold deposits and gold price, secondary gold deposits and gold price and gold price in the baseline model. Again, earlier results are not robust to including these terms. The coefficient on the interaction term between primary gold and gold price is positive and significant at the 1% level, whilst the interaction term between secondary gold and gold price enters the regression insignificantly, yet

with a negative sign. Similar results are obtained in the quarter and yearly model (not shown). Again, these results are consistent with the wage rate as a channel connecting resource price and violence, and not consistent with the weak property rights mechanism.

Mechanisms: wage rate versus the ‘prize’ of government

Besley and Persson (2008) offer an alternative explanation for the results obtained throughout this chapter. 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, case study evidence illustrated that primary diamonds provide a larger flow of government revenue than secondary diamonds. Because property rights over primary diamonds are better protected, it is easier for the government to obtain a portion of the rents from extraction, whether through taxation, a concession for extraction, or extraction by a state-owned enterprise. By contrast, it has proven challenging to bring small-scale mining for secondary diamonds into the formal economy, although in some countries, secondary diamonds are mined on a larger scale, for example in Namibia. Nevertheless, given the informal character of a large section of the secondary diamond production, the ‘prize’ of government mechanism would predict that primary diamonds are more strongly related to conflict than secondary diamonds. Similarly, we can also expect other primary gold to provide more substantial revenue flows to the government, compared to secondary gold, providing an alternative explanation for the results on gold obtained 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 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 in a country 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 17, columns (1) and (2), show the results of using these two dependent variables in the baseline regression. In the first column, the coefficient on the interaction term between primary diamonds and diamond price is positive and significant at the 10% level, suggesting that violence in provinces that contain diamonds increases with the diamond price in countries with primary diamonds. This is consistent with the wage rate mechanism. The second column suggests that violence in the capital does not increase with the diamond price in countries with a propensity towards primary diamonds, contrary to the predication of the ‘prize of government’ mechanism. The coefficient on the interaction term between secondary diamonds and diamond price does suggest that in countries with a propensity towards secondary diamonds, violence in the capital does increase with the diamond price. This result is not explained by either mechanism.

Columns (3) and (4) of Table 17 explore the relationship between the gold price and violence in diamond abundant areas and the capital respectively. The previous section has shown that diamond and gold deposits are correlated, so that violence in diamond (and likely gold) abundant areas may indeed increase with the gold price. This exercise again provides evidence in support of the wage rate mechanism, and little evidence to support the ‘prize’ of government mechanism. The price of gold is positively related to violence in provinces containing resources in countries with primary gold, and unrelated to violence in countries with secondary gold deposits

Table 17: Diamonds and Violence. Mechanisms

VIOLENT EVENTS	(1) Monthly FE	(2) Monthly FE	(3) Monthly FE	(4) Monthly FE
Prim. Diamonds *	1.711*	-0.0764	-0.446	-0.224
diamond price	(1.013)	(0.176)	(0.331)	(0.290)
Second. Diamonds *	-0.0267	0.134**	-0.0164***	0.135**
diamond price	(0.0160)	(0.0625)	(0.00574)	(0.0656)
Diamond price	-0.107	0.0100	0.0940*	-0.0329
	(0.113)	(0.334)	(0.0518)	(0.267)
Primary gold *			1.329***	0.0581
gold price			(0.0710)	(0.115)
Secondary gold *			-0.387	0.262
gold price			(0.305)	(0.843)
Gold price			-0.530	0.746
			(0.679)	(3.339)
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

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

(column (3)). Including the variables relating to gold in this regression weakens the result with regard to primary diamonds (the coefficient has the opposite sign and is no longer significant – as in the previous section), but strengthens the result with regard to secondary diamonds: the coefficient on the interaction term between secondary diamond propensity and diamond price is negative and significant, indicating that violence in diamond-abundant areas decreases with the price of diamonds in countries with secondary diamonds. None of the variables relating to gold are significantly related to violence in the capital (column 4), in contrast to the predictions of the ‘prize’ of government mechanism. Again, the result on secondary diamonds in column (4) is not consistent with either mechanism.

Taken together, these results provide evidence in favour of the wage rate mechanism, but no support for the prize of government mechanism.

Conclusion and policy implications

This chapter has investigated whether an increase in diamond price is related to an increase in violent activity in African countries that are likely to have diamonds, and if so through which mechanism. Potentially, a rise in diamond price could increase conflict activity through changing the wage rate and thereby the opportunity cost of conflict (Dal Bó and Dal Bó 2004) and/or through weak property rights protection, increasing the expected revenue from conflict (Garfinkel, Skaperdas, and Syropoulos 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). Evidence from case studies does not unequivocally link either type of diamond to conflict, and illustrates that it is possible that the primary and secondary diamond industry have opposite effects on the wage rate. I created a new indicator for the propensity of an area to hold primary and secondary diamonds respectively, based on geological regularities. Exploiting this, I interact both primary and secondary diamond propensity 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 quasi difference-in-difference model, intends to incorporate some of the critiques to earlier work on this topic.

The findings suggest that a rise in diamond price is positively related to violent activity in African countries that have a propensity towards primary diamonds, but is unrelated or negatively related to violence in countries with a propensity towards secondary diamonds. These results are not driven by the choice of diamond price data and are robust to controlling for cyclical effects. Results are weakened when instrumenting for diamond price, and when controlling for the presence of other resources, notably gold. 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, Skaperdas and Syropoulos (2008). 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 evidence in favour of the wage rate mechanism, but none in favour of the 'prize' of government mechanism.

These results have implications for policies regarding natural resources. Secondary diamonds have gained a reputation as 'conflict diamonds', whilst countries producing primary diamonds deliberately promote their diamonds as 'clean' (e.g. Botswana (Taylor and Mokhawa 2003)). One response to counter 'conflict diamonds' is the KPCS. This scheme requires all signatory countries to ensure all diamond imported and exported carry a certificate that these diamonds are not 'conflict diamonds', defined as diamonds mined by rebels to finance violent conflict against a legitimate government. The goal is to make illegally mined diamonds unmarketable, essentially driving their price down to zero.

In this chapter, I find no evidence that secondary diamonds are 'conflict diamonds', in the sense that a decrease in diamond price is related to a decrease in violent activity in areas with secondary diamonds. Given that the KPCS was in force throughout all but one year of the period under investigation (2002-2010, with the KPCS entering into force in 2003), it is possible that it was successful in severing the link between secondary diamonds and conflict. However, organizations such as Global Witness have repeatedly critiqued the implementation of the KPCS, particularly its failure to deal with governments, such as those in Zimbabwe and Cote d'Ivoire, that do not enforce the scheme strictly enough.²¹ This casts doubt on whether the Kimberley Process will have succeeded in severing the link between secondary diamonds and violent conflict from the early years of its inception onwards.

The finding that diamond price is positively related to violent activity in countries likely to have *primary* diamonds is not consistent with the image of primary diamonds as 'clean'. This chapter provides evidence that primary diamonds, potentially even those produced legally, may contribute to conflict indirectly, by influencing the wage rate. The KPCS and other campaigns dissuading consumers from buying 'conflict diamonds' appear ill-equipped to counter this effect: for a diamond to be classified as a 'conflict diamond', it has to fund rebellion directly. Another potential concern is the difficulty of legalizing artisanal diamond production under the KPCS. As the section evaluating case study evidence has illustrated, this problem has been noted in numerous countries with secondary diamonds. The theoretical model most supported by the analysis in this chapter suggests that decreasing the price of those diamonds that provide a livelihood to individuals and households may spur conflict through decreasing the opportunity cost of joining an armed group.

²¹ See for example: <http://www.globalwitness.org/campaigns/conflict/conflict-diamonds/kimberley-process>, accessed 21 March 2014.

This suggests the possibility that the KPCS, by decreasing the value of informally mined diamonds, could contribute to conflict. However, empirical evidence in this chapter does not support the existence of a significant negatively relationship between diamond price and violence in countries with a propensity towards secondary diamonds.

Furthermore, although there has been much awareness of the role of diamonds in conflict, the results presented in this chapter suggest that diamonds may be only one of the resources related to conflict through the wage rate mechanism. Including other on-Archon resources, including gold, in the analysis substantially weakens the results on diamonds. Furthermore, gold appears to be related to violent conflict in a similar way as diamonds: gold price is positively related to violence in countries with primary gold deposits, and unrelated to violence in countries with secondary gold deposits. If other capital-intensive resources are similarly related to conflict, it may be worth considering policies that address the impact that 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 public employment, can be Pareto improving; this Pareto improvement holds if public employment is unproductive in itself. 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 an increase 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. Iyengar, Hanson and Montén (2011) 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 (Iyengar, Montén, and Hanson 2011). In sum, this chapter suggests that public employment merits consideration as an alternative to other policies attempting to sever the link between natural resources and conflict. .

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 (thus improving 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.

CHAPTER 3

Information is liberating?

Results from a natural experiment on the impact of radio on anxiety, and anxiety on political attitudes

Abstract

This chapter investigates the impact of intensity of exposure to media on individuals' levels of anxiety and the impact of this anxiety on their political attitudes. A number of theories suggest that media consumption may, through different mechanisms, increase anxiety. Furthermore, there is an upswing in interest in the role of emotions in politics (Neuman et al. 2007). We exploit exogenous variation in the signal strength of a specific radio station, to investigate the impact of intensity of exposure to its broadcasts on how fearful residents of Western Equatoria State, South Sudan, are of an attack by an armed group. Our results show that inhabitants of villages with better radio reception report a higher level of fear of being attacked. This result is reasonably robust to controlling for armed group activity and various other factors. We provide suggestive evidence that results are consistent with the 'availability heuristic' (Tversky and Kahneman 1973). Furthermore, we find evidence that fear, as instrumented by radio reception, is associated with increased reliance on a civilian protection militia and decreased reliance on the government army. Considering two theories of the role of emotions in politics, our data appears most consistent with 'Affective Intelligence' (Marcus, Neuman, and Mackuen 2000).

Introduction

"Knowledge is power. Information is liberating," Kofi Annan is reported to have said²². A prominent source of such information is the media. However, whether the media indeed "liberates" is subject to debate. In developed countries the media is sometimes thought to cultivate a culture of fear (e.g. (Furedi 1997, 2005)). Studies of developing countries both highlight the media's polarizing effects (for example through "hate radio" in Rwanda), *and* its pacifying effects (it is widely believed that media can contribute to peace- and state-building, (e.g. (Orme 2010))). Simultaneously, there has been an upswing in interest in the role of emotions in politics, with particular attention to the role of fear, or anxiety. (Neuman et al. 2007).

²² Press Release SG/SM/6268 23 June 1997, available at <http://www.un.org/News/Press/docs/1997/19970623.sgsm6268.html>, accessed 7 October 2014.

This chapter contributes to the literature on media and fear, and on the role of anxiety in the formation of political preferences. It focuses on a developing country, South Sudan, an underrepresented category in both strands of literature. It exploits exogenous variation in signal strength of a radio station, Yambio FM. The intensity of Yambio FM's signal decreases with the distance to the point of transmission, but not uniformly. Residual variation in signal strength is likely due to geographic factors, such as minor differences in elevation, which are plausibly unrelated to our dependent variable of interest. The chapter uses interdisciplinary research methods, including a household survey of individuals and semi-structured individual and group interviews.

Specifically, we investigate the impact of the intensity of exposure to Yambio FM on the frequency of fear of being attacked by the Lord's Resistance Army (LRA) among residents of two counties in Western Equatoria State, South Sudan. Yambio FM is part of a larger network of radio stations broadcasting so-called "come home" messages encouraging LRA fighters to defect. Furthermore, the station provides isolated communities with information on LRA movements. At the time of research, the LRA was likely to be in neighbouring Democratic Republic of Congo (DRC) and Central African Republic (CAR), thus "come home" messages broadcast in South Sudan were extremely unlikely to reach any LRA fighters on South Sudanese soil. However, these broadcasts mean that other radio listeners frequently hear about the LRA on the radio.

This chapter explores the impact of intensity of exposure to these messages on fear of the LRA. We conclude that people living in a village with better reception of Yambio FM report significantly higher levels of fear of an LRA attack. This result is robust to controlling for actual LRA activity, presence of other armed forces, distance to the CAR or DRC border, phone coverage, displacement and date of enumeration. We also explore a number of theoretical mechanisms that connect exposure to radio broadcasts and fear. We fail to find clear cut results using the survey data, but interview data provide tentative support for the 'availability heuristic' for estimating risk, suggested by Tversky and Kahneman (1973).

In a second step, we study the impact of fear of the LRA, as predicted by exposure to Yambio FM, on political attitudes. In response to the LRA threat, people in Western Equatoria State have formed a civilian protection militia known as the Arrow Boys. This militia is generally perceived to be more effective in providing protection from the LRA than the government army, SPLA. This chapter explores whether ability to receive Yambio FM is related to attitudes towards the Arrow Boys and SPLA respectively. Although we do not obtain strong results for all indicators of political attitudes, we find evidence that more intense exposure to Yambio FM is associated with *increased* demand for the services of the Arrow Boys and *decreased* demands on the SPLA. Two competing theories provide an explanation for the relationship between anxiety and conflict. Interview data are most consistent with 'Affective Intelligence' (Marcus, Neuman, and Mackuen 2000).

These results can also have implications for our view of the role of media, specifically radio, in conflict-affected situations. As mentioned, radio is often thought to be a state-building tool. To the extent that we view increased reliance on an “informal” militia and decreased reliance on the government army as the opposite of “state-building,” radio does not appear to have the expected effect in this case. Furthermore, although the network of radio stations broadcasting “come home” messages intends to protect the local population, the local population does not appear to *feel* better protected as a result. Although *actual* protection does not necessarily equal *perceived* protection, increased fear may be an unintended side effect of providing information via the radio.

The remainder of this chapter is organised as follows. The next section explores existing literature, including theories on media and anxiety, and anxiety and political attitudes. Section three provides background knowledge on the area under research. Section four describes our data, identification strategy and hypotheses. Section five presents the results and section six concludes with a number of policy implications.

Theory and Literature

This chapter investigates how exposure to information supplied by media affects anxiety, and the impact of anxiety on political attitudes. The first relationship is informed by literature on how individuals use information from the media to estimate risk. The second stage ties in with literature on the role of emotion in political behaviour.

In both strands of literature, it is useful to recognize two broad theoretical approaches to individual decision-making: cognition and affect. Different definitions of these terms exist, but in general, cognition is associated with thinking (the perception, storage and processing of information) and affect is associated with emotion (the evaluation of information) (Marcus 2000; Neuman et al. 2007). Although there is still much debate on whether cognition or affect has primacy in decision making and on how the two interact (Neuman et al. 2007), research in psychology has established that affect and cognition are two independent mental processes, and there is a recognition that both can be a basis for decision making (Marcus 2000). The terms systemic and heuristic decision indicate a somewhat similar distinction.²³ Systemic decision making is a high-involvement process, where an individual actively seeks information and evaluates this in an effortful and structured manner. Heuristic decision making is a low-involvement process, in which an individual relies on mental shortcuts based on current knowledge and experience (Chaiken 1980; Tversky and Kahneman 1973).

We could consider cognition or systemic decision making as consistent with a rational choice model, and affect or heuristic decision making as deviations from rationality. However, in

²³ This field, as recognized by Neuman et al. (2007), is characterized by a plethora of concepts. However, it is not always clear whether or how these concepts differ, and in fact underlying concepts may be few.

the context of bounded rationality, which recognizes that information available may be imperfect and that obtaining further information is costly, neglecting to seek further information or relying on heuristic processes instead of cognitive ones, may be considered rational (Mackuen et al. 2007; Fielding and Shortland 2009). This will be illustrated below.

Media information and anxiety

How does information in the media influence an individual's risk estimation, specifically the risk of becoming a victim of violence? It is a popular idea that media contributes to a culture of fear (Heath and Gilbert 1996; Furedi 1997, 2005). A number of models explain how exposure to media information could increase perceived risk, based on different theoretical premises.

Fielding and Shortland (2009) present a model they term *costly information*, which is consistent with (bounded) rational choice. When information is costly, they argue, individuals may take the intensity of media coverage of adverse events as an indicator of risk. They contrast this with heuristic models of risk estimation. When faced with the complex task of estimating the probability of an incident, individuals may take a mental shortcut and base their estimation on the ease with which examples of such incidents come to mind (the *availability* of such incidents) (Tversky and Kahneman 1973). Frequent media coverage of violence increases availability and thereby perceived risk.

A number of alternative theoretical models also have their basis in affective or heuristic decision making, and place more emphasis on the content, rather than the frequency of media information. The theory of *substitution* (also called cultivation or mainstreaming) posits that individuals substitute their own experience of reality with the media's (specifically television's) representation of it. To the extent that media reporting is biased towards reporting violence, this increases perceived risk (Gerbner et al. 1980). Two related alternative theories are *resonance* and *affinity* (Eschholz 1997). The first holds that media reports on violence may resonate with an individual's experience if he or she has been a victim of violence in the past, thus increasing anxiety. Affinity hypothesizes that individuals identify with victims of violence in the media who belong to a similar demographic and therefore perceive increased risk to themselves.

Empirically, the question whether exposure to information from media and anxiety are related is unresolved. Eschholtz (1997), Wahlberg and Sjoberg (2000) and Heath and Gilbert (1996) provide overviews of this literature; all three conclude that results on the relationship between media exposure and anxiety are mixed. For example, of the twenty studies on TV viewing and fear of crime reviewed in Eschholtz (1997), nine see no relationship between the two, another nine find a positive relationship and two establish a negative relationship. The nine studies on newspaper reading and fear of crime are even more divided (four finding no relationship, three a positive and two a negative relationship). In two more recent studies, Weitzer and Kubrin (2004) find that TV-viewing is correlated to an increased level of fear of crime in Washington D.C., but find no

evidence for any impact of exposure to newspapers or radio (Weitzer and Kubrin 2004). Conversely, Ditton et al. (2004) studying four neighbourhoods in Glasgow fail to find a correlation between watching TV or reading newspapers and fear of crime (Ditton et al. 2004).

Some limitations of this literature already become apparent. The literature on media and anxiety is highly US-centric. Furthermore, as Wahlberg and Sjoberg (2000) highlight, *correlations* between media consumption and anxiety do not tell us whether information from media *causes* anxiety. The causality may run the other way. Individuals who are more afraid might deliberately avoid certain media to diminish their exposure to stressors (Ditton et al. 2004), or those that are afraid might seek out news about crime because they feel knowledge will somehow protect them (Eschholz 1997). Or media and fear of victimization may be unrelated if some intervening factor exists that is related to both media consumption and fear, such as affluence or actual crime risk (Hirsch 1981; Doob and Macdonald 1979).

Other studies attempt to distinguish between alternative theoretical mechanisms connecting media and anxiety. For example, Fielding and Shortland (2009) investigate how US demand for tourism in Israel responds to actual and media-reported Palestinian and Israeli deaths respectively. They conclude that tourism decreases in response to *actual* Israeli, but *reported* Palestinian deaths. They argue that these results are consistent with a rational choice model: because information about Palestinian deaths is costlier to obtain in the US, potential tourists take reported Palestinian deaths as an indicator for risk, but seek out additional information regarding Israeli deaths. Results are not consistent with heuristic models of risk estimation, as these cannot explain the difference in response to media coverage of violence against Israeli and Palestinians.

The cultivation theory implies that the effect of exposure to media is larger for those who have least experience of violence; as the gap between their experience and the reality as portrayed by the media is larger. Indeed, Liska and Baccaglini (1990) find this effect in their study and Ditton et al. (2004) draw similar conclusions. Investigating whether the relationship between anxiety and exposure to media is stronger for those with previous experiences of violence is often considered to be a test of the resonance mechanism (e.g. (Doob and Macdonald 1979)). Relatedly, the affinity mechanism predicts that this relationship would be strongest for those who belong to a demographic often shown as victims by the media, but who have not necessarily experienced violence themselves (e.g. (Hirsch 1981)).

In sum, the literature on the media and risk estimation gives us a number of theoretical reasons to believe that increased access to media could increase fear of being subject to violence: costly information, availability, substitution, resonance and affinity. It has proven challenging to establish the existence of this relationship empirically (especially in non-US contexts) as well as distinguishing between various competing theoretical mechanisms and premises.

Anxiety and political attitudes

What role does emotion, specifically anxiety, play in the formation of political opinion? Neumann et al. (2007) list no less than 23 named theories on the role of emotions in politics. One of the more influential theories is *Affective Intelligence* put forward by Marcus, Neumann and Mackuen (see (Mackuen et al. 2007; Marcus, Neuman, and Mackuen 2000)). This theory states that when faced with a familiar situation requiring a political opinion, cognitive decision-making is too costly, individuals rely on heuristic processes, including habit or partisan attitudes to shape their political attitude. In unexpected and uncertain situations, however, cognitive decision-making does pay off. A feeling of anxiety signals to individuals whether they are in a familiar or unexpected situation. When anxious, individuals actively seek out information (e.g. about the plans and behaviour of political figures) and engage in high-involvement cognitive decision making. The authors stress that “emotion’s impact is largely functional and rational”. Anxiety helps individuals to form a political opinion close to their true preference while avoiding the unnecessary costs of seeking and processing information. In this sense, Affective Intelligence is consistent with bounded rationality. However, the authors also acknowledge that emotional appraisal of the newness of a situation may be wrong and that anxiety is subject to manipulation (Mackuen et al. 2007).

Other theories propose a more direct role for emotion, and a more decided departure from rationality. An individual’s emotion when confronted with a political actor may directly translate into a political attitude, so-called *Affect Transfer* (Ladd and Lenz 2001, 2008). Relatedly, individuals may use information to build up a positive or negative *affective tag* attached to a political actor and then forget the information relatively quickly. Psychological research shows that once a tag is created, individuals may find it easier to process information that is consistent with this tag. Hence, new information contradicting the existing tag is not given adequate weight, and an individual’s political attitude may only very slowly, if at all, be updated to a point close to their ‘true preference’ (Cassino and Lodge 2007).

Empirically, there is much debate on the merits of Affective Intelligence versus theories proposing a more direct role for affect. Mackuen et al. (2007) provide evidence in favour of the theory using data from US National Election Surveys. They show that voters identifying either as Republican or Democrat are more likely to defect and vote for the opposite party if they are anxious. However, Ladd and Lenz challenge these conclusions, stating that the evidence presented is more consistent with Affect Transfer, and could be subject to endogeneity (i.e. voting against one’s own party induces anxiety) (Ladd and Lenz 2001, 2008).

The current state of the debate shows that a better understanding of the relationship between media and anxiety and the relationship between anxiety and political attitudes requires further study, especially in a non-US context.

Media and state-building

A final strand of literature that this chapter contributes to is the literature on the role of media in state-building, especially in situations affected by violent conflict. The power of media, especially of radio, in these contexts has been greatly emphasized in practitioner and policy literature. Orme (2010) for example, states that “[UN radio stations] have helped end violent conflict and make political transition possible” (Orme 2010). Similarly, BBC Media Action (2012) maintains that “media and communication have huge potential to support peaceful transition to self-governance” (BBC Media Action 2012). It is often unclear exactly *how* media will aid in state-building. One reasoning may be that media are considered to be the fourth estate in established democracies, and hence essential for transforming a post-conflict country into a democracy. This argument somewhat resembles theoretical models of the impact of media on the behaviour of politicians. According to this model, media provides citizens with information, which changes voting patterns and voter participation, decreasing the (re-)election chances of badly performing politicians, which in turn increases the incentive for current politicians to perform more in line with citizens’ wishes (Sobbrio Forthcoming).

However, the role of the media as the fourth estate, in a situation where the remaining three pillars of democracy are essentially non-existent, is increasingly called into question. Humphreys and Weinstein (2012) do not find evidence that an intervention spreading information about politicians’ behaviour in Uganda improved their performance; Fergusson et al. conclude that Brazilian politicians exposed by the media as dealing with paramilitary groups received more votes after exposure; and Malesky et al. find that Vietnamese parliamentary delegates under increased scrutiny curtail activities critical of the regime (Fergusson, Vargas, and Vela 2013; Humphreys and Weinstein 2012; Malesky, Schuler, and Tran 2012). This chapter will provide further evidence reinforcing the doubts about the media’s power in contexts where working structures of democracy do not exist.

Background and context

This study is based on data gathered in two counties of the South Sudanese state of Western Equatoria. This state lies in the south-west of South Sudan, and borders the CAR to the west, and the DRC to the south. Yambio FM derives its name from the state capital, from where it also transmits. The majority of its broadcasts are in the local language, Pazande. The two counties under study, Ezo and Tambura, border DRC and CAR respectively and lie up to a day’s travel by car, or between 60 and 160 kilometres as the crow flies, away from Yambio. Both Ezo and Tambura are densely forested; the fertile soil supports up to three harvests per year. Small-scale agriculture is the dominant way of earning a livelihood.

LRA and fear

The Lord's Resistance Army (LRA) is an armed group originating from northern Uganda. It is infamous for its abduction of adults and children, either as a method of recruiting fighters, or for a brief duration, for example to carry a load. In 2005, the LRA moved to Western Equatoria State, and was based in DRC's Garamba National Park during peace talks between the Government of Uganda and the LRA, which took place in South Sudan's capital Juba from 2006 to 2008. These peace talks ended with a military offensive against the LRA executed by the Ugandan army (UPDF), supported by the US, which further scattered the LRA across the South Sudanese, CAR and DRC borderlands.

Since 2008, the LRA has been most active in DRC and CAR. Although the exact location of the LRA varies and is uncertain, the LRA Crisis Tracker (an online resource run by the NGOs Invisible Children and Resolve) provides a database compiling reports of LRA related abductions, clashes, looting, displacement, violence and sightings. Between 2008 and the time of our research in April 2013, it reported 1613 LRA related incidents in DRC, versus 363 in CAR and 175 in South Sudan. From 2012 onwards, only two LRA related incidents were reported in South Sudan. In the year preceding our research, no incidents took place in Ezo or Tambura according to the LRA Crisis Tracker. Semi-structured interviews confirm that the LRA has not been active in WES for a while, with a typical response being "The LRA is no longer in the land."²⁴ Thus all sources indicate that the LRA has not been present in South Sudan since 2012, and that the threat of LRA related violence has been relatively low for some time.

Despite the absence of LRA activity in the most recent years, fear of the LRA among the population of Ezo and Tambura is high. In a survey carried out by the authors, 75 per cent of respondents indicated that in the past 12 months, they had feared "often" that the LRA would come and attack their village. In interviews, respondents recognized the absence of LRA activity close to them, but expressed fear that the LRA would return along with a profound sense of insecurity, also due to the broader effect that killings have on the community.

Arrow Boys and other armed actors

After the offensive on the LRA in 2008, and a series of LRA attacks that followed it, a number of communities in Western Equatoria State formed civilian protection militia, commonly known as the Arrow Boys. Contrary to what the name suggests, Arrow Boys can be men of all ages as well as women; members of the group patrol the roads and the bush armed with guns, bows and arrows. Arrow Boys are usually organised at the village level. Membership of the Arrow Boys is fluid, as more people appear to join temporarily when information about a security threat is received. However, all sources indicate that the Arrow Boys militia is an important actor in the region: more than 80 per cent of the respondents to the household survey indicated that their household had

²⁴ Author interview with county official, Tambura, 10 May 2013.

supported the Arrow Boys in the last year by giving them food. Fifty-six per cent of respondents to the survey said that they, or a member of their household, had been a member of the Arrow Boys in the preceding year. This percentage varied between the villages visited, but was never lower than a third of the respondents. A chief summed up the Arrow Boys' membership simply as: "Everybody became an Arrow Boy."²⁵

Other armed actors in the region include the South Sudanese government army (SPLA), the Ugandan army (UPDF), UN soldiers under the UNMISS mission, an African Union (AU) force, as well as a small contingent of US soldiers.

Attitudes towards the central government and the SPLA

People living in Western Equatoria State have an uneasy relationship with the central government and with the government army, the SPLA. Interviews reveal a general sense that the government has not provided the people of Western Equatoria with adequate protection, especially against the LRA. In a community meeting a very angry middle-aged woman explained that the government had done nothing to support them: "Government has forgotten. They have given no help. To me what government could have done is given protection from LRA attacks."²⁶ Some respondents argued that the lack of protection was a deliberate government policy. One example of this line of argument came from a spiritual leader:

It's a frightening thought that such a situation [as we had with the LRA] is used to wipe away people. It was an opportunity for other people to enjoy seeing us wiped away. That is what happened to us as civilians. This part of the country we're in, many people need it. There is good grass. There is [so much] fruit that [it] is even spoiling. There is minerals. We were left to die in the hands of [the LRA].²⁷

Dissatisfaction with the central government is also reflected in the survey responses; more than 50 per cent of respondents disagreed (strongly) with a statement indicating that their expectations for the central government had been satisfied.

The SPLA and the ruling party in central government (SPLM) continue to be closely related, the SPLM having been originally founded as the political arm of the SPLA. Complaints emerging from interviews about the SPLA include that they do not actively gather information about LRA activity and that they do not respond to information about the LRA brought to them (Schomerus and Rigterink 2014). Survey respondents also report that the SPLA has committed violence against them or their family in the past, including abductions. Reported trust in the SPLA is low, with more than 50 per cent of survey respondents indicating that they trust the SPLA rarely or never. This contrasts sharply with the Arrow Boys, for whom this percentage is less than 12 per cent.

²⁵ Author interview payam chief, 22 May 2013.

²⁶ Community meeting, boma in Tambura County, English/ Pazande, 5 May 2013.

²⁷ Author interview, spiritual leader, Western Equatoria State, 1 May 2013.

Media and Information

Very few media sources are accessible to residents of Ezo and Tambura Counties. Print newspapers are not available, and television can only be watched in the public bars in the county capitals, if at all. Radio is the only media with a meaningful presence in our research area. About a third of the households surveyed indicated they had a working radio, which is a lower bound of the number of people who listen to radio broadcasts, if we consider that people may gather to listen to a radio owned by another household. These findings are echoed by other research, which indicates that newspapers and television barely reach beyond the South Sudanese capital of Juba, and that radio is the main source of media information in South Sudan (BBC Media Action 2012).

The most consistently available radio station is UN-funded Radio Miraya, which broadcasts from Juba. Unlike Yambio FM, Radio Miraya uses a transmitter with an extensive range so reception is quite uniform throughout the research area. Interviews suggest that people find information broadcasted by Radio Miraya to be Juba-centric, and of limited relevance to them personally. Contributing to this is the fact that this radio station broadcasts in English and Arabic, whereas the overwhelming majority (93 per cent) of survey respondents indicate they speak Pazande as their first language. Only 41 per cent name either Arabic or English as their second language. The reliability of the Yambio FM signal varies strongly among the localities that we visited. The next section will elaborate on this.

Given these limitations, it is unsurprising that word-of-mouth is named in interviews as the most important and reliable way of getting information. This includes personal calls, and getting information in the border market or from those crossing the border.

Data and methods

This chapter is the result of an interdisciplinary research project, carried out as part of the Justice and Security Research Programme (JSRP), a research project funded by the UK Department for International Development (DfID). Methods employed in this chapter are interdisciplinary not only in the sense that the chapter uses data from both semi-structured interviews and a household survey, but also because the hypotheses under study and the survey questionnaire were designed in close collaboration across disciplines. Therefore, our hypotheses and questionnaire are informed by theoretical literature as well as by knowledge of the area and its security situation derived from previous interview-based research in the area.

Data

Quantitative data in this chapter was gathered through a survey of individuals in Ezo County and parts of Tambura County in April and May 2013. In South Sudan, the county is the next administrative level down from the state; two lower levels of administration exist: the *payam*

(roughly a cluster of villages) and the *boma* (roughly a village). Our area of research was Ezo County, which consists of six *payams* and 26 *bomas*, and Tambura County's two southern-most *payams* that border Ezo (two *payams*, nine *bomas*). We randomly sampled seven *bomas* in Ezo (27 per cent) and three *bomas* in Tambura (33 per cent).

Within these *bomas*, households were randomly selected from a list of households in the *boma*, which either had already been drawn up, or was drawn up on the spot by the *boma* head men. As we had no reliable information on the number of households in any *boma* prior to going there, a fixed number of 44 households was sampled in each *boma*, except in two cases, where the total number of households did not exceed 44. Within the sampled households, one respondent was selected randomly from a list of individuals over the age of 18 living in the household, drawn up in collaboration with the household head or another readily available household member if the household head was not available. The total sample consists of 433 respondents, an estimated 4.3 per cent of the total adult population in sampled *bomas*. This sampling scheme implies we oversampled households in smaller *bomas*, and individuals in smaller households; any descriptive statistics presented in this chapter are weighted accordingly.

All questionnaires were administered in the local language Pazande by two teams of enumerators made up of residents of Ezo or Tambura County. The questionnaire included sections on demographics, willingness to contribute to public goods in the *boma*, attitudes towards various forms of public authority, security, experiences of violence, attitudes towards central government, and access to information. Questions relevant to this chapter include:

1. Do you or a member of your household own a radio that works? Can your radio receive Yambio FM?
2. In the past 12 months, how often have you feared that the LRA would come and attack your village (on a four-point scale: never, rarely, sometimes, often)?
3. How often do you trust the following authorities (on the same four-point scale, authorities including SPLA and the Arrow Boys)?
4. In the past 12 months, how often have you brought an issue or complaint in front of the following authorities (including SPLA and Arrow Boys)?
5. If you are afraid to be physically harmed by someone outside your family, who would you go to in order to get protection (asked as open question to respondents, answer codes for SPLA and Arrow Boys supplied to enumerators)?

More information on the household survey can be found in the survey report (Rigterink, Kenyi, and Schomerus 2014).

Qualitative data in this chapter stems from open-ended semi-structured individual and group interviews. About 70 of these interviews were conducted over two weeks in December 2012 and in

April-May 2013 in the same area that is covered by the household survey. The research presented is also informed by earlier interviews in the region, conducted since 2006. Interviewees were selected because they hold a position of authority, because they represent a particular group (for example women, youth, Arrow Boys), or because they were encountered in day-to-day interactions. Interviews took place in seven out of the ten *bomas* also covered by the household survey, amongst other locations. Only interviews that were conducted in the same *bomas* also covered by the individual household survey were used for the summary analysis and are directly quoted in this chapter.

Natural experiment: Yambio FM

The independent variable of interest in this chapter is intensity of exposure to broadcasts by Yambio FM. Yambio FM is part of a network of nine radio stations that broadcast “come home” messages to the LRA in South Sudan, DRC and CAR (The Resolve 2013; Invisible Children 2013). A number of these are supported by the NGO Invisible Children²⁸ or by the UN peacekeeping operation MONUSCO in the DRC (The Resolve 2013). It is unclear how much support Yambio FM receives exactly or from whom, but our research suggests that Yambio FM is indeed broadcasting information about the LRA, with a strong emphasis on “come home” messaging.²⁹ “Come home” messages are intended to encourage LRA members to escape and to give them instructions to do so safely. To achieve this, former LRA members are invited to speak on the radio about their experience of escaping, sometimes in Acholi, the language spoken in the area of northern Uganda from which the LRA originates. According to Invisible Children, a secondary goal of the network of radio stations is to provide isolated communities with a source of information about their security (Invisible Children 2013).

We investigate the impact of intensity of exposure to Yambio FM in general and any impact on fear measured may be due to any information this radio station broadcasts. However, our research suggests that inhabitants of Ezo and Tambura County are especially sensitive to information about the LRA and likely to remember it. In interviews, even quite broad questions such as “what is life like here?” would provoke responses regarding the LRA. Furthermore, respondents to interviews generally say they have not heard of radio messages providing them with information about their security situation, but can recall hearing, or hearing about, LRA commanders talking on the radio.³⁰ From the household survey, respondents seem more familiar with “come home” messages than with the radio station itself; 69 per cent of all respondents indicate they have heard about messages to the LRA being broadcast on South Sudanese radio, more than the 64 per cent who have listened to or heard of Yambio FM.

²⁸ <http://invisiblechildren.com/program/fm-radios>, accessed 11 Februari 2014.

²⁹ Author informal conversation with employee of Yambio FM, 26 April 2013.

³⁰ E.g.: author interview with Payam Chief, Ezo County, 22 May 2013.

It should again be noted that despite the fact that “come home” messages broadcasted by Yambio FM are known to a substantial proportion of the local population, they are extremely unlikely to reach any LRA fighters on South Sudanese soil – or any LRA fighters at all. As set out in the previous section, all available information suggests that the LRA does not have a structural presence in South Sudan and Yambio FM’s reach into DRC or CAR does not seem sufficient to reach LRA fighters there.

Reports differ on other radio stations broadcasting “come home” messages in South Sudan. Invisible Children (2013) mentions a radio station in Ezo Town. If this refers to an independent radio station, the only likely candidate is Bangani Radio, also called Ezo County FM. However, when the authors visited Ezo Town in April 2013, this radio station was not operational. Respondents to interviews agreed that this radio station had not been broadcasting for some time, although reports of the date it ceased working varied between 2009 and 2012. It is also disputed whether the station ever broadcast “come home” messages. One respondent stated that “Bangani radio was never used for messages and sensitization,”³¹ while in a community meeting just miles outside Ezo Town, a man argued about Ezo County FM: “The functioning radio helped community; UPDF passed messages to LRA so people could return.”³² How exactly the radio station was used remains unclear. Resolve (2013) and Invisible Children’s websites³³ classify the station in Ezo Town as a relay station, which merely passes on Yambio FM’s broadcasts. Resolve (2013) also suggests there is a second relay station for Yambio FM in Tambura town. We were not able to locate either relay station.

As highlighted in the previous section, reception of Yambio FM is distinct from general radio reception, specifically of reception of the main alternative station Radio Miraya. The latter, using a different type of transmitter, can generally be received throughout the research area.

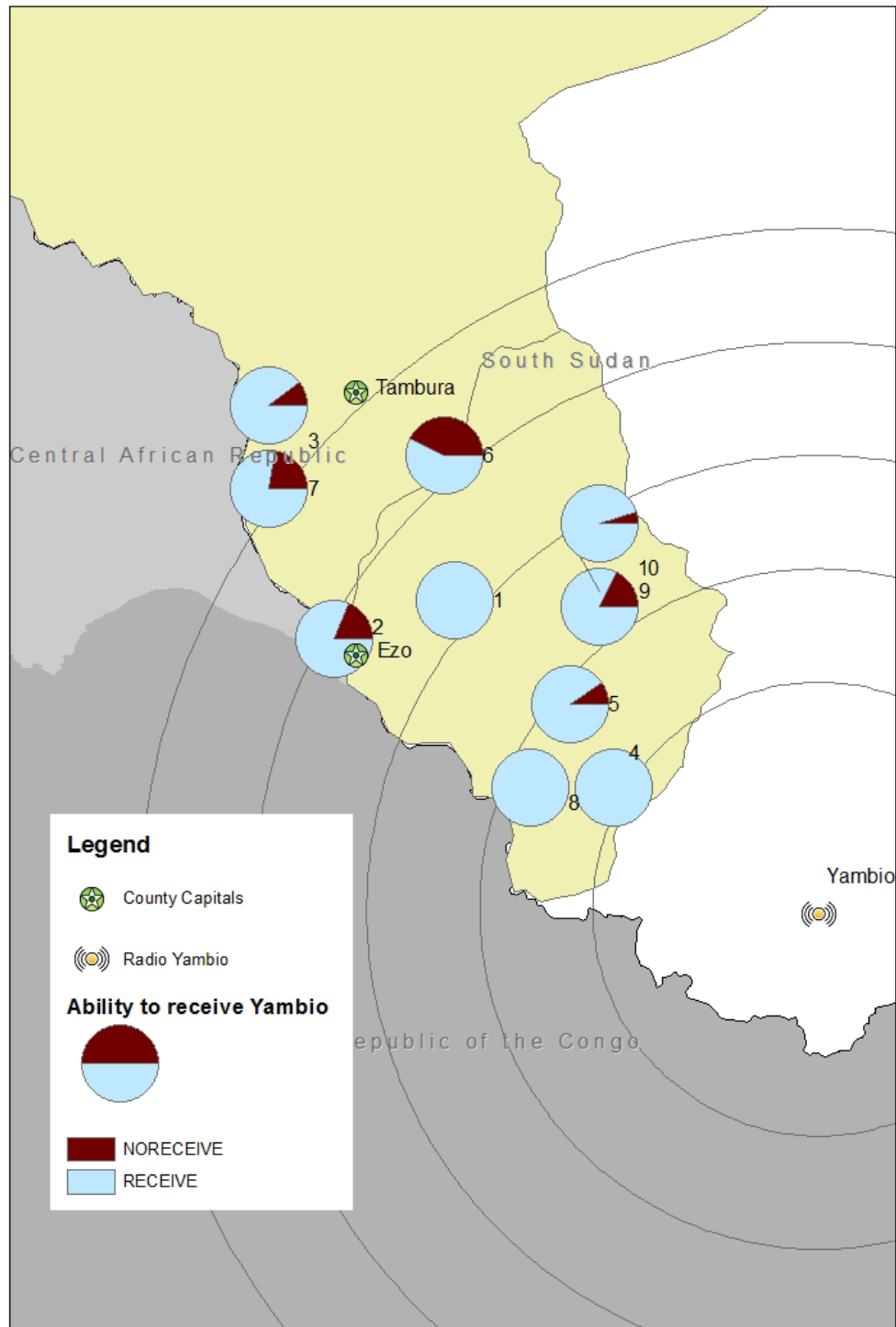
To investigate the impact of Yambio FM broadcasts, we exploit exogenous variation in signal strength due to geographical factors, following Olken 2009, Enikolopov, Petrova, and Zhuravskaya 2001, Yanagizawa-Drott 2012 and DellaVigna et al. 2011. We measure signal strength by the percentage of radio owners in each *boma* that state they can or cannot receive Yambio FM. Figure 4 gives an overview of this percentage in the ten *bomas* under investigation. It indicates that Yambio FM’s signal strength decreases with the distance to the transmitter in Yambio. The official broadcast range of Yambio FM is between 75 km (Invisible Children 2013) and 100 km (Resolve 2013), the first two circles in Figure 4, and we can see a clear decrease in signal strength beyond this range. There is no clearly noticeable increase in signal strength for those *bomas* in close proximity to Ezo or Tambura Towns, reportedly locations of relay stations.

³¹ Author interview county official, 30 April 2013.

³² Community meeting *boma* outside Ezo Town, 3 May 2013.

³³ Ibidem.

Figure 4: Reception of Yambio FM



Although the distance as the crow flies to Yambio is an important predictor of the signal strength of, and hence the intensity of exposure to, Yambio FM, this is not our preferred explanatory variable. The reason for this is that we cannot assume that distance to Yambio is exogenous. Any number of factors may exist that are related to both distance to Yambio and our dependent variables of interest: fear of the LRA and political attitudes. One obvious problem is that communities living closer to Yambio and therefore with more exposure to Yambio FM may feel less isolated and are therefore less afraid of the LRA. This would bias our estimates of the impact of exposure to Yambio FM downward.

Instead, we exploit the fact that although Yambio FM's signal becomes weaker with the distance to Yambio, this decrease is not uniform. For example, Figure 4 shows that *bomas* five and nine have approximately the same percentage of households not receiving Yambio FM, even though they are about 50 kilometres apart. *Bomas* nine and ten are within two hours' walking distance of each other, but have an almost 15 percentage point difference in the percentage of non-receiving households. And *boma* six has by far the worst radio reception but is by no means the farthest away from Yambio town. A univariate OLS regression of percentage of non-receivers in the *boma* on distance to Yambio results in an R^2 of 0.35. A rough interpretation of this is that the distance to Yambio explains about 35 per cent of variation in radio reception. Including straight-line distance to Ezo and Tambura Towns raises the R^2 of this regression to 0.49.

The remainder of the variation in signal strength is likely due to geographic factors, such as elevated terrain blocking the line-of-sight to the point of transmission (DellaVigna et al. 2011; Enikolopov, Petrova, and Zhuravskaya 2011; Olken 2009; Yanagizawa-Drott 2012). This is plausibly unrelated to other factors that may affect our dependent variables of interest (fear of LRA attacks and attitudes towards the SPLA or the Arrow Boys), making it a natural experiment. Therefore our main specification includes “*boma* radio reception,” one hundred minus the percentage of radio owners in a *boma* that cannot receive Yambio FM,³⁴ as the explanatory variable of interest, and controls for distance to Yambio, Ezo and Tambura Towns (see Equation (3.1)). This is intuitively similar to using the residual variation in radio reception, the residuals obtained when regressing one hundred minus the percentage of non-receivers in the *boma* on the straight-line distance to Yambio, Ezo and Tambura Towns, as the main independent variable.³⁵

This identification strategy would be invalid if an intervening factor exists that is related to both residual variation in radio reception and our dependent variables. One concern may be that the LRA is more active in areas with better residual radio reception, possibly because the group is

³⁴ This permutation makes interpreting the coefficient on radio reception easier later, as a higher number for *boma* radio reception now implies greater radio reception. This measure differs marginally from the percentage of radio owners in a *boma* that *can* receive radio Yambio, by reason of missing data and respondents who answered ‘Don’t know’ or refused to answer the question altogether.

³⁵ Results from this are very similar, but not identical to the ones presented in this chapter. Reason for this is that our main model is an ordered probit model, not a linear specification.

Table 18: Correlation between residual radio reception and various boma, individual and household level characteristics

A: Distance to closest LRA incident...		B: Average distance to the 10 closest LRA incidents...		C: Other Boma characteristics	
in the last year	-0.0317 (0.9306)	in the last year	-0.0525 (0.8856)	Years since last LRA victim in Boma	0.0349 (0.9238)
in the last year, involving civilians	-0.0513 (0.8881)	in the last year, involving civilians	-0.0407 (0.9112)	Distance to border CAR	-0.084 (0.8174)
in the last 2 years	0.0569 (0.8759)	in the last 2 years	-0.0688 (0.8503)	Distance to border DRC	0.06 (0.8693)
in the last 2 years, involving civilians	-0.0252 (0.9449)	in the last 2 years, involving civilians	-0.0287 (0.9373)		
in the last 5 years	0.4234 (0.2228)	in the last 5 years	0.1539 (0.6713)		
in the last 5 years, involving civilians	0.2425 (0.4996)	in the last 5 years, involving civilians	0.0956 (0.7928)		
D: Individual characteristics		E: Household asset ownership			
Gender	0.0812 (0.0916)*	# tukuls in compound	0.1197 (0.0127)**		
Age	0.028 (0.5613)	# poultry	0.097 (0.0436)**		
Education	-0.0454 (0.3459)	# goats	0.0184 (0.7024)		
		# phones	-0.0683 (0.156)		
		# motorcycles	-0.0415 (0.3894)		
		# bicycles	0.0901 (0.0611)*		
		Radio ownership	0.0388 (0.4232)		

p-values in parenthesis.
Significance: * 10% level, ** 5% level, *** 1% level

hindered by the same geographic features that inhibit the signal. We deem this unlikely for a number of reasons. First, elevation differences in the area are very minor: the difference between the lowest and highest point in our research area is less than 350 meters.³⁶ Similar differences in elevation are found in a notoriously flat country such as The Netherlands. Second, it is *mountainous* terrain, not the absence of it, that is commonly associated with the presence of armed groups (Buhaug and Rød 2006; Collier and Hoeffler 2004). Finally, the geographic obstacle blocking the radio signal is not necessarily close to the signal's "target" village; it just has to be in the direct line of sight between the transmitter and the village. Given that the *bomas* under study are more than 50 and up to 160 kilometres away from the radio transmitter, any geographic features inhibiting the signal are potentially far removed from the non-receiving *bomas*.

Nevertheless, we explore the correlation between LRA activity and residual radio reception in Table 18. As mentioned, residual radio reception is equal to the residuals obtained when regressing *boma* radio reception on the distance to Yambio, Ezo and Tambura Towns. Using data from the LRA Crisis Tracker and the STATA "geodist" package, we calculate the straight-line distance from every *boma* to the closest LRA incident in the one, two and five years preceding the research period, and the average distance to the ten closest LRA incidents over the same time intervals. We also distinguish between incidents that involve direct violence against civilians (abductions and violence), and those that do not (looting, sightings, clashes and displacement). There is no significant (bivariate) relationship between any of these measures of LRA activity and residual radio reception (Panel A and B of Table 18). The same holds true for other potential indicators of LRA activity in panel C: number of years since the LRA last claimed a victim in the *boma*, as reported by survey respondents who indicated they lived in the *boma* at that time, and the distance to the border with CAR and DRC respectively, the two countries where the LRA is suspected to be. Hence, we find no evidence that the LRA is more active in areas with better residual radio reception. However, the analysis that follows will also explicitly control for LRA activity.

Table 18 also explores the correlation between residual radio reception and individual level characteristics. Residual radio reception is not significantly related to age and level of education, although it is significantly related, at the 10 per cent level, to gender (Panel D). We do observe a significant correlation between residual radio reception and ownership of some specific assets (the number of buildings in respondents' compounds, the number of bicycles and the number of poultry owned) but not in the case of other assets under investigation. This may raise the concern that individuals in areas with better radio reception are wealthier compared to individuals with worse reception, although Table 18 does not constitute strong evidence that this is the case across the board and it is not obvious that asset ownership would be systematically related to fear of the LRA for example. To mitigate concerns on this account, we include all variables measuring asset

³⁶ U.S. Geological Survey's Center for Earth Resources Observation and Science (EROS), 30 Arc-second DEM of Africa.

ownership as standard control variables in the analysis to follow (with the exception of number of motorcycles owned, which contains too little variation).

Our observations when visiting the *bomas* strengthened the idea that variation in reception of Yambio FM is exogenous. For example, we observed no obvious correlation between the ease of reaching a village and radio reception. Two of the villages that the survey team had most trouble reaching (this required travelling by motorbike for close to an hour on a narrow road through the bush) had some of the best reception of Yambio FM in the sample. Another area that was difficult to reach, and where residents told us that they were rarely visited by, for example, NGO employees, was characterized in the survey as having above median reception of Yambio FM.

When visiting the villages, we also saw no evidence of individuals taking action to improve their reception of Yambio FM, for example by putting up an antenna or by moving to a place in the village with better radio reception. This may lead to reversed causality, if individuals take these steps on such scale as to meaningfully impact the percentage of radio owners able to receive Yambio FM village-wide. When visiting the villages, we saw no evidence of such practices. Furthermore, it is important to realize that possibilities to move, even within one's village of birth, are limited. People are highly reliant on land for agriculture and this is not commonly bought and sold but rather distributed on the basis of personal ties. In interviews, we discussed the availability of information explicitly, but moving within the village to obtain better information was not mentioned. Thus, it seems very unlikely that radio reception would be a consideration when people consider where to live. Survey results show that between-village mobility is also low. We will elaborate on the latter point in the next section.

Another concern may be spill-over effects. Reported exposure to Yambio FM is high in many villages under study. Taking into consideration that information broadcast by Yambio FM may be further distributed by word of mouth, one may worry that in practice no 'control group' of villages or individuals with poor exposure to Yambio FM exists.

Given the lay-out of homesteads in the villages we visited, spill-over effects between households are very likely. Homesteads almost invariably consist of a collection of relatively small huts; activity during the day would typically take place outside. Hence, it is very possible to hear the neighbours' radio. We also saw evidence that information can spread within the *boma* quickly via word of mouth. For example, in one *boma*, a large number of people came together in a central place in the village for group interviews with only two days' notice and many people in a village would generally know of the presence of the survey team within one or two days of our arrival. In interviews, people also stressed the importance of word of mouth as their most important way of accessing information.³⁷ On the other hand, the population density in the villages we visited is very low. Groups of homesteads are typically interspaced with stretches of farmland. Although the *bomas* we visited were small in terms of household population (on average just below 300 households), it

³⁷ Author interview with woman leader, 14 May 2013.

could typically take close to an hour to walk from one end of the village to the other along the main road or path. Some households were more than half an hour walking distance away from the main path. Hence, there may still be variation in access to information within a *boma*.

It is important to note that these spill-over effects would bias our results *downwards*. Intuitively, if there is in practice no difference between the “treatment group” and the “control group” in terms of intensity of exposure to Yambio FM due to spill-over effects, we would observe no impact of Yambio FM when comparing the “treatment group” to the “control group.” Hence, as far as spill-over effects are concerned, the estimates presented in this chapter could be considered as a lower bound to the true impact of Yambio FM.

Some further words on the measurement of reception of Yambio FM: it would appear that there is a substantial difference between actual radio reception, and radio reception as reported in the survey. Interviews suggest that even in *bomas* in which 100 per cent of radio owners report that they are able to receive Yambio FM (and in which we happened to sample 100 per cent of the households), inhabitants complain about the unreliability of the signal.³⁸ In general, interviews seemed to unearth more complaints about poor quality of reception of Yambio FM than Figure 4 would suggest. It seems likely that respondents have a tendency to report that they are able to receive Yambio FM, even if reception is infrequent or poor. This may be amplified by the wording of the question “can your radio receive Yambio FM”, which may hint that non-reception is a reflection on the quality of the respondent’s radio, by a bias towards the more positive answer “yes”, or by respondents’ inability to distinguish between Yambio FM and Radio Miraya. DellaVigna et al. (2011) notice a similar difference between signal strength hand-measured with a radio receiver and reported ability to receive particular radio stations through a survey, indicating reception in 56 per cent versus 87 per cent of villages under study respectively.

It should also be noted that on or around 25 April 2013, Yambio FM temporarily stopped broadcasting due to a defective transmitter.³⁹ It resumed broadcasting roughly three months later.⁴⁰ The breakdown took place shortly before the start of survey data collection, in May 2013. This may have affected the research, either by influencing the measurement of the quality of radio reception, or because of a waning impact of Yambio FM after the temporary stop. We deem both unlikely. First, the question “can your radio receive Yambio FM” was framed in general terms, making it unlikely that respondents would have answered “no” purely because they were *temporarily* unable to receive Yambio FM. Indeed, reported ability to receive Yambio FM is high for all *bomas* visited. It should also be noted that the two enumeration teams did not visit villages in order of their distance to Yambio, and that the highest levels of non-reception were recorded in the first villages visited. To mitigate any remaining concerns, we will also present a specification including date-of-

³⁸ Author focus group discussion, 23 May 2013.

³⁹ <http://www.gurtong.net/ECM/Editorial/tabid/124/ctl/ArticleView/mid/519/articleId/10858/Yambio-Fm-Breaks-Down.aspx>, accessed 12 February 2014.

⁴⁰ <http://www.gurtong.net/ECM/Editorial/tabid/124/ID/12051/Default.aspx>, accessed 12 February 2014.

enumeration fixed effects. Second, all data was gathered over the course of the month immediately following Yambio FM's breakdown, a period likely too short to expect its impact to disappear entirely. It is important to realize that this should bias our results *downward*. Hence any impact of Yambio FM found in our analysis could be considered a lower bound to its true impact when fully operational.

Hypotheses and models estimated

Exploiting the natural experiment created by “black spots” in coverage, we investigate the impact of intensity of exposure to Yambio FM's broadcasts, on fear of the LRA and the impact of fear of the LRA on attitudes towards the SPLA and the Arrow Boys.

Existing literature on media and fear suggests that greater exposure to broadcasts about the LRA may increase individuals' fear of an LRA attack. To investigate this, we will estimate the following model:

$$FEAR\ LRA_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 DISTANCE_b + \beta_3 X_i + \varepsilon_{bi} \quad (3.1)$$

where $FEAR\ LRA_{bi}$ is the individual-specific level of fear of the LRA, measured on a four-point scale, BRR_b (*boma* radio reception) is the extent of reception of Yambio FM at the *boma* level and constructed as described in the previous section, $DISTANCE_b$ is a vector including the straight-line distance from the *boma* to Yambio, Ezo and Tambura respectively and X_i is a vector of individual-specific control variables including the age, gender, education, household size and asset ownership. As $FEAR\ LRA_{bi}$ is measured on a four-point scale, we use an ordered probit model to estimate (3.1), although similar results are obtained using an ordered logit model. The literature on media and anxiety implies $\beta_1 > 0$.

Standard errors in all models are clustered at the *boma* level and calculated using the Cluster Robust Variance Estimator (CRVE) (see (Cameron, Gelbach, and Miller 2008)). This is done to allow for within-*boma* correlation of standard errors. In addition, it has been shown that when estimating the effect of an aggregate variable (in this case reception of Yambio FM at the *boma* level) on micro units (in this case individuals), commonly used standard errors are biased downwards substantially (Moulton 1990). The CRVE is shown to be subject to this bias to a lesser degree (Bertrand, Duflo, and Mullainathan 2004; Cameron, Gelbach, and Miller 2008). However, clustered standard errors based on the CRVE may still tend to over-reject the null hypothesis when the number of clusters is small (i.e. fewer than 30) (Cameron, Gelbach, and Miller 2008). Cameron et al. show this for Ordinary Least Squares (OLS) and propose four types of bootstrapped standard errors, which they show are an improvement on the CVRE under OLS. Unfortunately, there is no literature on the performance of bootstrapped standard errors in an ordered probit or ordered logit model, although it is clear that three out of four types of bootstrapped standard errors proposed by Cameron et al. cannot be calculated for non-linear models (Cameron and Miller 2013). When

running the only possible bootstrapping procedure, pairwise-cluster bootstrap-t, on the data used in this chapter, we ran into computational problems. $FEAR LRA_{bi}$ is measured on a four point scale, and some outcomes on this scale (i.e. low or no fear of the LRA) are rare. Therefore, for a substantial proportion of bootstrap samples (about 14 per cent), the sample either contains no observations on the rare outcome (implying that the coefficients in the ordered logit or probit model are calculated with respect to a different set of intercepts – leading to numerically very different estimates of the β vector compared to the original regression), or the ordered logit regression on the sample fails to achieve convergence. Computational problems with the pairwise-cluster bootstrap-t procedure are also noted by other sources for OLS (Cameron, Gelbach, and Miller 2008) and probit regression (Kline and Santos 2012). In the absence of further research on clustered bootstrapped standard errors in ordered probit or logit models, we provide clustered standard errors based on the CRVE. However, as these can over-reject for a small number of clusters, these estimates should be interpreted with some caution.

We analyse data from interviews using a method analogous to model (3.1). Using the software MAXQDA, we coded the location of each interview. These locations were classified using the survey data as having above or below median reception of Yambio FM. Interviews were done in seven out of ten *bomas* included in the survey: three of these had above, and four of these had below median radio reception. Each text segment in the interview transcript relating to (a) access to information; (b) the LRA; (c) the Arrow Boys; and (d) attitudes towards the SPLA or government, was coded as such. To investigate the impact of reception of Yambio FM, we compared interview segments on the LRA in areas with above and below median radio reception.

In addition, we estimate the following model using individual level reception of Yambio FM:

$$FEAR LRA_{bi} = \alpha_b + \beta_1 INDIVIDUAL RR_i + \beta_2 X_i + \varepsilon_{bi} \quad (3.2)$$

where $INDIVIDUAL RR_i$ is individual radio reception, an indicator equalling one if the respondent's household has a working radio that can receive Yambio FM. Note that this specification includes *boma* fixed effects, which makes including the $DISTANCE_b$ vector obsolete.

Model (3.2) has the advantage of allowing the inclusion of *boma*-fixed effects, capturing any time-invariant *boma* specific factors related to both fear of the LRA and individual radio reception that may bias the estimate of β_1 . Intuitively, Model (3.2) exploits within-*boma* differences in the ability to receive Yambio FM only, that is to say differences between respondents living in the same *boma*.

Note the following caveats to Model (3.2). First, using fixed effects prevents us from exploiting the most important source of variation in radio reception, variation between *bomas*. Second, spill-over effects are likely strong within the *boma*. To the extent that radio owners share information broadcast by Yambio FM with those that do not own a radio or cannot receive the

station, the model's estimate of β_1 would be biased downwards. Taking both these points into account, Model (3.2) provides a more stringent test of the hypothesis than Model (3.1). It may well fail to find an impact of exposure to Yambio FM if within-*boma* variation in radio reception is small, either because of spill-overs or for another reason. Third, note that Model (3.2) introduces a new source of endogeneity, since households that decide to buy a radio may be systematically different from those that do not. For instance, those households who are more afraid of the LRA may buy a radio in order to receive more information about security threats.

Finally, *FEAR LRA* is an ordinal variable (measured on a four-point scale), so Model (3.2) requires us to use an ordered logit or probit model with fixed effects. However, both ordered logit and ordered probit are maximum likelihood estimators, and maximum likelihood cannot consistently estimate parameters in finite samples in the presence of fixed effects (Cameron and Miller 2013; Lancaster 2009). Hence, including a full set of *boma* dummies in Model (3.2) and estimating it using ordered logit or probit would lead to inconsistent results. Therefore, we use the "Blow-Up and Cluster" ordered logit estimator (*bucologit*) (Baetschmann, Staub, and Winkelmann 2011). The idea underlying this estimator is that a fixed effects logit model (with a dichotomous dependent variable) *can* be estimated consistently using conditional maximum likelihood estimation (CML) (Chamberlain 1979). One could simply transform the ordinal variable into a dichotomous one - using some cut-off point - and estimate by CML, but this would not use all available information, and would thus be inefficient. One alternative is to estimate results for every possible cut-off point and then combine these estimates. The *bucologit* estimator does both in a single step, by replacing every observation by as many copies of itself as there are possible cut-off points and estimating CML on the thus expanded sample. In the context of our four-point scale, this implies that observations for villages in which responses vary across the full scale are duplicated three times, observations for villages in which respondents' answers do not use one extreme of the scale are duplicated twice, etc. *Bomas* in which all respondents gave the same answer contain no within-*boma* variation and are dropped (for *FEAR LRA*, this applies to one *boma*). Baetschmann et al. (2011) show that the *bucologit* estimator is theoretically consistent, that it is never outperformed by other commonly used consistent estimators and outperforms the latter in small samples.

Earlier, we identified a number of mechanisms potentially explaining the connection between media exposure and fear: costly information, availability, substitution, resonance and affinity. Distinguishing between these mechanisms is challenging, as not all of them have testable implications in this case. Substitution, resonance and affinity are easiest to distinguish. Resonance implies that the fear-inducing effect of the radio broadcast is strongest for those who have been victimized by the LRA in the past. Affinity suggests that the effect is strongest for those who belong to a group that is likely to be victimized (regardless of personal experience). Substitution predicts the opposite, suggesting that those who are *least* likely to be victimized and those who do

not have personal experience of victimization are most affected by media reports. Hence, we explore these mechanisms using the following models:

$$FEAR LRA_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 BRR_b \times VICTIM_i + \beta_3 DISTANCE_b + \beta_4 X_i + \varepsilon_{bi} \quad (3.3)$$

$$FEAR LRA_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 BRR_b \times RISK CAT_i + \beta_3 DISTANCE_b + \beta_4 X_i + \varepsilon_{bi} \quad (3.4)$$

where $VICTIM_i$ indicates whether a particular individual has been personally exposed to violence by the LRA, and where $RISK CAT_i$ is an indicator for risk of victimization. Our data suggests that men, and respondents in particular age categories, report having been a victim of LRA violence significantly more often than women or those in other age categories, so we experiment with age and gender as relevant indicators for risk of victimization. In both cases, $VICTIM_i$ and $RISK CAT_i$ respectively are also included as variables in themselves (i.e. not interacted), subsumed in X_i . In context of these models, affinity suggests $\beta_2 > 0$ for ‘risky’ demographics in Model (3.4), resonance suggests $\beta_2 > 0$ in Model (3.3) and substitution implies $\beta_2 < 0$ in both models.

Few ways to test for the costly information and availability mechanism readily present themselves. One way to test for the costly information mechanism is to investigate the presence of other sources of information. Fielding and Shortland (2009) do this when they compare US media coverage of Palestinian and Israeli casualties, and argue that US tourists have more low-cost opportunities to seek additional information on the latter rather than the former. In our case, we may expect that people with access to alternative sources of information may rationally be less inclined to take the intensity of media coverage on the LRA as an indicator of risk, compared to individuals with no access to other information. From interviews we know that an important other relevant source of outside information is phone conversations with people in other areas. Therefore we estimate:

$$FEAR LRA_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 BRR_b \times PHONES_i + \beta_3 DISTANCE_b + \beta_4 X_i + \varepsilon_{bi} \quad (3.5)$$

where $PHONES_i$ is the number of phones owned by the respondent’s household. Based on the costly information mechanism, we may expect $\beta_2 < 0$ in Model (3.5).

We also investigate the mechanism connecting media coverage and fear qualitatively. Using coded interview segments, we compare *how* people in *bomas* with above and below median radio reception talked about their fear of the LRA and their access to information. For example: whether people in villages with above median radio reception had a tendency to state that they were resigned to having no other sources of information (costly information), or whether people in villages with above median radio reception appeared to be able to recall instances in which they had been afraid of the LRA more concretely (availability).

In addition to the effect of Yambio FM on fear of the LRA, we also explore the effect of anxiety, as instrumented by exposure to Yambio FM, on political attitudes. Interviews suggest that the attitudes of inhabitants of Ezo and Tambura Counties towards the SPLA and the Arrow Boys are closely connected with how effectively these actors are perceived to be responding to threats by the LRA. As the section on background has established, the SPLA is generally perceived as inactive in the face of LRA threats, whereas the Arrow Boys' response is seen as effective. If people experience heightened fear as a result of Yambio FM's broadcasts and they see the Arrow Boys act on these perceived heightened threats and the SPLA doing nothing, the authority of the Arrow Boys may be strengthened and that of the SPLA undermined. In short, fear of the LRA raises the demand for protection, and thereby the position of actors perceived as effectively providing this protection. Looking at theoretical models, *Affect Transfer* suggests that anxious individuals may transfer their negative feelings to related actors directly. In this case, fear of the LRA may impact attitudes towards those actors associated with protection from the LRA positively, and attitudes towards actors thought to contribute to this insecurity negatively. *Affective Intelligence* on the other hand, suggests that anxious individuals engage in more cognitive deliberation of their political attitudes, seek out more information on the behaviour of the Arrow Boys and SPLA, and feel more positive towards the former and more negative towards the latter on the basis of this information.

We estimate this set of models:

$$ATT\ ARROW\ BOYS_{bi} = \beta_0 + \beta_1 \widehat{FEAR\ LRA}_i + \beta_2 \mathbf{DISTANCE}_b + \beta_3 \mathbf{X}_i + \varepsilon_{bi} \quad (3.6)$$

$$ATT\ SPLA_{bi} = \beta_0 + \beta_1 \widehat{FEAR\ LRA}_i + \beta_2 \mathbf{DISTANCE}_b + \beta_3 \mathbf{X}_i + \varepsilon_{bi} \quad (3.7)$$

$ATT\ ARROW\ BOYS_{bi}$ and $ATT\ SPLA_{bi}$ are individual-specific indicators for the respondent's attitude towards Arrow Boys and the SPLA respectively. We experiment with various indicators, including the professed level of trust the respondent has in each actor (on a four-point scale), an indicator for whether the respondent has brought an issue or complaint in front of either actor in the last year and an indicator for whether the respondent *would* turn to either actor in case of a (hypothetical) threat to his/her security. $\widehat{FEAR\ LRA}_i$ in both models is considered endogenous and is instrumented for using the quality of reception of Yambio FM in the *boma* (\mathbf{BRR}_b). We expect $\beta_1 > 0$ in Model (3.6) and $\beta_1 < 0$ in model (3.7), based on the interviews and the theories presented.

Both models are estimated by IV probit when the dependent variable is a dummy indicator. In the case of trust, which is measured on a four-point scale, we use Two Stage Least Squares (2SLS), because no IV model for ordered probit exists. This treats the ordinal dependent variable as continuous. There is evidence that parametric estimation is robust to this particular violation of its assumptions (Norman 2010).

One concern with the IV strategy is that reception of Yambio FM may influence political attitudes directly, by broadcasting information about the Arrow Boys or the SPLA. This would

violate the exclusion restriction. We judge this unlikely in the case of the Arrow Boys. The Arrow Boys are organised at the community level and although their presence has been widely recognised by both national and international actors, the way they have engaged with communities is much more directly than through radio. Hence, they are unlikely to feature on a radio station broadcasting from a day's driveaway. In interviews, respondents did not mention getting information about the Arrow Boys over the radio. None of the respondents mentioned calling in local information to Yambio FM, even though we asked this question specifically. It is more likely that people in our research area receive information about the SPLA through Yambio FM broadcasts. However, when talking about their attitudes towards the SPLA, respondents to the interviews did not mention receiving information about this actor over the radio, and instead referred to their personal observations. As will be illustrated in a later section, when respondents mentioned information broadcast about military actors, this referred to international troops. Furthermore, Yambio FM has become intimately connected with its broadcasts about the LRA, to the point that a greater percentage of survey respondents can recall hearing about radio messages to the LRA than the percentage able to recall hearing about Yambio FM itself. Nevertheless, to the extent that respondents receive information about the Arrow Boys or SPLA via Yambio FM, our IV strategy conflates the impact of fear of the LRA and the impact of having access to this information.

We also estimate reduced form models:

$$ATT\ ARROW\ BOYS_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 DISTANCE_b + \beta_3 X_i + \varepsilon_{bi} \quad (3.8)$$

$$ATT\ SPLA_{bi} = \beta_0 + \beta_1 BRR_b + \beta_2 DISTANCE_b + \beta_3 X_i + \varepsilon_{bi} \quad (3.9)$$

using an ordered probit model. The equivalent set of models using individual-level radio reception and fixed effects is:

$$ATT\ ARROW\ BOYS_{bi} = \alpha_b + \beta_1 INDIVIDUAL\ RR_i + \beta_2 X_i + \varepsilon_{bi} \quad (3.10)$$

$$ATT\ SPLA_{bi} = \alpha_b + \beta_1 INDIVIDUAL\ RR_i + \beta_2 X_i + \varepsilon_{bi} \quad (3.11)$$

These models (will be estimated by bucologit estimator for dependent variables measured on an ordinal scale (i.e. trust), and by logit estimator with fixed effects for dummy indicators (i.e. bringing an issue in front of an actor, and turning to an actor in case of a threat).

The analysis of the survey data does not distinguish between two theories on the effect of anxiety on political attitudes presented: Affect Transfer and Affective Intelligence. To distinguish between these two theories, we compare interview segments from *bomas* with above and below median reception of Yambio FM, coded as concerning the Arrow Boys or the SPLA (or the government in general – in a number of cases interviewees make little distinction between the two). Specifically, we examine whether respondents in areas with above median radio reception are more likely explain their attitude towards the Arrow Boys or SPLA using concrete information on the behaviour of

these actors (Affective Intelligence), whether respondents in areas with below median radio reception tend to support the Arrow Boys or SPLA based on habit or patriotism (Affective Intelligence), or whether respondents in areas with above mean radio reception relate their attitudes directly to their emotions (Affect Transfer).

Results

Yambio FM and fear of the LRA

Table 19 displays our baseline results on the relationship between intensity of exposure to Yambio FM and fear of the LRA. Fear of the LRA is measured by the answer to the question: “In the last 12 months, how often have you feared that the LRA would come and attack your village?” on a four-point scale (never, rarely, sometimes, often).

As a first pass, column (1) presents an ordered probit regression with fear of the LRA as dependent variable, and including the distance to Yambio and control variables as the only explanatory variables. As highlighted before, this may have been our preferred specification, had distance to Yambio not been arguably endogenous to the model. The coefficient on distance to Yambio has the expected sign (the further away from Yambio FM, the lower the fear of the LRA), but it is not statistically significant. Possibly, this is because intervening factors (e.g. degree of isolation) bias this coefficient downwards. Adding the distance to Ezo and Tambura Towns, the possible locations of two relay stations (column (2)), also results in insignificant coefficients on all variables included in ***DISTANCE_b***.

Columns (3) and (4) of Table 19 show our baseline results: the results obtained when estimating Model (3.1), using an ordered probit and an ordered logit regression respectively. Both models show a positive and significant relationship between *boma* radio reception and fear of the LRA, indicating that individuals living in *bomas* where Yambio FM’s signal is stronger are more likely to report that they have been frequently afraid of an LRA attack.

This effect is non-negligible in size: the ordered probit model suggests that moving from the lowest level to the highest level of radio reception found in our sample is associated with a 31 percentage-point increase in the probability that an individual reports to be afraid of the LRA “often”, from approximately 61.4 per cent to 92.4 per cent. The ordered logit model predicts a somewhat larger increase, from 58.5 per cent to 92.5 per cent.

A Brant test on the ordered logit model provides no evidence that the proportionality of odds assumption⁴¹ has been violated. Unfortunately, this particular test is not available for the ordered probit model.

⁴¹ The assumption that the relationship between each pair of outcome groups (never, rarely, sometimes, never) is the same. See (Brant 1990) for more details.

Table 19: Yambio FM and fear. Baseline results

FEAR LRA	(1) oprobit	(2) oprobit	(3) oprobit	(4) ologit	(5) oprobit	(6) bucologit
Boma radio reception			2.676** (1.236)	5.072** (2.564)		
Boma radio reception 1					22.46** (9.655)	
Individual radio reception						0.0138 (0.244)
Distance to Yambio	-3.450 (2.316)	4.447 (13.83)	-10.10 (14.36)	-27.33 (30.01)	-0.566 (12.12)	
Distance to Ezo		-8.825 (9.553)	-11.55** (5.603)	-20.68** (10.11)	-4.223 (6.094)	
Distance to Tambura		12.95 (14.50)	-13.55 (19.54)	-36.18 (40.97)	-3.510 (14.72)	
Gender	0.164 (0.165)	0.139 (0.119)	0.113 (0.102)	0.101 (0.218)	0.0763 (0.0835)	0.0588 (0.155)
Age	0.955 (0.652)	0.909* (0.538)	0.905* (0.549)	1.622* (0.938)	0.941* (0.539)	1.285 (1.122)
Education	-0.516** (0.248)	-0.527* (0.283)	-0.502* (0.272)	-0.793 (0.549)	-0.473* (0.265)	-0.502 (0.423)
# adults in household	-0.150*** (0.0484)	-0.132 (0.0897)	-0.140 (0.0905)	-0.258 (0.164)	-0.145 (0.0887)	-0.218 (0.176)
# children in household	0.106*** (0.0387)	0.107*** (0.0322)	0.0973*** (0.0311)	0.171*** (0.0620)	0.0919*** (0.0301)	0.185*** (0.0611)
# houses in compound	9.906* (5.845)	7.492 (8.971)	8.119 (9.507)	16.71 (17.59)	9.392 (9.424)	13.37 (16.90)
# poultry owned	0.352 (0.561)	0.240 (0.489)	0.146 (0.500)	0.288 (0.960)	0.140 (0.502)	0.626 (0.852)
# goats/sheep owned	-0.279 (1.574)	0.000976 (0.867)	0.483 (1.123)	0.680 (2.228)	0.511 (1.054)	-0.686 (2.381)
# cycles owned	-3.423 (9.832)	-1.921 (7.612)	-4.021 (8.321)	-11.15 (14.54)	-3.385 (8.165)	-19.32 (17.31)
Owns working radio	-0.105 (0.171)	-0.154* (0.0788)	-0.175** (0.0790)	-0.342** (0.146)	-0.173** (0.0738)	
Observations	423	423	423	423	423	721

Robust (clustered) standard errors in parentheses

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

Coefficients on the control variables are fairly unremarkable. Fear of the LRA seems to be systematically higher for older respondents, and those who enjoyed fewer years of education. The number of children in the household is consistently positively related to fear; possibly because respondents from households with a larger number of children fear that these children could become a target of an LRA attack. However, this interpretation remains speculative. Radio ownership is associated with lower frequency of fear of the LRA in the models presented.

Column (5) investigates a slightly different way of constructing *boma* radio reception. A small number of surveys came back with the data on radio ownership missing, but indicating that the household's (potentially non-existing) radio could *not* receive Yambio FM. During data cleaning, this is treated as if the answer to the radio ownership question was recorded in the wrong place, under the question on reception of Yambio FM just below it. However, an alternative way to interpret this is that the household does have a radio (but the answer to this question was not recorded), and that it cannot receive Yambio FM. Column (5) provides results when the data is recoded in this way. As Table 19 shows, this does not have an impact on the results: the coefficient on *boma* radio reception is still positive and significant.

Lastly, column (6) presents the results when using individual radio reception (Model (3.2)). As highlighted before, this exploits within-*boma* variation in ability to receive Yambio FM only, and as such is a more stringent test of the hypothesis that more intense exposure to Yambio FM leads to increased fear of the LRA. Note that this model includes *boma* fixed effects, that the variable “owns working radio” is excluded because this is strongly collinear with individual radio reception and that the bucologit estimator “blows up” the dataset according to cut-off points in the dependent variable so the number of observations increases. As is apparent from column (6), using Model (3.2), we fail to find evidence that exposure to Yambio FM increases fear: the coefficient on individual radio reception is positive, yet statistically insignificant.

Respondents to interviews were similarly more likely to express anxiety when talking about the LRA in areas with better reception of Yambio FM. In areas with above median radio reception, people described their fear of the LRA in practical terms, recounting concretely how fear influenced their day-to-day lives. This came up in four cases, three of which are quoted here. Members of a women's group described how women from both sides of the border with the DRC were no longer moving across and that free movement was now a prerogative of armed men: “Before LRA we used to go and buy rice and palm oil from there, sometimes nuts.”⁴² A middle-aged man described how “life before LRA was not bad, but with some problem, but people used to go without fear. Since LRA, people cannot even go 200 metres to cultivate. And we are still scared of the people they killed. So life before was good because there was no fear. Now there is still fear in our heart.”⁴³ In a third *boma*, an executive chief explained how convincing people to return to their villages had taken two years since the last reported LRA attack: “Some are still reluctant because they fear LRA can come back.”⁴⁴

In areas with below median radio reception, while the LRA often came up, the topic of actual fear of the LRA came up in only one coded text segment. In this case, fear of the LRA was used as an example in a different context—as a reason to support a government headed by a to-be-crowned Zande King—and clearly placed in the past: “The king will alert them what is coming.

⁴² Author discussion with Women's Group, 23 May 2013.

⁴³ Author community meeting, 23 May 2013.

⁴⁴ Author interview Executive Chief, 22 May 2013.

Because in the past [the people] received [security] information late. Like the insecurity of the LRA, they did not know they were coming, but the king would have alerted them.”⁴⁵

Overall, our baseline results suggest a significantly and substantially higher level of fear of the LRA among individuals living in *bomas* better able to receive Yambio FM. Similar results are not found when looking at within-*boma* differences in the intensity of radio reception.

Robustness: radio and fear

As mentioned earlier, one may be concerned that these results are driven by actual LRA activity. If *bomas* with better radio reception also are at greater risk of an LRA attack, people in these *bomas* would likely fear the LRA more due to this risk, rather than as a result of Yambio FM’s broadcasts. Although we have shown earlier that *boma* radio reception is uncorrelated to LRA activity, Table 20 explicitly controls for it. In the interest of brevity, in what follows we only report ordered probit estimates, but similar results are obtained for ordered logit regression. Furthermore, we omit the coefficients on the control variables, and for the variables included in the ***DISTANCE_b*** vector.

We employ various measures of LRA activity: the distance to the closest LRA Crisis Tracker incident (either directly involving civilians or not) in the year, two years and five years preceding our research, the average distance to the ten closest LRA-related events (involving and not directly involving civilians) in the same periods, and the number of years since the last person the *boma* in our sample reported to be victimized by the LRA whilst living in the *boma*. In the latter case, we distinguish between personal victimization (the respondent was wounded, abducted, or their dwelling was destroyed by the LRA) and indirect victimization (close family member killed or abducted by the LRA).

Table 20 shows that indicators for LRA activity are generally not significantly related to fear of the LRA. Most of the coefficients are insignificant. Of the three coefficients that are significant, one has an unexpected positive sign, indicating that fear *increases* with distance to the average ten closest LRA attacks in the last two years.

More importantly, Table 20 assesses whether our baseline results are robust to controlling for LRA activity. Columns (1) and (2) show that controlling for years since the last victim in the *boma* does not affect the results; the size of the coefficient on *boma* radio reception increases compared to the baseline estimates when including these two variables, and the coefficient is now significant at the 1 per cent level. Columns (3)-(6) use LRA Crisis Tracker data on LRA activity. Our results are qualitatively unaffected in column (4) and (5), but the coefficient on *boma* radio reception loses statistical significance in the models presented in columns (3) and (6). This could imply that earlier results are spurious, and that the earlier observed relationship between radio reception and fear is driven by actual LRA activity.

⁴⁵ Author interview with payam chief, 15 May 2013.

Table 20: Controlling for LRA activity

	(1)	(2)	(3)	(4)	(5)	(6)
FEAR LRA	oprobit	oprobit	oprobit	oprobit	oprobit	oprobit
Boma radio reception	3.256*** (0.810)	4.327*** (0.886)	2.908 (2.864)	4.428** (2.220)	4.932*** (1.193)	4.390 (2.762)
Years since last LRA victim in Boma	0.339 (0.231)					
Years since last personal LRA victim in Boma		0.103 (0.0904)				
Distance to closest LRA- related incident...						
Last year			-7.761* (4.143)			
Last 2 years			5.093 (4.175)			
Last 5 years			-2.480 (7.821)			
Involving civilians last year					-3.177 (4.149)	
Involving civilians last 2 years					5.028** (2.116)	
Involving civilians last 5 years					-6.928*** (1.514)	
Distance to 10 closest LRA-related incidents...						
Last year				-0.234 (0.766)		
Last 2 years				0.429 (0.522)		
Last 5 years				-0.654 (0.684)		
Involving civilians last year						0.478 (1.262)
Involving civilians last 2 years						0.00104 (1.935)
Involving civilians last 5 years						-0.774 (1.237)
Observations	423	423	423	423	423	423

Robust (clustered) standard errors in parentheses

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

Although we do not want to discount this possibility, it is also possible that adding three more *boma*-level variables for distance creates multicollinearity, inflating the standard errors and causing the coefficient of interest to lose significance. In this context, it is important to note that coefficients of interest lose statistical significance due to an increase in the size of the standard error, not due to a decrease in the size of the coefficients. The coefficient in column (3) is similar to the one obtained in our baseline specification, whilst the coefficient presented in column (6) is considerably larger. Calculating the correlations between the six measures of LRA activity from column (3) and column (6) and the three variables in the ***DISTANCE_b*** vector, reveals that the two sets of variables are indeed correlated. Out of the 18 correlation coefficients, 12 exceed 0.4 and three exceed 0.75. Entering the six indicators for LRA activity in the baseline specification separately results in the coefficient on *boma* radio reception to be statistically significant at the 1 per cent level in all cases.

These arguments, combined with the unchanged results in the other models presented in Table 20 and the lack of statistical significance of most of the indicators for LRA activity leads us to conclude that our baseline results are at least reasonably robust to controlling for actual LRA activity. We do not find strong evidence that the relationship between intensity of exposure to radio and fear of the LRA is driven by actual LRA activity.

One may also suspect that armed forces provide better protection against an LRA attack to inhabitants of *bomas* with poor radio reception. This is slightly counterintuitive: it is perhaps more logical to suspect that *bomas* that are more easily reached by a radio signal are also more easily reached by armed forces. However, there may be some logic to the argument if armed forces focus their protection efforts on remote or difficult to reach areas.

We deem this implausible; first of all because we have seen no evidence that other armed forces have a greater presence in remote areas. Quite the reverse: the largest bases of the UN or the SPLA are near the county capitals. Furthermore, interviews suggest that armed forces such as the UN, the SPLA and the UPDF are perceived as ineffective in providing protection against the LRA.

Nevertheless, Table 21 shows our baseline specification, including five indicators for whether the respondent has seen US, UN, AU, SPLA or UPDF soldiers respectively, in the past year. Confirming information obtained through interviews, none of these indicators is significantly related to fear of the LRA. Controlling for these indicators has little to no effect on the coefficient for *boma* radio reception: our results appear robust to controlling for the presence of other armed forces.

Table 22 addressed a number of other potential concerns regarding the robustness of the relationship between reception of Yambio FM and fear of the LRA. One such concern may be that radio coverage is better in *bomas* closer to the border with either DRC or CAR, and that inhabitants of these *bomas* are also more afraid of the LRA, either because the LRA is closer to them or because they feel more isolated and less protected living in a border area. As we would usually associate

Table 21: Controlling for presence of other armed forces

FEAR LRA	(1) oprobit	(2) oprobit	(3) oprobit	(4) oprobit	(5) oprobit
Boma radio reception	2.421* (1.260)	2.612** (1.267)	2.686** (1.219)	2.569** (1.201)	2.652** (1.227)
Seen US Army last year	0.414 (0.378)				
Seen UN last year		-0.0877 (0.238)			
Seen AU last year			0.0571 (0.164)		
Seen SPLA last year				-0.197 (0.219)	
Seen UPDF last year					-0.159 (0.172)
Observations	414	421	418	421	421

Robust (clustered) standard errors in parentheses

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

border areas with *poor* radio coverage this is potentially counterintuitive, but not impossible, since Yambio is relatively close to the DRC border. Therefore, columns (1) and (2) of Table 22 include the straight-line distance from the *boma* to the DRC and CAR border respectively as control variables. Controlling for distance to the CAR border does have an impact on the coefficient of interest: it decreases slightly in size and its significance level is reduced to 10 per cent. This suggests that proximity to the CAR border may drive part of the observed relationship between *boma* radio reception and fear of the LRA. However, even controlling for distance to the CAR border, availability of Yambio FM is still associated with a significantly higher level of fear of the LRA. Controlling for distance to the DRC border does not meaningfully change our baseline results.

Column (3) of Table 22 investigates phone coverage. We may imagine that phone and radio coverage are correlated, and that information or rumour about the LRA received when calling someone may be the actual driver of fear, rather than radio. Column (3) takes the number of phones owned in a *boma* as a proxy for the quality of phone coverage, since inhabitants of *bomas* without coverage are less likely to own a phone. Column (3) does not provide evidence that the observed relationship between *boma* radio reception and fear of the LRA is driven by phone coverage.

Another cause for concern may be displacement. Ezo and Tambura Counties have experienced high rates of displacement, particularly, but not exclusively, because of LRA violence. More than 60 per cent of respondents to our survey indicate that they have been displaced in the past, mostly in two waves. The first displacement wave took place around 1990 and was not LRA related; the second occurred around 2008-2009 and was likely a response to violence committed by

Table 22: Controlling for various other factors

FEAR LRA	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	oprobit	oprobit	oprobit	oprobit	oprobit	oprobit	oprobit
Boma radio reception	3.632*** (0.982)	1.859* (1.028)	2.076* (1.182)	2.606** (1.242)	2.573** (1.196)	5.160** (2.630)	4.730*** (1.428)
Distance to DRC	-5.640*** (2.139)						
Distance to CAR		-6.012 (4.238)					
Boma phone ownership			-0.0487** (0.0198)				
Resident indicator				-0.297 (0.184)			
Movee indicator					0.555** (0.262)		
Date of interview fixed effects	NO	NO	NO	NO	NO	NO	YES
Observations	423	423	423	423	423	396	422

Robust (clustered) standard errors in parentheses

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

the LRA or to military operations targeting the LRA. This may have an impact on our results in a number of ways. First, it is possible that areas with better radio coverage experienced higher rates of displacement, and that those who have been displaced experience higher levels of fear, even after returning to their original place of residence. Second, those who fear the LRA more intensely may have moved to places with better radio reception, perhaps because they think they can protect themselves better there. Out of these two explanations, the first appears most likely: our data indicates that out of the 60 per cent of respondents that indicate they have been displaced, more than 50 per cent now live at their original place of residence, whereas less than 10 per cent moved somewhere else.

Column (4) of Table 22 includes an indicator equalling one if the respondent is a continuous (non-displaced) resident of the *boma*. Column (5) includes an indicator equalling one if the respondent has moved to the *boma* from somewhere else. Coefficients on both indicators have the expected sign: continuous residents report significantly less fear of the LRA and respondents who moved significantly more. However, our original results are robust to including both indicators, suggesting that our results are not driven by displacement.

Furthermore, one may be concerned that the results are somehow driven by higher numbers of minorities living in areas with better radio reception. Column (6) of Table 22 shows our baseline regression, excluding respondents that do not have South Sudanese nationality, or that indicate that they do not speak Pazande as their first language. As may be evident, respondents to

our survey are very homogenous, and only 27 individuals are excluded. Excluding them does not affect the original results.

A final robustness check is including date-of-enumeration fixed effects. These may be relevant given the breakdown of Yambio FM shortly before execution of our survey. It is possible that respondents enumerated later would increasingly report that they are unable to receive Yambio FM and that date of enumeration is also somehow related to fear of the LRA. However, column (7) shows that including date-of-enumeration fixed effects has no meaningful effect on the coefficient of interest.

Overall, our results have proven reasonably robust to controlling for LRA activity, presence of other armed forces, distance to the CAR or DRC border, phone coverage, displacement and date of enumeration.

Mechanisms: Yambio FM and fear

Now that we have established that the relationship between reception of Yambio FM and fear of the LRA is reasonably robust, we turn to the mechanisms connecting media and fear. As described earlier, the substitution, resonance and affinity mechanisms provide testable implications, maintaining that the fear-inducing effect of radio messages is stronger for certain groups than for others. Substitution implies it is strongest for those *without* previous experiences of violence and/or for low-risk groups, resonance predicts the strongest effect for those previously victimized and affinity hypothesizes that radio is most fear-inducing for high-risk groups.

We use an ANOVA test to confirm that significant differences exist between demographic groups in terms of how likely individuals in these groups are to report that they have experienced violence by the LRA. Specifically, men and individuals in the older two age brackets (41-50 years and older than 50 years) are more likely to report having been a victim of LRA violence. We consider these groups to be “high-risk” and other groups to be “low-risk”. In addition, we also use an individual-specific indicator for whether the respondent reports ever having fallen victim to LRA violence, again distinguishing between direct and indirect experiences. We interact *boma* radio reception with these variables for “risk group” and personal experience of violence.

The first four columns of Table 23 display the result of this exercise. Only one of the interaction terms gives a significant result: the interaction between radio reception and the age category 26-30 years is significant and negative. This age category was classified as “low-risk,” so this appears to provide some support for the affinity mechanism. However, none of the other results supports this. The interaction terms for the two high-risk age categories have negative signs, contrary to the prediction of the affinity mechanism, although they are not significant. The increase in the size of the coefficient on *boma* radio reception compared to the baseline model suggests that the fear-inducing effect of radio for the omitted (low-risk) age category of 18-25 years is *stronger* compared to the other age groups, in direct contradiction to the affinity mechanism. Furthermore,

Table 23: Yambio FM and fear. Mechanisms

FEAR LRA	(1) oprobit	(2) oprobit	(3) oprobit	(4) oprobit	(5) oprobit
Boma radio reception	2.416*	3.344***	1.484	2.284**	2.573**
	(1.379)	(1.086)	(1.186)	(1.154)	(1.252)
Interaction: male gender	0.448				
	(0.639)				
Interaction: age 26-30		-1.137**			
		(0.517)			
Interaction: age 31-40		-0.106			
		(0.997)			
Interaction: age 41-50		-1.467			
		(1.530)			
Interaction: age 50+		-0.129			
		(1.520)			
Interaction: LRA victim			4.622		
			(2.848)		
Interaction: personal LRA victim				0.441	
				(1.391)	
Interaction: # phones owned					0.974
					(174.411)
Observations	423	423	423	423	423

Robust (clustered) standard errors in parentheses

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

the interaction terms on male gender, males being a high risk group, is positive, but not significant. Concluding, we find some weak evidence in favour of the affinity mechanism, and none in favour of the resonance or substitution mechanisms.

The last column of Table 23 provides a provisional test for the costly information mechanism. This may imply that people with better access to outside information sources are less inclined to take frequency of radio reporting as an indicator for insecurity. Therefore, we interact boma reception of Yambio FM with the number of mobile phones (the main other source of outside information according to the interviews) in the respondent's household. The coefficient on the interaction term is insignificant, providing no evidence to support the costly information mechanism. Overall, survey data does not provide clear evidence in favour of the substitution, affinity, resonance or costly information mechanisms.

We examine the costly information, and availability mechanisms further using interview data. The processes described by these mechanisms may be mostly subconscious, thus we cannot definitively rule out either mechanism. However, interview data does provide suggestive evidence that the availability mechanism may be most relevant in this context.

We have already seen that interview respondents in areas with above median radio reception were very specific about instances when they had experienced fear of the LRA: when going across the border to the market, when going to cultivate, when making decisions on whether to return to their original village after having fled. Respondents in areas with below median radio reception did not bring up such specific examples. This appears to be more consistent with the availability mechanism, hypothesizing that media coverage of a phenomenon makes it easier for people to recall similar instances and that they therefore judge them more likely. It is not obviously consistent with the costly information mechanism, which suggests that people take the frequency of media coverage as an indicator for risk.

Judging their own level of being well-informed, people in areas with above median radio reception were rather reluctant to characterize radio as a solid means of communication and information gathering. Interview respondents expressed mistrust about information broadcasted. When asked how radio reception helped them in being informed, one respondent in an area with above median radio reception was reluctant to credit the radio with much information value. By way of example, he said that he had heard that the Americans were sending 200 or 100 military personnel, and that they were stationed in Nzara, “but we have not seen them.”⁴⁶ The information about foreign troops only became valuable to him after he was connected to the troops through a personal contact. A disconnect between what people heard on the radio and their experience of the situation was often described: “We just heard of UPDF by the roadside and we heard on radio about other soldiers. But we have not seen them. There is no evidence. How do you prove they are there?”⁴⁷

Respondents in areas with above median radio reception indicate that they actively sought out information from other sources, which they trust more. A typical response, particularly regarding cross-border communication was “We speak to chiefs in Congo, but we have no communication with Central Africa. If they [the LRA] attack Congo, they can send a letter, but it takes time, two, three days, so we can prepare.”⁴⁸ Credible information sources that were highlighted by residents in areas with above median radio reception were hunters from their own community who were seeing LRA tracks or “they can see LRA has been sleeping here, cooking food here. They can tell me and then we can make plans to attack.”⁴⁹ Others highlighted that the best information was exchanged between border residents who patrolled the forest and that the best response was to warn people directly, rather than send out warnings over the radio: “We have no other source of information apart from our neighbours in DRC....Even in [the *payam* capital] there was no proper information so we form ourselves as Arrow Boys to patrol the border for footsteps of the LRA. We do that once or twice a month.”⁵⁰ In a different area with above median radio reception, people had no expectation that they could rely on the radio for good information: “Nobody told us LRA is no longer in area, [that] we can come back. We make patrol to find out

⁴⁶ Author interview Executive Chief, 22 May 2013.

⁴⁷ Author discussion with Women's Group, 23 May 2013.

⁴⁸ Author interview Executive Chief, 22 May 2013.

⁴⁹ Author interview Executive Chief, 22 May 2013.

⁵⁰ Author discussion with Arrow Boys, 23 May 2013.

and when we did not find LRA we told chief who said go back because you still have some cassava and I will support you. If it was not for the chief, we would not be here.”⁵¹

Respondents in areas with below median radio reception also spoke about seeking out other sources of information, but statements to this effect were often coupled with expressions of resignation about not being able to find out more and living in information isolation: “We have limited idea about issues to do with Yambio, only our own *boma*.”⁵² Even when asked to contribute payments—for example for the crowning of the Zande king—people obliged but just commented that they had never found out what had happened with their donations: “There is not any other news about it.”⁵³ Another group commented on their contributions to the crowning of the king: “Up to now we are wondering what is delaying.”⁵⁴ It was noted that rumours were plentiful, but that it was doubtful how useful they were: “I heard through rumours that [US soldiers] came, very many and they took them by plane to the jungle to the LRA. But I don’t know how true it was.”⁵⁵ Another chief said: “We only heard of [Ugandan troops] going to Central Africa. We are far from the main road the UPDF is using, but we heard of them.”⁵⁶ Lack of information was expressed acutely by some respondents: “People are always complaining that the government is neglecting us and not giving any information. It is true, there is nothing here to show the presence of the government.”⁵⁷ Respondents also spoke about gathering bits of information when travelling to the state capital: “I was in Yambio when I heard about AU forces. I have seen UN forces in Yambio, but there is no other news.”⁵⁸

In villages with below median radio reception people were similarly sceptical about the usefulness of radio as a source of information. One chief explained: “About LRA it is not necessary to get information from radio, they can see by the action. This village has been attacked and these people have been killed.”⁵⁹ A group of Arrow Boys was outright dismissive of the radio as a tool to end violence; they said it had been inappropriate that a captured LRA commander had been allowed to talk on the radio, something they considered as elevating him in his status: “Would Kony also get to talk on the radio?”⁶⁰

Interviews suggest that people in areas with above median radio reception put little trust in information received over the radio and actively seek out other sources of information. This does not square well with the costly information mechanism, which suggests that individuals use information received over the radio as a shorthand indicator for risk because seeking out additional information is too costly. However, we cannot rule out that this is a subconscious process, and

⁵¹ Author community meeting, 23 May 2013.

⁵² Author community meeting, 6 May 2013.

⁵³ Author interview with payam chief, 15 May 2013.

⁵⁴ Author community meeting, 6 May 2013.

⁵⁵ Author interview with woman, 11 May 2013.

⁵⁶ Author interview with payam chief, 15 May 2013.

⁵⁷ Author interview with woman, 11 May 2013.

⁵⁸ Author community meeting, 20 May 2013.

⁵⁹ Author interview with payam chief, 15 May 2013.

⁶⁰ Author discussion with Arrow Boys, 23 May 2013.

therefore does not become apparent from the interviews. The observations that respondents' levels of anxiety appear to be influenced by reception of Yambio FM, even though they do not particularly trust information broadcasted, and the vivid description of this anxiety in areas with above median radio reception, appears most consistent with the availability mechanism.

Impact of anxiety: the Arrow Boys and the SPLA

The results above suggest that Yambio FM's broadcasts increase fear of the LRA among the inhabitants of Ezo and Tambura Counties. These sentiments may in themselves have an important impact on the daily lives of people in this area. However, a number of theories, notably Affect Transfer and Affective Intelligence, suggest that anxiety can have *political* consequences: anxiety could transfer directly to political actors positively or negatively associated with its source, or anxiety can induce individuals to engage in more cognitive deliberation of their attitudes. We compare attitudes toward the Arrow Boys and the SPLA. Interviews have shown that inhabitants of Ezo and Tambura Counties perceive the Arrow Boys as effective in providing protection against the LRA, and the SPLA as ineffective in doing this.

We attempt to capture the extent to which the Arrow Boys and the SPLA have a position of authority with three questions. First, we asked respondents whether they brought an issue or concern in front of either the Arrow Boys or the SPLA in the past year. We did not specify which type of issue this could be. Second, we asked respondents who they *would go to if* they feared for their personal safety or that of their family. The reasoning behind both measures is that if an actor is considered a "go-to" actor in case of a concern, either in practice or hypothetically, this is an indicator for their position of authority. A third question is on how frequently the respondent trusts both the Arrow Boys and the SPLA, on a four-point scale: often, sometimes, rarely, never. A number of studies have shown that trust is an important factor in the extent to which individuals are willing to cede authority to someone else, and the extent to which they are willing to cooperate with this authority (Dijke and Verboon 2010; Cremer and Tyler 2007).

Taking these three indicators for the authority position of the Arrow Boys and the SPLA as dependent variables, we estimate IV probit and 2SLS regressions using fear of the LRA, instrumented by *boma* radio reception, as the explanatory variable of interest. All control variables from our baseline specification and the variables in the ***DISTANCE_b*** vectors are also included (results omitted from the table for brevity). In experimental terms, fear of the LRA is the 'treatment' in our model, and village-level reception of Yambio FM increases the availability of this 'treatment'. Results show the effect of fear for the 'compliers', those respondents who 'take the treatment' – i.e. who directly or indirectly hear the information broadcast by Yambio FM and are more afraid of the LRA as a result. We investigate the relative likelihood that respondents from particular subgroups are compliers by running the first stage for a subsample of respondents only, and calculating the ratio of the resulting coefficient and the first stage coefficient for the full sample

Table 24: Fear and political authority

Instrument: Boma radio reception	(1) ivprobit	(2) ivprobit	(3) ivprobit	(4) ivprobit	(5) 2SLS	(6) 2SLS
DEPENDENT:	Brought issue in front of Arrow Boys SPLA		Would go for protection to Arrow Boys SPLA		Trust in Arrow boys SPLA	
Fear of LRA	1.210 (1.095)	-2.046*** (0.358)	1.582*** (0.398)	-2.132*** (0.297)	0.273 (0.383)	-0.102 (1.631)
Observations	423	423	414	414	415	417

Robust (clustered) standard errors in parentheses

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

(Angrist and Pischke 2008). The results indicate that female respondents, and respondents in the age category 31 to 40 years are more likely to be compliers than the average respondent in the sample.

Table 24 shows the results of our main regressions. Columns (3) and (4) provide the strongest results: those respondents with more intense exposure to Yambio FM, are significantly *more* likely to say they would go to the Arrow Boys to get protection, and *less* likely to say they would turn to the SPLA. Both coefficients are significant at the 1 per cent level. This suggests that fear of the LRA, as instrumented by reception of Yambio FM, strengthens the position of the Arrow Boys, whilst weakening that of the SPLA.

Results are less clear-cut in the case of actual issues brought in front of the Arrow Boys and SPLA. The coefficients on reporting to the Arrow Boys has the expected positive sign (column (1)), and the one on reporting to the SPLA the expected negative sign (column (2)), but only the coefficient on the SPLA is significant. Hence, we find evidence that those respondents more exposed to Yambio FM's broadcasts, and therefore fearing the LRA more, have brought fewer demands in front of the SPLA. However, we do not find clear evidence that these respondents have brought more demands in front of the Arrow Boys.

The final two columns of Table 24 show results taking trust in both actors as a dependent variable. Both coefficients of interest have the expected sign, but neither is significant. Thus, we do not find clear evidence that fear of the LRA is related to significantly increased trust in the Arrow Boys and decreased trust in the SPLA.

Table 25 shows the equivalent results for a reduced form model, where we enter *boma* radio reception directly into the regression (Panel A). This serves mainly as a comparison for the individual model with fixed effects Panel B). We estimate the individual model in the reduced form only, because an IV model would require an IV probit and IV bucologit with fixed effects, neither of which exists.

The reduced form estimates in Panel A are comparable to those presented in Table 24: respondents in areas with a greater degree of reception of Yambio FM are *more* likely to consider the Arrow Boys a ‘go-to’ actor in case of insecurity and less likely to think of the SPLA as such (columns (3) and (4)). Results on trust are stronger compared to those obtained earlier, with the coefficient on the SPLA now significant at the 10 per cent level (column (6)). Results on issues brought to both actors in the past month are weakened; both coefficients have the expected sign but are insignificant (columns (1) and (2)).

Panel B of Table 25 presents the results for the individual model with *boma* fixed effects. Note that the number of observations is substantially lower for columns (2) and (4). This is because reporting an issue to the SPLA, and a respondent saying that he/she would go to the SPLA for protection are rare. In six and two *bomas* respectively, this did not occur at all, and there is no within-*boma* variation to exploit. These *bomas* are dropped from the relevant regressions.

Table 25: Reception of Yambio FM and political authority.

Panel A: Reduced form *boma*-level model

	(1)	(2)	(3)	(4)	(5)	(6)
	probit	probit	probit	probit	oprobit	oprobit
DEPENDENT:	Brought issue in front of Arrow Boys		Would go for protection to Arrow Boys		Trust in Arrow Boys	
		SPLA	SPLA	SPLA	SPLA	SPLA
Boma radio reception	0.808 (1.240)	-3.457 (2.548)	1.296*** (0.492)	-7.292*** (2.469)	0.463 (0.613)	-4.484* (2.568)
Observations	429	429	420	420	421	423

Panel B: Reduced form individual model

	(1)	(2)	(3)	(4)	(5)	(6)
	FE logit	FE logit	FE logit	FE logit	bucologit	bucologit
DEPENDENT:	Brought issue in front of Arrow Boys		Would go for protection to Arrow Boys		Trust in Arrow Boys	
		SPLA	SPLA	SPLA	SPLA	SPLA
Individual radio reception	0.964** (0.456)	-0.919 (1.731)	0.629** (0.263)	-0.745 (0.748)	0.0254 (0.211)	0.282 (0.255)
Observations	426	170	417	330	751	1,053

Robust (clustered) standard errors in parentheses

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

In the case of the relationship between Yambio FM and fear, the model using individual radio reception failed to reproduce the results obtained using *boma* radio reception. In this case, however, some similar results are found. Respondents with individual access to Yambio FM brought significantly more issues to the Arrow Boys in the past year, and are significantly more likely to (hypothetically) go to the Arrow Boys for protection. The equivalent coefficients for the SPLA have the expected sign, but are not significant (the lower number of observations used possibly contributes to this). No support for the hypothesis presented is found for the trust variables.

Overall, we find some evidence that fear of the LRA, as instrumented by the degree of reception of Yambio FM, has an impact on the authority position of the Arrow Boys and the SPLA. This effect is not observed consistently across models and across indicators for authority. However, we do find that *boma* radio reception is robustly associated with the extent to which people would turn to the Arrow Boys and SPLA for protection. Fear of the LRA appears to increase demand for protection by the Arrow Boys and to decrease such demands on the SPLA. Results consistent with this are also found in some models using trust in, and actual reporting to, the SPLA and the Arrow Boys; these are not consistently significant.

Impact of anxiety: mechanisms

Two theoretical mechanisms explaining the connection between anxiety and political attitudes were proposed: Affect Transfer and Affective Intelligence. In this case, negative feelings related to the LRA may directly transfer to political actors positively or negatively associated with the LRA (Affect Transfer), or anxious individuals may make a greater cognitive effort to form a political opinion, instead of relying on habit or patriotism (Affective Intelligence). To distinguish between these two mechanisms, we again turn to the interview data.

In areas with above median radio reception, people often stressed that participation in the Arrow Boys came with great sacrifices in the short term—no food or water in the bush, long walks in pursuit of footprints, risk of being killed—and long-term in terms of loss of vocational or educational opportunities. In these areas, the Arrow Boys were directly linked to the LRA phenomenon, with the suggestion that once this was over, the Arrow Boys would also cease to exist⁶¹, primarily so that the Arrow Boys could go back to pursue their normal lives.

Often the actions of the Arrow Boys were put in direct contrast with those of the SPLA or the government, which are often used interchangeably. Both SPLA and government were portrayed as actively refusing to help people, as summed up by one respondent in his narrative of how the Arrow Boys came about:⁶² “All chiefs called for a meeting and advised youth that they needed to defend themselves. Otherwise they were all going to die and government was not coming to help

⁶¹ Author interview Executive Chief, 22 May 2013.

⁶² Author interview Executive Chief, 22 May 2013.

them.”⁶³ One respondent recounted his experience with the government army: “It has never happened that the SPLA has followed the LRA into the bush.”⁶⁴

Distrust in the government’s interest in protecting civilians was often linked to the information that people had obtained about the presence of foreign and national troops, in areas with above median reception of Yambio FM: “Why bring more soldiers if they don’t protect us? If they bring more they can even kill us. So we can protect ourselves, our boys are there.”⁶⁵ Respondents linked the international military presence to the lack of discernible protection offered from the SPLA: “The SPLA does not do anything.”⁶⁶ Some of what people observed, however, was cause for distrust. While knowing about the presence of troops was considered a useful thing, lack of specific information contributed to feeling exposed by the government: “Planes - you cannot recognise if they are SPLA or UPDF, that is also why we don’t trust our government.”⁶⁷ Some concrete complaints about the government were mentioned: “[The chief] is using his own motorcycle. If the government does not want to look after us, the chief should be provided with means of transport.”⁶⁸

In areas with below median radio reception, support for the Arrow Boys in interviews appeared equally strong as in areas with above median radio reception. Yet in stark contrast there was no suggestion that the Arrow Boys were a temporary phenomenon linked to the LRA. A number of functions of the Arrow Boys, some actual and some imagined for the future, were proposed. One of these functions suggested was as a permanent protection force against future attacks by other tribes: “The other reason for keeping the Arrow Boys around is for Dinka tribe. Because these are not rational people and they are looking to fight. So [we] have to keep the Arrow Boys around in case they come to fight.”⁶⁹ One Arrow Boy described their role in the community: “They are soldiers, police in the community, there is no government.”⁷⁰ Or as one Arrow Boy phrased it: “People want to stay with Arrow Boys.”⁷¹ It was proposed that they could become the personal force or militia of the Zande King: “In case LRA is no longer there and there is no government support, they will keep the group and if the king is crowned, they will turn into the militia of the King to protect the community.”⁷²

Other respondents presented the Arrow Boys as the only possible solution to the security issues they were experiencing; help was seen as only valuable if it supported the Arrow Boys.⁷³ This sentiment was mirrored in the perception of a group of young men who recounted how they had

⁶³ Author discussion with Arrow Boys, 23 May 2013.

⁶⁴ Author discussion with Arrow Boys, 23 May 2013.

⁶⁵ Author discussion with Women’s Group, 23 May 2013.

⁶⁶ Author discussion with Arrow Boys, 23 May 2013.

⁶⁷ Author discussion with Arrow Boys, 23 May 2013.

⁶⁸ Author community meeting, 23 May 2013.

⁶⁹ Author interview with payam chief, 15 May 2013.

⁷⁰ Author discussion with Arrow Boys, 29 May 2013.

⁷¹ Author discussion with three young men, 11 May 2013.

⁷² Author discussion with Arrow Boys, 20 May 2013.

⁷³ Author community meeting, 6 May 2013.

asked for government support of the Arrow Boys and were turned back because, in their interpretation, the government was comfortable letting them die: “If we are not supported, the enemy will defeat us.”⁷⁴

The above suggests that respondents in areas with above median reception of Yambio FM expressed more clearly in interviews what the Arrow Boys were presently doing, and linked their attitudes about the SPLA to (lack of) information obtained through observation. In areas with above median reception of Yambio FM, the envisioned tasks of the Arrow Boys were broader and less well defined. Also, the Arrow Boys were more commonly presented as the only effective security actor without basing this on concrete information. Overall, it would appear that respondents in areas with better reception of Yambio FM, and consequently with higher fear of the LRA, base their political attitudes on more concrete information. This would be consistent with the Affective Intelligence mechanism, but is hard to square with Affect Transfer.

Conclusion and discussion

This chapter has investigated the impact of intensity of exposure to media (specifically radio) on anxiety, and the impact of anxiety on political attitudes. We exploited exogenous variation in the coverage of Yambio FM, concluding that intensity of exposure to a radio station that frequently broadcasts information about the LRA is associated with higher incidence of fear of an LRA attack. This result is robust to controlling for actual LRA activity, presence of other armed forces, distance to the CAR or DRC border, phone coverage, displacement and date of enumeration. Investigating various theories about media and fear, we tentatively conclude that these results are most consistent with *availability* (Tversky and Kahneman 1973). Increased anxiety, as instrumented by degree of reception of Yambio FM, is related to increased reliance on the Arrow Boys, and decreased reliance on the SPLA, although results are not consistent across indicators. A comparison of interview data from areas with above and below median radio reception suggests that these results are consistent with the theory of Affective Intelligence (Marcus, Neuman, and Mackuen 2000).

As such, the chapter contributes to existing literature on media and fear. It provides evidence for a link between exposure to media and fear, in the context of a developing country. Similarly, it provides suggestive evidence for the Affective Intelligence theory. To our knowledge, neither set of theories has been explored in a developing country before.

Although this is not a study into the effectiveness of Yambio FM, these results could have some implications for the radio station’s programming. According to Invisible Children’s promotional material, the goal of the radio network to which Yambio FM belongs is “protection” of people in isolated communities against the LRA. Our results suggest that whatever Yambio FM’s other

⁷⁴ Author youth group meeting, 20 May 2013.

impact, people in local communities do not *feel* better protected against the LRA as a result of being able to receive Yambio FM; in fact, quite the contrary.

Of course, it is possible that people simultaneously *feel* more afraid, whilst they are in fact better protected. This could be because LRA fighters are defecting as a result of “come home” messages. Alternatively, this could be because communities receive better information on LRA movements, making them more afraid, but leaving them better able to protect themselves. In the extreme, we may think that fear is not necessarily a bad thing, if it leaves people more alert or cautious.

With regard to LRA fighters coming home as a result of messages, we have argued that it is extremely unlikely that Yambio FM will systematically reach any LRA fighters on South Sudanese soil or even beyond. The LRA Crisis Tracker records 59 LRA returnees in South Sudan in total, none of which occurred in 2013, and only 11 in 2012. However, about a quarter to a third of Yambio FM’s area of coverage is in the DRC, where it may reach more LRA fighters. Even if “come home” messaging does reach the LRA, it is very difficult to impossible to tell whether it indeed *causes* defections. Ultimately, the success of “come home” messages is unsure, and any such success may have to be weighed against the increased feelings of fear that they inspire among radio listeners.

Alternatively, Yambio FM may contribute to the protection of communities through its function as “early warning radio network”, informing communities about LRA movements. Invisible Children’s promotional material sees a tight link between being informed about a threat and being protected against it. Our research suggests that people living in Ezo and Tambura Counties have very limited options for protection, especially since they perceive the many formal armed forces in the area as ineffective. The Arrow Boys however, are seen as an effective answer to LRA threats and our results suggest that people living in areas with better coverage by Yambio FM call on them more often.

In sum, regardless of whether Yambio FM achieves its goals, its broadcasts appear to have a number of unintended consequences. Taking our results at face value, instilling fear of the LRA in the local population and increasing reliance on a civilian protection force could be two one of these. We do not make a moral judgement on whether this is a good or a bad development, but it is likely unexpected as well as unintended.

As illustrated in the literature section, building or supporting radio stations in areas affected by violent conflict is a fairly common activity in the aid community, and one may wonder to what extent our results can be generalized to other radio stations. Since this chapter only represents a single case study, we caution against any such generalization. However, a comment we receive fairly frequently is that Yambio FM must be an exception to the rule in that it provides biased information about the LRA, unnecessarily scaring the local population. The argument tends to be that had Yambio FM provided so-called correct information about LRA activity, it would not have this unintended impact. However, it is not at all clear that the *content* of the radio messages is the

material factor in this case. In fact, we find suggestive evidence in favour of the availability mechanism, which centres around the *frequency* of reporting rather than on its content. It is quite possible that the frequency of the messages is what connects radio and fear. If this is the case, we cannot exclude the possibility that other radio stations broadcasting “correct” information would have similar unintended effects.

Although it may be obvious, we want to state explicitly that the unintended consequences highlighted are *not* a reason to automatically conclude that ignorance is bliss and to stop any information provision to people in conflict-affected areas. We consider the right to information about one’s own situation as intrinsically valuable.

Finally, consider the final part of our argument, that increased fear of the LRA has political consequences, strengthening the position of the Arrow Boys and weakening the position of the SPLA. As we have highlighted earlier, evidence on this point is not definitive. Not all measures of “authority” give strong results, even though results with regard to reliance on the two actors in case of a (hypothetical) threat to security are solid.

Despite this, one may wonder whether increased reliance on the Arrow Boys is an indication of a shift in authority positions as such. One may think that the Arrow Boys are a temporary phenomenon, conveniently familiar and close to local communities now, but destined to disappear if and when the LRA does. However, numerous interviews suggest that the Arrow Boys are now performing functions in the community other than defence against the LRA. For example, one Chief explained that the Arrow Boys should be “responsible for home guards in areas where army cannot reach.”⁷⁵ Another respondent said: “If there is only community fighting with no injuries, the chiefs and headmen can handle it. If people have weapons they go to the Arrow Boys.”⁷⁶ Other responses indicate that the Arrow Boys are becoming an integral part of decision-making processes: “When there is any decision to be taken, the *payam* administrator calls the chief, the youth, the Arrow Boys.”⁷⁷ Most signs indicate that the Arrow Boys are not a transient phenomenon and that they are becoming a local authority.

The flip side of this argument is that radio messages may weaken the position of the state army, the SPLA. Again, we make no judgement on whether this would be a good or a bad development. However, since South Sudan is a newly independent nation, it is now considered by the international community to be in need of a state-building agenda, which commonly involves increasing legitimacy of national institutions, including the army. By this metric, decreasing the willingness of the population to turn to the SPLA with issues and concerns appears to be the opposite of state-building.

⁷⁵ Author interview, 17 December 2012.

⁷⁶ Author interview, 15 May 2013.

⁷⁷ Author interview, 15 May 2013.

Conclusion

A number of conclusions on the common theme of causes and consequences of violent conflict emerge from the three essays presented in this thesis.

The introduction to this thesis highlighted some recommendations by Blattman and Miguel (2009) for those studying violent conflict: these authors see a need to exploit experimental and quasi-experimental variation to better *identify* the causes of violent conflict, and a need for theoretical models to inform the empirical literature, to explore the *mechanisms* that connect violent conflict to its supposed causes. This thesis, especially chapter one which concludes that endogeneity can drive the results of studies on the causes of violent conflict to a large extent, contributes to the mounting evidence that ‘endogeneity matters’. The thesis exploits several sources of *plausibly exogenous variation*. It contributes to the literature a new measure for the propensity of an area to contain diamonds (chapter two), based on geological regularities. It also exploits sources of exogenous variation proposed in the literature, natural and subsoil capital in chapter one, and variation in radio reception due to geographical factors in chapter three.

In chapter one and two, the thesis investigates the *mechanisms* connecting violent conflict to proposed causes, in this case natural resource abundance. Chapter one concludes that agricultural capital is negatively related to civil war onset. Chapter two concludes that an increase in diamond price is related to increased violence in areas with a propensity for primary diamonds, but unrelated to violent activities in areas with a propensity for secondary diamonds. Both provide support for the *income* or *opportunity cost of conflict* mechanism; the idea that capital-intensive resource production depresses the wage rate, and thereby the opportunity cost of conflict. A critical assessment of the empirical evidence in favour of existing theoretical models in chapter one also suggests that the *income* mechanism has been supported most strongly empirically in existing literature. However, the most common policy interventions aiming to break the link between natural resources and conflict appear to operate with different mechanisms in mind, and the *income* mechanism has not clearly been systematically translated into policy. Hence, this thesis suggests that more consideration could be given to the *income* mechanism when considering various policies: this would imply differentiating between capital-intensive and labour-intensive natural resources and considering policies such as labour-intensive reconstruction spending.

Another common theme in this thesis is *unexpected consequences* of seemingly benign interventions. The clearest example is provided in chapter 3: intensity of exposure to radio broadcasts of Yambio FM is associated with increased feelings of fear, while the stated goal of this radio station is to provide people with security. Increased anxiety potentially has undesirable political outcomes: increasing support for a civilian militia and decreasing support for the government army. In this sense, the intervention appears to accomplish the opposite of its goals: protection and state-building. Results from chapter two also leave open the possibility that the Kimberley Process

Certification Scheme could have unexpected consequences. Case study evidence suggests that the KPCS is most likely to affect secondary diamonds mined by artisanal methods. Chapter 2 finds secondary diamonds to be unrelated to violence. Furthermore, if we take the opportunity cost of conflict mechanism at face value, it is possible that decreasing trade in secondary artisanal diamonds could depress livelihoods and lower the opportunity cost of violence. This latter prediction is not supported by the analysis presented in chapter two however.

It should be noted that in both cases, these unexpected consequences of an intervention could arise because the envisioned *mechanism* behind the intervention does not play out in reality. Media could theoretically contribute to state-building because they inform the public about the government's performance, which influences people's voting behaviour. Although I do not exclude the possibility that this (also) happened in the case under investigation in chapter 3, people in Ezo and Tambura are shown to not exclusively rely on this mechanism and instead form their own authority geared towards protection, parallel to 'official' government. The mechanism underlying the design of the Kimberley process appears to be based on the idea that natural resources are connected to violent conflict through raising the *returns to conflict*, i.e. increasing the amount of 'lootable' wealth. This mechanism is not supported by the analysis presented in chapter 2. These observations have policy implications: those that design an intervention should carefully consider the *mechanisms* through which they envision it to work, and critically assess existing empirical evidence for these and how realistic these mechanisms are in the context in which the intervention is to be implemented, especially if this context is a situation affected by violent conflict.

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Appendix A

Source: (Collier and Hoeffler 2004)

Democracy: The degree of openness of democratic institutions is measured on a scale of zero (low) to ten (high). Source: <http://www.cidm.umd.edu/polity/index.html>. The data are described in (Jagers and Gurr 1995).

Diaspora: We used the data on foreign born population from the US Bureau of the Census and divided these numbers by the total population in the country of origin. <http://www.census.gov/population>

Ethnic dominance: Using the ethno-linguistic data from the original data source (USSR 1964) we calculated an indicator of ethnic dominance. This variable takes the value of one if one single ethno-linguistic group makes up 45 to 90% of the total population and zero otherwise. We would like to thank Tomila Lankina for the translation of the original data source.

Forest coverage: We used the FAO measure of the proportion of a country's terrain which is covered in woods and forest. Source: <http://www.fao.org/forestry>

GDP per capita: We measure income as real PPP adjusted GDP *per capita*. The primary data set is the Penn World Tables 5.6 (Summers and Heston 1991). Since the data are only available from 1960-92 we used the growth rates of real PPP adjusted GDP *per capita* data from the World Bank's World Development Indicators 1998 in order to obtain income data for the 1990s. These GDP per capita data were used to calculate the average annual growth rate over the previous five years.

Geographic dispersion of the population: We constructed a dispersion index of the population on a country by country basis. Based on population data for 400 km² cells we generated a Gini coefficient of population dispersion for each country. A value of 0 indicates that the population is evenly distributed across the country and a value of 1 indicates that the total population is concentrated in one area. Data is available for 1990 and 1995. For years prior to 1990 we used the 1990 data. We would like to thank Uwe Deichman of the World Bank's Geographic Information System Unit for generating this data. He used the following data sources: Center for International Earth Science Information Network (CIESIN), Columbia University; International Food Policy Research Institute (IFPRI); and World Resources Institute (WRI). 2000. Gridded Population of the World (GDP), Version 2. Palisades, NY: IESIN, Columbia University. Available at <http://sedac.ciesin.org/plue/gpw>.

Inequality: Inequality was either measured as income inequality (Deiningner and Squire 1996) or as inequality in land ownership (source: Deiningner and Squire, unpublished). Both inequality measured are provided as a Gini coefficient.

Male secondary school enrolment rates: We measure male secondary school enrolment rates as gross enrolment ratios, i.e. the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers. Source: World Bank Development Indicators, 1998.

Mountainous terrain: The proportion of a country's terrain which is mountainous was measured by John Gerrard, a physical geographer specialized in mountainous terrain. His measure is based not just on altitude but takes into account plateaus and rugged uplands. The data are presented in (Gerrard 2000).

Peace duration: This variable measures the length of the peace period (in months) since the end of the previous civil war. For countries which never experienced a civil war we measure the peace period since the end of World War II.

Population: Population measures the total population. The data source is the World Bank's World Development Indicators 1998.

Primary commodity exports/GDP: The ratio of primary commodity exports to GDP proxies the abundance of natural resources. The data on primary commodity exports and GDP were obtained from the World Bank. Export and GDP data are measured in current US dollars.

Social, ethnolinguistic, and religious fractionalization: We proxy social fractionalization in a combined measure of ethnic and religious fractionalization. Ethnic fractionalization is measured by the ethnolinguistic fractionalization index. It measures the probability that two randomly drawn individuals from a given country do not speak the same language. Data are only available for 1960. In the economics literature this measure was first used by (Mauro 1995). Using data from (Barrett, Kurian, and Johnson 1982) on religious affiliations we constructed an analogous religious fractionalization index. Following (Barro 1997) we aggregated the various religious affiliations into nine categories: Catholic, Protestant, Muslim, Jew, Hindu, Buddhist, Eastern Religions (other than Buddhist), Indigenous Religions, and no religious affiliation.

The fractionalization indices range from zero to 100. A value of zero indicates that the society is completely homogenous whereas a value of 100 would characterize a completely heterogeneous society.

We calculated our social fractionalization index as the product of the ethno-linguistic fractionalization and the religious fractionalization index plus the ethno-linguistic or the religious fractionalization index, whichever is the greater. By adding either index we avoid classifying a country as homogenous (a value of zero) if the country is ethnically homogenous but religiously divers, or vice versa.

War data: A civil war is defined as an internal conflict in which at least 1,000 battle related deaths (civilian and military) occurred per year. We use mainly the data collected by (Small and Singer 1982) and according to their definitions (Singer and Small 1994) we updated their data set for 1992-99.

Appendix B

Source: (Collier, Hoeffler, and Rohner 2009)

Democracy: We measure democracy with the democracy indicator from the Polity IV data set. It ranges from 0 (autocratic) to 10 (fully democratic). Data source: <http://www.cidcm.umd.edu/inscr/polity/>

Economic growth: Using World Bank World Development Indicators (WDI) data for GDP per capita we calculated the annual growth rates (World Bank 2006).

Former French African colony: This dummy takes a value of one for the following countries: Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Rep., Cote d'Ivoire, Djibouti, Gabon, Guinea, Madagascar, Mali, Mauritania, Niger, Senegal, Togo. This variable is zero for all countries for the last period 2000–04.

GDP per capita: We measure GDP per capita annually. Data are measured in constant 1995 US dollars and the data source is World Bank, 2006.

Peace: The number of years since the end of the last civil war. If the country never experienced a civil war we count all years since the end of World War II.

Population: Population measures the total population, in our regressions we take the natural logarithm. Data source: World Bank, 2006.

Primary commodity exports: The ratio of primary commodity exports to GDP proxies the abundance of natural resources. The data on primary commodity exports and GDP were obtained from the World Bank. Export and GDP data are measured in current US dollars.

Social, ethnolinguistic, and religious fractionalization: We proxy social fractionalization in a combined measure of ethnic and religious fractionalization. Ethnic fractionalization is measured by the ethnolinguistic fractionalization index. It measures the probability that two randomly drawn individuals from a given country do not speak the same language. The religious fractionalization index measures this probability for different religious affiliations. The fractionalization indices range from zero to one. A value of zero indicates that the society is completely homogenous whereas a value of one would characterize a completely heterogeneous society. We calculated our social fractionalization index as the product of the ethno-linguistic fractionalization and the religious fractionalization. Data source: Fearon and Laitin (2003).

War starts: Our main measure is based on (Gleditsch 2004) and can be downloaded from <http://weber.ucsd.edu/~kgledits/expwar.html> (12 July 2006). Our alternative measure comes from

the Armed Conflict Database (Gleditsch et al. 2002) and can be found on http://www.prio.no/page/CSCW_research_detail/Programme_detail_CSCW/9649/45925.html (12 July 2006).

Young men. We define this variable as the proportion of young men aged 15–49 of the total population (%). Data Source: UN Demographic Yearbook 2005