

MONTANA STATE UNIVERSITY

Conflict Minerals

The Resource Curse and Implications in the DRC

Prepared by Chris Fisher with contributions from Dominic Parker, Ph.D (Montana State University Department of Agricultural Economics and Economics) and Bryan Vadheim (Montana State University Undergraduate Research Assistant)

ABSTRACT: Many resource abundant nations have experienced lower than average economic growth over the past 50 years. The theorized reasons for which are generally grouped under the title “resource curse”. While the curse affects many developing nations, it is nowhere more prevalent than in the Democratic Republic of the Congo. An economy largely built on the foundation of mineral abundance, the DRC has been plagued with poor growth and extremely high civil conflict rates. Using the DRC, I first consider the literature surrounding the resource curse and examine the mechanisms at work. I then propose new data to better understand the relationship between high mineral content, mineral price and conflict. The data will then help frame new policy enacted in the Dodd-Frank Act pertaining to conflict minerals mined in the DRC. The effects of which will be discussed as well as possible consequences of economic policy purposed to reduce violent conflict.

I. Introduction

The Democratic Republic of the Congo (DRC) has been listed among the most underdeveloped economies of the past 50 years, continually experiencing low and negative economic growth rates. Located in the central region of Africa, the nation holds vast reserves of valuable minerals. Despite these reserves, a lack of economic development has persisted this past century. Further, this region of the world has been plagued with conflict. Civil war, including violence against civilians, has reportedly been the cause of over 5.4 million deaths this past decade alone (BSR, 2010). There has been scholastic conjecture that these events are not independent of each other, but are rather the culmination of outcomes sprouting from the geological holdings of the region. Paul Collier of Oxford University and the World Bank, explains, “at least over the past four decades, resource abundance has often been associated with problems of unfulfilled economic growth potential and high risks of large-scale violent conflict” (2003).

The center of much conflict policy debate is the Kivu region; where militarized groups struggle for control, mineral deposits are vast and conflict persists thwarting economic and human development. The Kivus Shown on the map in dark blue (fig 3) as well as the surrounding areas such as Rwanda have been a hotspot of violent activity the past ten years (fig 2). Most recently, the Dodd-Frank Wall Street Reform and Consumer Protection Act SEC. 1502 both defined conflict minerals in the DRC, as well as set trade guidelines to address the devastating level of conflict in the region. “It is the sense of Congress that the exploitation and trade of conflict minerals originating in the Democratic Republic of the Congo is helping to finance conflict characterized by extreme levels of violence in the eastern Democratic Republic of the Congo,

particularly sexual-and gender-based violence, and contributing to an emergency humanitarian situation therein” (2010). Section 1502 continues to outline disclosure rules for SEC companies using tin, tantalum, tungsten or gold in their production chain. These measures would seek to differentiate conflict free goods from those that are not, thereby allowing consumer preference to rule. Though it is not yet known how effective these vague measures will be, it does bring to light the general sentiment felt by some in the US legislature.

Their policy goal, defined as reducing the level of conflict in the DRC, is sought by reducing the demand for minerals mined in the region. The reduction in minerals supplied by the conflict-zone mines in the DRC (those found in the Kivu region), would decrease the income to the militarized groups operating the mines. Implicit to the policy are assumptions between conflict and the funding therein. This paper seeks to address potential links between price of conflict minerals mined in the DRC and violence within immediate reaches of those mining areas. In the following sections I will explore the mechanisms by which conflict may be affected by the resources and use those assumptions to analyze data from the region. Further, this paper will propose a cost benefit methodology to critically analyze policy similar to that passed by the US in 2010 purposed to end conflict related to the mining of minerals in the DRC.

II. Review of Literature

i. Resource Curse in the DRC

The DRC is said to be plagued with resources. In areas around the world, heavy endowments of natural resources have been correlated with poor development outcomes. Resources with high

rents, especially oil and minerals, are theorized to steer multiple incentive structures which lead to these outcomes. The phenomenon, or natural resource curse as it is commonly referred to, is an observed correlation in which bad development outcomes in the past century have followed regions of the world heavily endowed with scarce natural resources. Sachs & Warner (1995) find the effect to be robust when measured in GDP growth and resource endowments per country. With few exceptions (Malaysia, Mauritius and Iceland), growth rates between 1970 and 1990 tend to be correlated with natural resource stock measured in 1970 (fig 1). These basal correlations are independent of previous growth rates and geographic variables which may otherwise effect observed growth.

“Almost without exception, the resource-abundant countries have stagnated in economic growth since the early 1970s, inspiring the term, curse of natural resources. Empirical studies have shown that this curse is a reasonably solid fact. It is not easily explained by other variables or by alternative ways to measure resource abundance” (Sachs & Warner, 2001). While the effect is visibly present the question remains, by which mechanisms do resource allocations perversely effect economic growth? Collier (2003) offers five popular explanations in which resources may lead to poor growth:

Increased rent seeking or the “honeypot theory”

The increased rents from the resources create a valuable “honeypot” in which conflict develops, thereby reducing economic growth. An alternative to this theory is that the honeypot actually increases likelihood of regional secession because the resource is treated as public thereby increasing group propensity to exclude extra-regional claims on that resource.

Financial gains to violent rebel groups

Resources may prolong conflict and distort any potential resource benefit by funding violence.

Detachment of government

Abundant funding from natural resources can reduce the need for government taxation thereby detaching the electorate from the elected. This subversion of the democratic incentive structure leads to poor outcomes via corruption, and inefficient governance.

Dutch disease

Dutch disease is a process by which a booming resource sector increases the tradable value of a nation's currency which reduces the returns from investment in manufacturing sectors.

Exposure to price shocks

Price shocks are more dramatic in economies with few exports (i.e. natural resource dependent nations). These shocks, both positive and negative, reduce growth rates in the short and medium runs via output and income losses as well as poor economic management decisions and protracted conflict.

These mechanisms can be thought of in two functional forms: resources harming economic growth and resources fueling conflict. Neither of these relationships is entirely separable; however, the primary focus of this analysis will be on the latter.

ii. Mining in the DRC

While evidence of both of these effects persist, perhaps more pervasive in the DRC are conflict-rooted effects surrounding mineral wealth. “Over 50% of the mines in the eastern DRC are controlled by armed groups, who demand taxes, bribes or other payments for the minerals extracted from the mines. Although extremely difficult to track the amount of funding with certainty, one estimate from the Enough Project, an NGO leading a campaign focused on crimes against humanity, places the figure between \$140 and \$225 million in 2008” (fig 4) (BSR, 2010).

According to the U.S. Geological Survey, the latest data indicate 13.4% of the DRC’s GDP was accounted for by mineral production (2011). However, given black market and other non reported income from mining, these estimates may be low. Rebel groups in the conflict ridden eastern DRC, rely primarily on what are known as conflict minerals. These mineral deposits of: Gold, Tin, Tantalum, and Tungsten, are directly owned and mined or taxed by these groups. Estimates from the World Bank place some 10 million Congolese in the artisanal mining industry (BSR, 2010).

Although artisanal mining is viewed by many as seasonal, part-time, or migrant work; work opportunity in the DRC is scarce, making mining a necessary occupation. “The prolonged presence of violent militia in many rural areas forced many farming communities to abandon their traditional agro-pastoral livelihoods and rely on coping strategies such as ASM [Artisanal & Small-Scale Mining] to secure an alternative source of income....Allowing each miner five dependents, it can be assumed that up to one fifth of the population probably survive through ASM; when the ubiquitous middlemen and associated businesses are considered, artisanal

mining emerges as one of the most important elements of the Congolese economy.” It is also estimated that the Kivu region contains 400,000 miners (D'Souza, 2007). The typical pay structure of these miners involves taxation per quantity mined where the militarized group controlling the mine pays each miner some amount much less than the mineral is worth. These mining operation observations describe a free market where miners choose to work, they are not forced.

With these relationships in mind, examining financial motives of rebel groups and rent seekers as well as exposure to price shocks at the micro level will lead to a better understanding of not broad, but mine-level effects of the resource curse.

iii. A Rational Choice Model

In order for price effects to be relevant to conflict, rational choice assumptions must be made. If conflict is assumed to be irrational, its incidence would tend to be random and any analysis would be fruitless. The two competing theories describing root causes of conflict are grouped as those of greed and those of grievance. Grievance models predict conflict is rooted in ethnic division and other commonly understood divisions between groups of people. This conflict type is less rational within an economic model, though it has still been formalized. Greed models of conflict predict conflict is rooted in one group's economic benefit of conflict. For example, if group “A” stands to gain enough by appropriating the rents of some good, they do so under the greed model. This model formalizes gains and losses of tradable goods rather than the non-tradable motivations of the grievance model.

Testing these competing theories, Collier and Hoeffler (2004) find that “greed considerably outperforms grievance. Consistent with the greed theory, both dependence upon primary commodity exports and a large diaspora substantially increase the risk of conflict. Inconsistent with the grievance theory, greater ethnic and religious diversity reduce the risk of conflict.” Furthering the greed hypothesis, they find that the higher conflict rates in sub-Saharan Africa (as compared to nations of similar development), are not due to systematic differences in poor social characteristics. Rather, sub-Saharan Africa has relatively desirable societal makeup that reduces conflict but contains poor economic variables that drastically increase conflict rates in the region (Collier & Hoeffler, 2002).

Conflict described by greed can therefore be understood within the resource rich regions of the DRC where mines are areas of interest to rent seeking groups. These artisanal mines are areas that largely do not require capital and produce minerals whose relative worth is determined by international commodity prices. The short run profitability of these mines creates power struggles where if a primary group, for example the government, fails to control a resource, instability persists creating highly conflictual short run windfalls tied to a mine location (Caselli, 2006).

Further evidence of these geographical ties to conflict in areas with high natural resource rents is found in Columbia, where conflict is shown to be fueled by rent seeking combatants. Here, an exogenous shock lead to an increase in the production of coca for the subsequent production of the lucrative drug cocaine. A Difference in Difference model shows violent conflict increased within the production areas of the windfall good whereas other urban area control groups

remained unaffected. The violent rent seeking was thereby geographically linked to the area in which the good was produced (Angrist & Kugler, 2008).

These short run windfalls represent benefits to controlling groups which would be thought to increase with mineral price. Therefore the higher the mineral price, the larger the benefit to mine control and gains from conflict over those mine sites. However, contrary to these findings, a study focusing on sub-Saharan Africa concluded that if a nations export price indices fell, its likelihood of civil war outbreak increased. “For example, between 1981 and 2006, a 20% year-to-year drop in countries export price indices raised the probability of civil war outbreak by around 2.8 percentage points” (Cicccone & Brückner, 2010). Similarly, conflict was also shown to follow economic downturns stemming from foreign aid shocks. Using AidData’s comprehensive database, Nielsen et al (2010) finds that negative aid shocks increase conflict and positive shocks do not. These papers describe effects of conflict arising around areas where the rent of some primary good (control of aid or resource) become relatively reduced.

Working within these conflicting frameworks, the following empirical paper lends itself to the rational choice dichotomy. It posits a differential relationship between conflict and labor intensive goods, and conflict and capital intensive goods. Columbian exports, coffee and oil, had systematically different effects in relation to price of those goods and conflict. A fall in the trading price of coffee and a rise in trading price of oil both were shown to increase violence. Where a “rise in the price of the labor intensive good is predicted to reduce conflict by raising wages relative to contestable resources, and reducing the size of the appropriation sector. In contrast, a rise in the price of the capital intensive good is predicted to increase conflict by increasing the value of contestable resources relative to wage.” Therefore, “violence increases as

the opportunity cost effect predominates in the case of a price shock to labor intensive goods. In contrast, the rise in oil prices increases contestable revenue and pirating in the oil region, but does not affect wages” (Dube & Vargas, 2008).

A rational choice model may therefore be one based on the pool of available miners and soldiers, stemming from the opportunity cost of joining a conflict group defined by the predominate wages of possible income sources, and the value of the rent infused natural resource.

III. Research Model

i. Model and Data

The model describes mines occurring within a defined radius of a conflict, where conflict and mine data are georeferenced. The area of analysis is the heavily contested region of the DRC known as the Kivus (North and South). The mine data used was provided by International Peace Information Service (IPIS), which recorded militarized artisanal mining sites in the Kivus during August 2009. The assumed property rights of these mines are designated by some asserted force of a militarized group. Because there is no dominant hegemon in the region, these income sources (mines), are contested over within some violent dichotomy where mine value, location, and cost of obtaining and controlling a mine result in some equilibrium. I further assume that the mine sites remain constant during the period of interest, 2001-2010. Artisanal mines are located in areas of extreme mineral content because they are relatively capital free. The mines rely on surface mining techniques primary operated by laborers digging by hand or shovel. While resources may become exhausted in an area, it is unlikely that mine sites will dramatically

change over this ten year period. Mines would more likely expand from the original recorded site given the mine control structure.

Conflict data provided by Armed Conflict Location & Event Dataset (ALCED), defines the dependent variable. Each conflict is described by mine within some radius (1, 5, 15 and 25 miles). The conflict is distributed by a weight system where all mines that fall within the defined radius share some portion of that conflict dependant on distance from the conflict. For example, in radius 1 (conflict with a radius of one mile) - conflict 1, mine A (0.25 miles away) and mine B (1 mile away) are given .75 and .25 conflict points respectively. Because it is not entirely possible to define conflict by actual cause, using distance as a proxy for weighted cause, mine effects may more accurately be developed. I assume that the conflict directly surrounding a mine is caused by the mine; this assumption is within the scope of the research listed in the review.

I model endogenous conflict patterns, proxied by conflict weighted points, by exogenous world price values which are recorded by month and mineral. The price values are a proxy for mine value, the primary variable describing a conflict. I use world mineral prices and normalize them against the peak price of the ten year period. This allows for a general interpretation of price across different mine and mineral types.

ii. Formalized Model

$$Y_{(\text{weighted conflict})} = \beta_0 + \beta_1(\text{mine value}) + \epsilon, \text{ where:}$$

Y: the distance weighted conflict

β_1 : approximate value of the mine

iii. Results

In all radius groups (1, 5, 15, 25), there was a negative coefficient attached to mine value (output listed in appendix). Radius groups 1 and 5 did not include enough observations to warrant any statistical significance; although a similar pattern did emerge in the statistically significant radius groups 15 and 25. The attached coefficient is low (between -0.2 & -0.1); however, it is important to abstract away from the idea of nominal conflicts because the weighted conflict score is rarely assigned to one single mine. Given the relatively small conflict score scale, which observes a mean of 0.286 with a standard deviation of 0.6 over 7756 observations and price with a mean value of 0.448 and standard deviation of 0.2, the coefficient is of sufficient size and significance to characterize behavior. A 0.2 decrease in the nominal price of minerals mined at a given mine increased the conflict score by one. Because a conflict score of 1 represents roughly 3.5 conflict score means ($1/0.286$), the apparent effect of mine valuation on conflict over those mines becomes strikingly large. The model suggests a negative relationship between mine valuation and conflict where a relatively higher value of a mine would have some pacifying effects.

An immediate criticism to a linear regression model as simple as the one presented here is the absence of other explanatory variables. A primary concern would be a time based relationship between conflict events and price. However, as indicated by the price-time graphs as well as conflict-time graph in the appendix (fig 5-9), the results found do not seem to follow a time trend, rather, it would seem as though the results found in the model are systematically smaller

than perhaps they should be. The price time-series show an intuitive increase in prices overtime. The data are weighted towards gold mines (4048 obs.) and tin mines (2773 obs.), of 7756 total observations, which exhibit a rising price overtime peaking during conflict data spikes. The time periods of elevated price data seem to be collinear with the conflict data. Price coefficients would seemingly be skewed towards the outlying conflict spikes; however as the model shows price is negatively associated with conflict. It is important to note that these high prices continue while conflict decreases, indicating an exogenous shock rather than one explained by price. These graphs would seem to indicate a reduced possibility of high prices causing conflict rather it would appear as though the conflict was elevated despite the high price level. In spite of what would seemingly skew the results toward a positive relationship, the price coefficient remains negative.

Although the model is overly simplistic in nature and a far cry from an empirical analysis applicable to general extrapolation, the relationship is unexpected. Where one would expect to find higher prices inciting violence, the opposite is reflected by the data. In the following sections, I discuss relevant policy surrounding the state of conflict and minerals in the Kivu region and suggest a framework in which policy should be viewed.

IV. Discussion

Though it is yet to be seen what effects the policy will have, standard economic analysis would reveal two potential competing effects. The first may be an inward shift in the world supply of the minerals (tin, tungsten, tantalum & gold) or an increase in production cost, thereby increasing the relative price. As mineral producers, refiners, and users begin documenting mineral sources,

and minerals of questionable origin become segregated, world price of “non-conflict” minerals would likely increase. Mineral supply that is not clean of the conflict mineral label would be worth relatively less than the conflict free minerals in the short run. The long run price equilibrium may again revert to a lower price, but the disruption of the supply should initially increase price. The second may be a decrease in the value of militarized mines, where the reduction of demand for minerals mined in the DRC drive down the price.

These estimated price reactions are contingent on two assumptions. Firstly, the policy is carried out. This assumption requires that all manufactures named in the policy carry out the documentation process and that consumer demand shifts the supply of minerals away from those originating in the DRC, a hard assumption to make given the high costs of the policy. The vast array of products containing these minerals (from ball point pens to turbine engines) and the number of tiers in the supply chain (from mining to refining, manufacturing intermediate parts and producing final products) the policy is estimated to cost roughly 8 billion dollars per year (Byer, 2011).

The second assumption is that mineral smuggling cannot overcome the newly implemented documentation policy. The vast majority of mines in the region are gold which requires little refining. Further, gold unlike many other valuable minerals is nearly impossible to identify by source of extraction. If by any other less obvious means, the supply chain from the DRC can overcome the differentiation process, or the policy becomes largely ignored due to the high cost of implementation; the Dodd-Frank act would have little effect.

It is, however, still too soon to determine policy effects; but assuming an expected rise in the world price of the minerals, due to some short run friction as the new policy is implemented and a reduction in the value of the minerals mined in the DRC, gives a framework to understand policy implications in the DRC.

The model indicates an effect brought by the policy, aimed at reducing conflict in the DRC, that would actually increase conflict. If the policy were to, as assumed reduce mine valuation, total regional income would decrease. The resulting reduction of income to the region would increase conflict around those areas of mineral production. Though these results do not feel intuitive, similar results were found in other studies. Reductions in foreign aid significantly increase conflict within a region (Nielsen, Findley, Davis, Canland, & Nielson, 2010) (Cicccone & Brückner, 2010). The primary source of conflict in these studies, given a reduction of income, was one centered on the opportunity cost of conflict. The income source of a region losing value significantly reduces relative wages in that region. Within the scope of the Kivus, mining wages would diminish resulting in marginal increases of individuals choosing more conflictual occupations, such as joining a militant group. The resulting lower opportunity cost of conflict shift the scales towards conflict.

Similarly a pattern emerges reflecting the reduction of wages of a labor intensive good similar to artisanal mining. “We find that a sharp fall in coffee prices in the 1990s increased violence differentially in regions growing more coffee, by lowering wages and the opportunity cost of joining armed groups” (Dube & Vargas, 2008). “In some areas, such as Orientale, up to 80% of the miners are ex-combatants (militia and soldiers), a livelihood which is keeping them from rejoining militia forces” (D'Souza, 2007).

V. Conclusion

Analyzing growth, resources, and the very real consequences of the resource curse in the DRC, brings to light conflicting policy packages. Prescribing solutions to reduce the flow of resources to militant groups seems intuitive. Removing the ability to fund conflict, thereby reducing conflict, addresses part of the greed motivated aspect of the resource curse. However, as this research has shown, there are alternative possible outcomes within the scope of such responsible sourcing policy. One of these possibilities is an increase in conflict not fueled by an abundance of mineral wealth, but rather a lack thereof. Policy makers should be wary of such ambiguous effects. Current estimates put the total cost of the Dodd-Frank Act at around 8 billion dollars per year (Byer, 2011). If the intended goal is not met but subverted and these estimates hold, such a policy is clearly not worth pursuing. As humanitarian concerns mount and demand for minerals found in the DRC and other conflict laden regions in the world increase, better understandings of the resource curse and conflict minerals need to improve. "It is estimated that the DRC contains 80% of the world's columbite-tantalite (coltan) reserves, 49% of its cobalt reserves, and 10% of its copper reserves; while the gold potential is substantially under explored" (D'Souza, 2007). Perverse incentives in the DRC will persist and the mineral-rich nations' impact will be an ever increasing concern to those interested in the betterment of the world's development. This research has helped to explore the vast relationships between resources, economic development, and conflict. If a policy is enacted, it should more holistically address not one, but all of the different aspects at play. Reducing militant income also reduces the surrounding populations' income. These changes in income then change the dynamics of conflict. Conflict does not simply subside, nor does the relatively high value of conflict minerals regardless of supply chain

controls. If the world sentiment were truly in favor of seeking resolution in the DRC and other such states, further analysis needs to be taken on to more fully understand the economic drivers of conflict, and better fuel a solution.

VI. Appendix

i. Bibliography

(2011). Retrieved from US Geological Survey: <http://www.usgs.gov>

Angrist, J. D., & Kugler, A. D. (2008). RURAL WINDFALL OR A NEW RESOURCE CURSE? COCA, INCOME, AND CIVIL CONFLICT IN COLOMBIA. *The Review of Economics and Statistics* , 191-215.

BSR. (2010). *Conflict Minerals and the Democratic Republic of Congo*. BSR.

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

Byer, C. (2011). *A Critical Analysis of the SEC and NAM Economic Impact Models and the Proposal of a 3rd Model in view of the Implementation of Section 1502 of the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act*. Tulane University.

Caselli, F. (2006). Power Struggles and the Natural Resource Curse. 1-22.

Ciccone, A., & Brückner, M. (2010). INTERNATIONAL COMMODITY PRICES, GROWTH AND THE OUTBREAK OF CIVIL WAR IN SUB-SAHARAN AFRICA. *The Economic Journal* , 519–534.

Collier, P. (2003). Natural Resources, Development and Conflict: Channels of Causation. *World Bank* .

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

Collier, P., & Hoeffler, A. (2002). On the Incidence of Civil War in Africa. *The Journal of Conflict Resolution* , 13-28.

Collier, P., & Hoeffler, A. (2005). Resource Rents, Governance, and Conflict. *The Journal of Conflict Resolution* , 625-633.

Dodd-Frank Wall Street Reform and Consumer Protection Act, H. R. 4173 (Senate and House of Representatives of the United States of America January 5, 2010).

D'Souza, K. P. (2007). *Artisanal Mining in the DRC (Key Issues, Challenges and Opportunities)*. World Bank.

Dube, O., & Vargas, J. (2008). COMMODITY PRICE SHOCKS AND CIVIL CONFLICT: EVIDENCE FROM COLOMBIA. *unpublished manuscript, Harvard University* , 1-60.

Gambino, T. (2011). Democratic Republic of the Congo. *World Development Report 2011* .

Hodler, R. (2006). The curse of natural resources in fractionalized countries. *European Economic Review* , 1367-1386.

Nielsen, R. A., Findley, M. G., Davis, Z. S., Canland, T., & Nielson, D. L. (2010). Foreign Aid Shocks as a Cause of Violent Armed Conflict. *American Journal of Political Science* , 219-232.

Raleigh, C., & Hegre, H. (2009). Population size, concentration, and civil war. A geographically disaggregated analysis. *Political Geography* , 224-238.

Raleigh, C., Hegre, H., Karlsen, J., & Ormhaug, C. (2006). Armed Conflict Location and Event Dataset (ACLED) Codebook, Version 1-2006. *Centre for the Study of Civil War, International Peace Research Institute, Oslo (PRIO)* .

Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An Armed Conflict Location and Event Dataset : Special Data Feature. *Journal of Peace Research* , 651-660.

Raleigh, C., Linke, A., Hegre, H., & Karlsen, J. (2010). Introducing ACLED-Armed Conflict Location and Event Data. *Journal of Peace Research* ; 1-10.

Sachs, J. D., & Warner, A. M. (1995). Natural Resource Abundance And Economic Growth. *National Bureau of Economic Research* , 1-54.

Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European Economic Review* .

Spitaels, S., & Hilgert, F. (2009). *Militarised Mining Areas in the Kivus (August 2009)*. International Peace Information Service.

Weidmann, N. B., & Ward, M. D. (2010). Predicting Conflict in Space and Time. *Journal of Conflict Resolution* , 883-901.

ii. Figures

Figure 1 (Sachs & Warner, 2001)

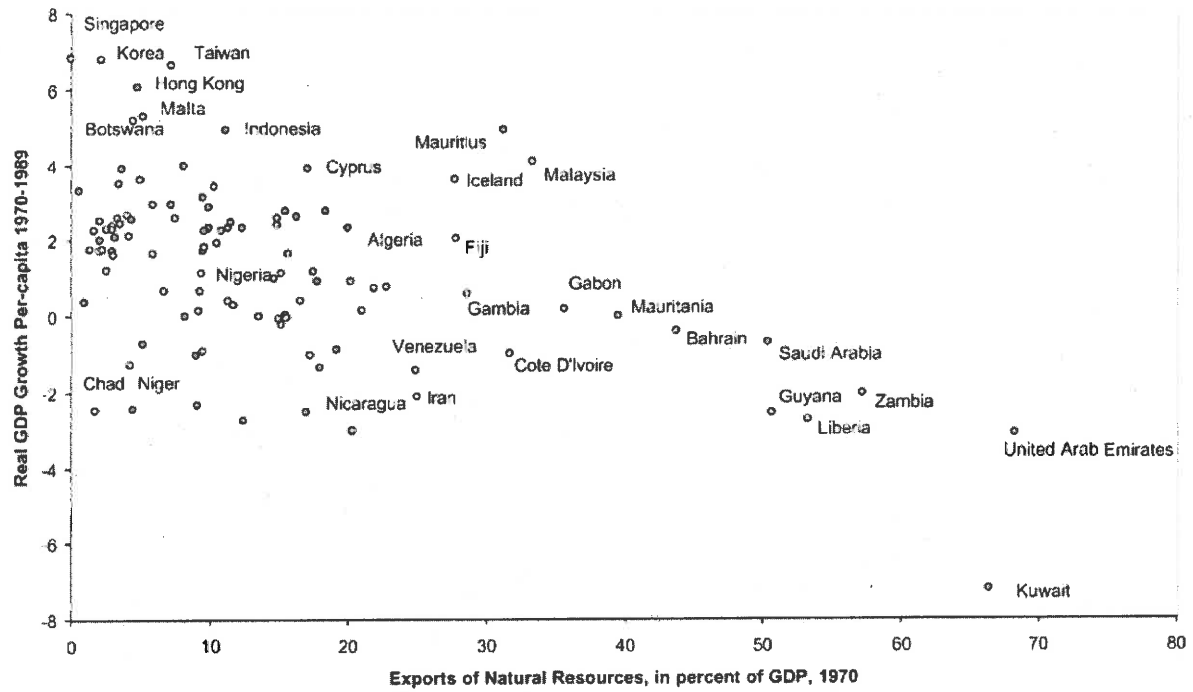


Figure 2 (Raleigh, Linke, Hegre, & Karlsen, Introducing ACLED-Armed Conflict Location and Event Data, 2010)

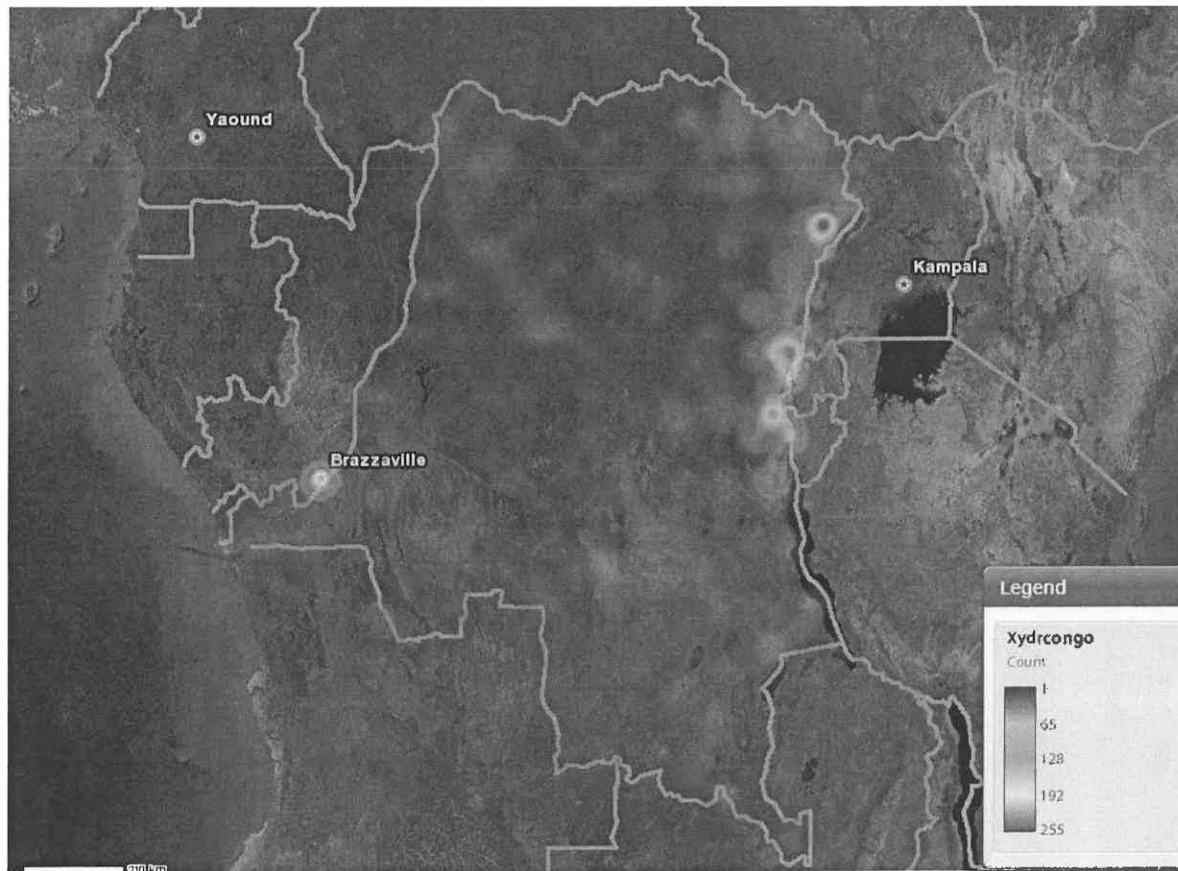


Figure 3

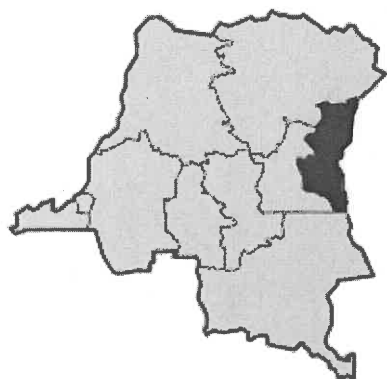
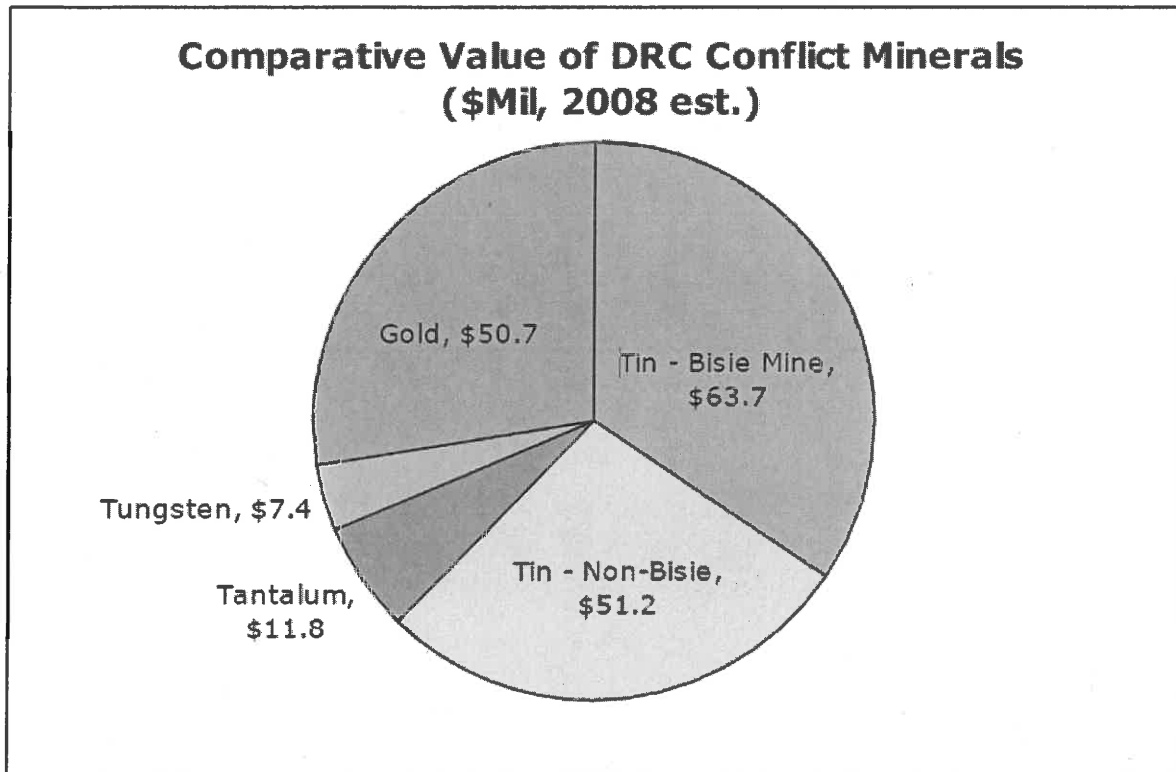
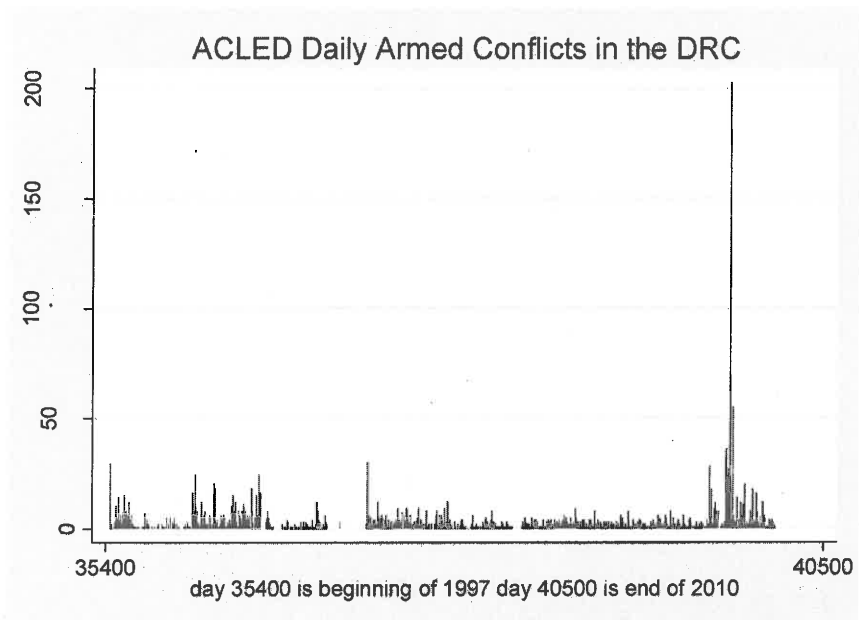


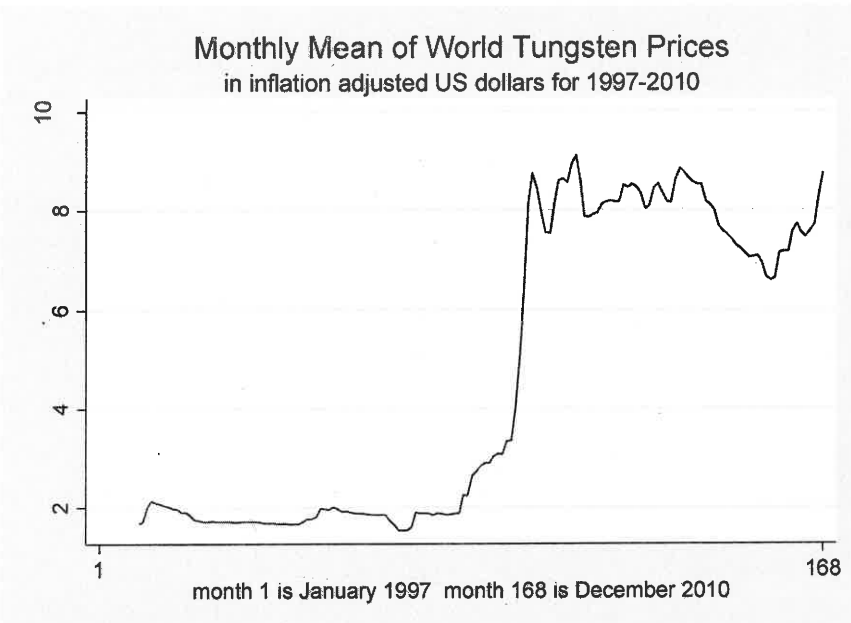
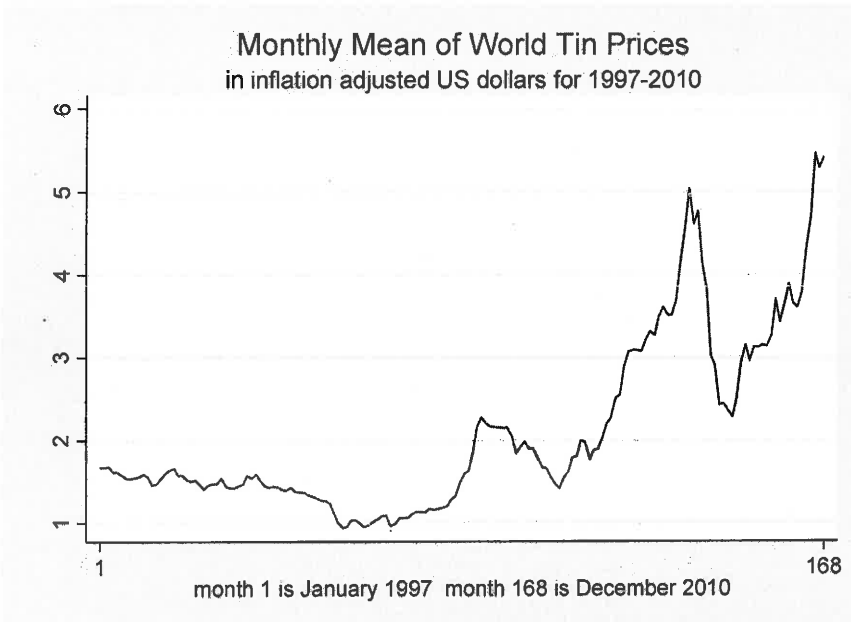
Figure 4 (BSR, 2010)

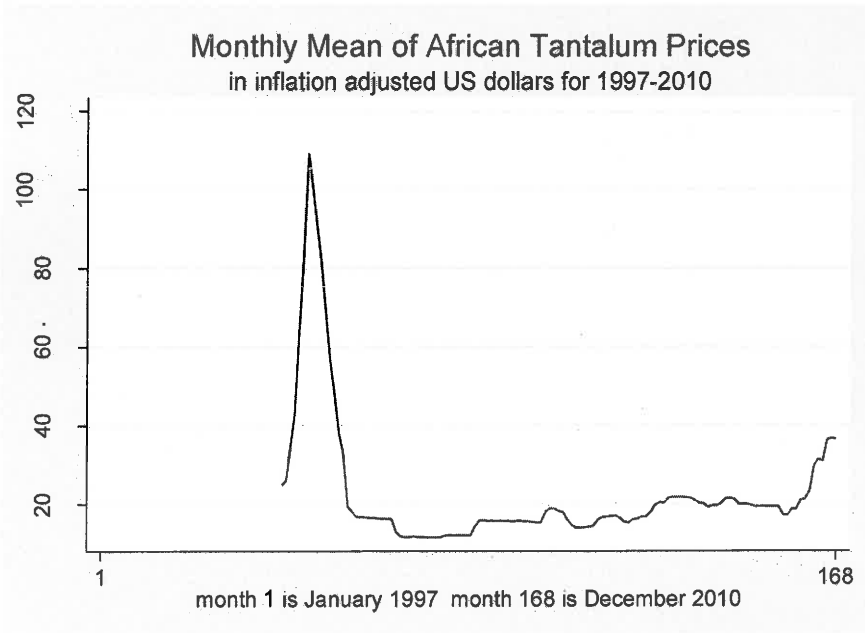


Source: The Enough Project / RCS Data

Figures 5-9







iii. Output

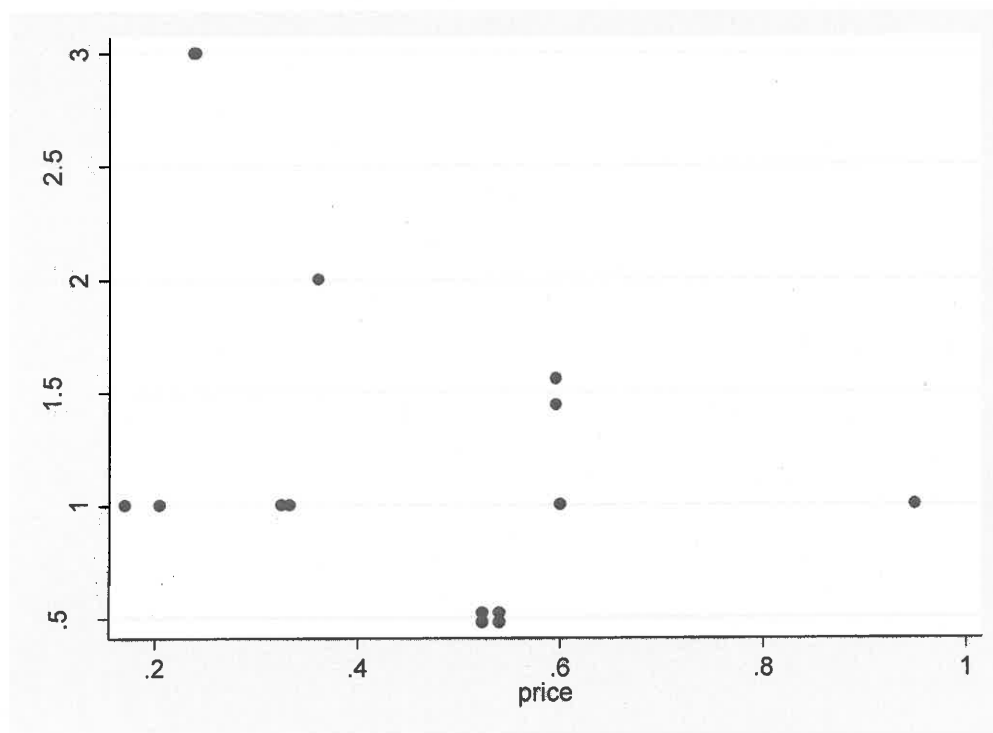
Radius 1

. reg conflict price if radius =1

Source	SS	df	MS
Model	1.46769478	1	1.46769478
Residual	7.97415458	13	.613396506
Total	9.44184936	14	.674417812

Number of obs = 15
 F(1, 13) = 2.39
 Prob > F = 0.1459
 R-squared = 0.1554
 Adj R-squared = 0.0905
 Root MSE = .7832

conflict	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
price	-1.558223	1.007354	-1.55	0.146	-3.734479	.6180342
_cons	1.967072	.4959003	3.97	0.002	.8957448	3.0384

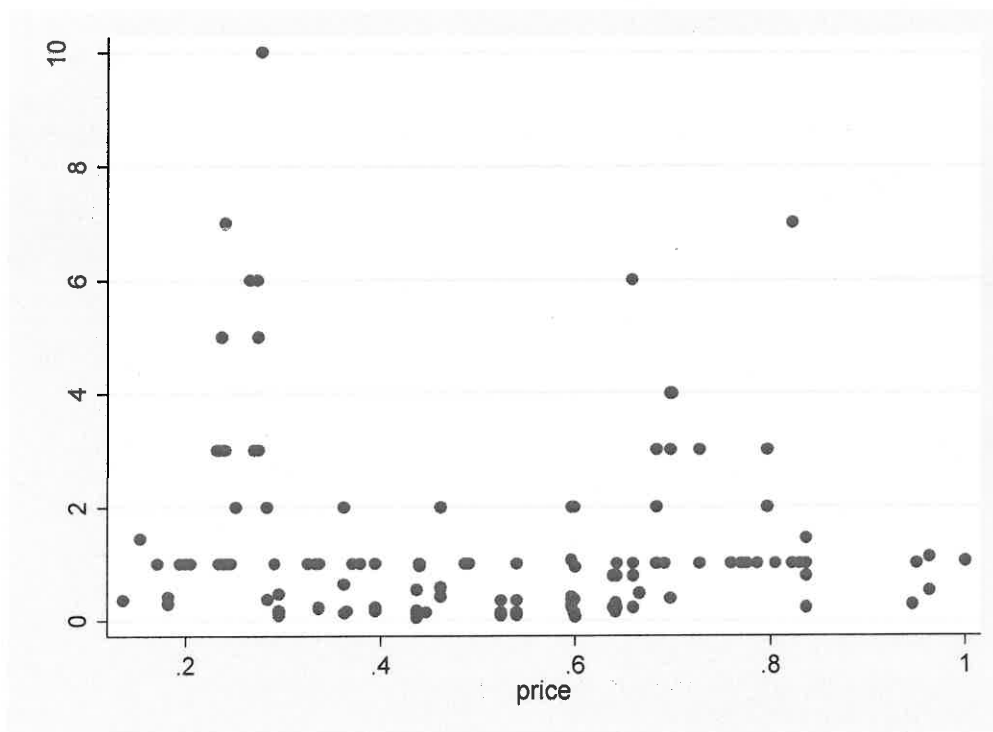


Radius 5

. reg conflict price if radius ==5

Source	SS	df	MS	Number of obs =	136
Model	4.39379293	1	4.39379293	F(1, 134) =	1.69
Residual	347.942226	134	2.59658377	Prob > F =	0.1956
Total	352.336019	135	2.60989643	R-squared =	0.0125
				Adj R-squared =	0.0051
				Root MSE =	1.6114

conflict	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
price	-.8430925	.6481218	-1.30	0.196	-2.124965	.4387794
_cons	1.707215	.3619373	4.72	0.000	.9913664	2.423064



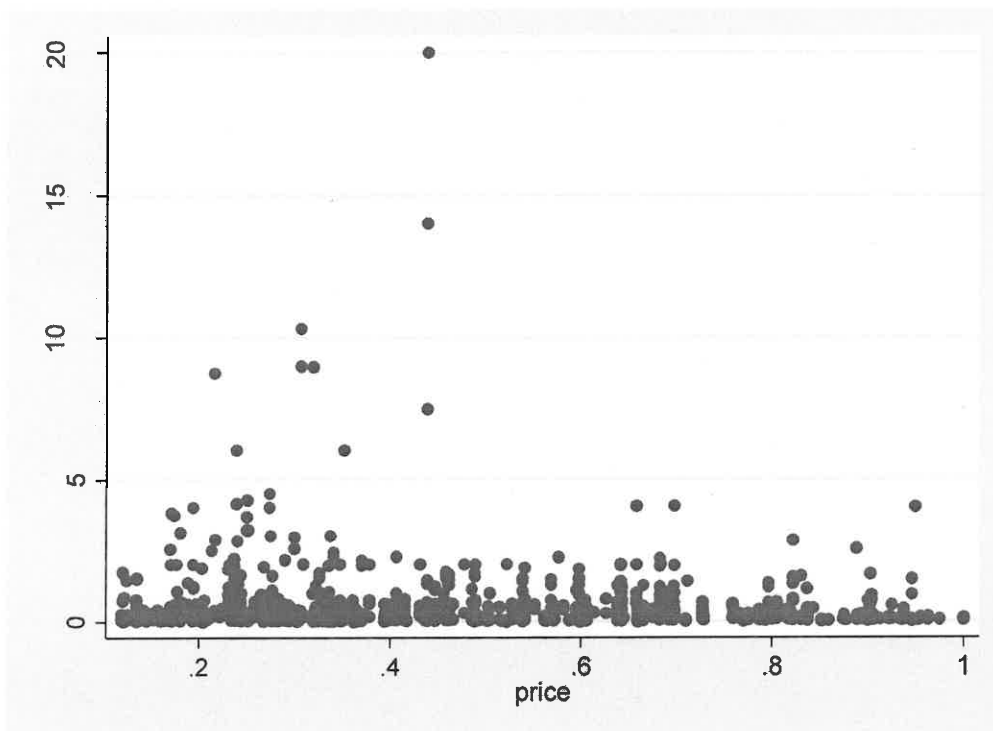
Radius 15

. reg conflict price if radius ==15

Source	SS	df	MS
Model	3.75028555	1	3.75028555
Residual	1535.67592	1983	.774420535
Total	1539.42621	1984	.775920467

Number of obs = 1985
 F(1, 1983) = 4.84
 Prob > F = 0.0279
 R-squared = 0.0024
 Adj R-squared = 0.0019
 Root MSE = .88001

conflict	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
price	-.2170672	.0986394	-2.20	0.028	-.410515 -.0236194
_cons	.4623798	.0487663	9.48	0.000	.3667413 .5580184



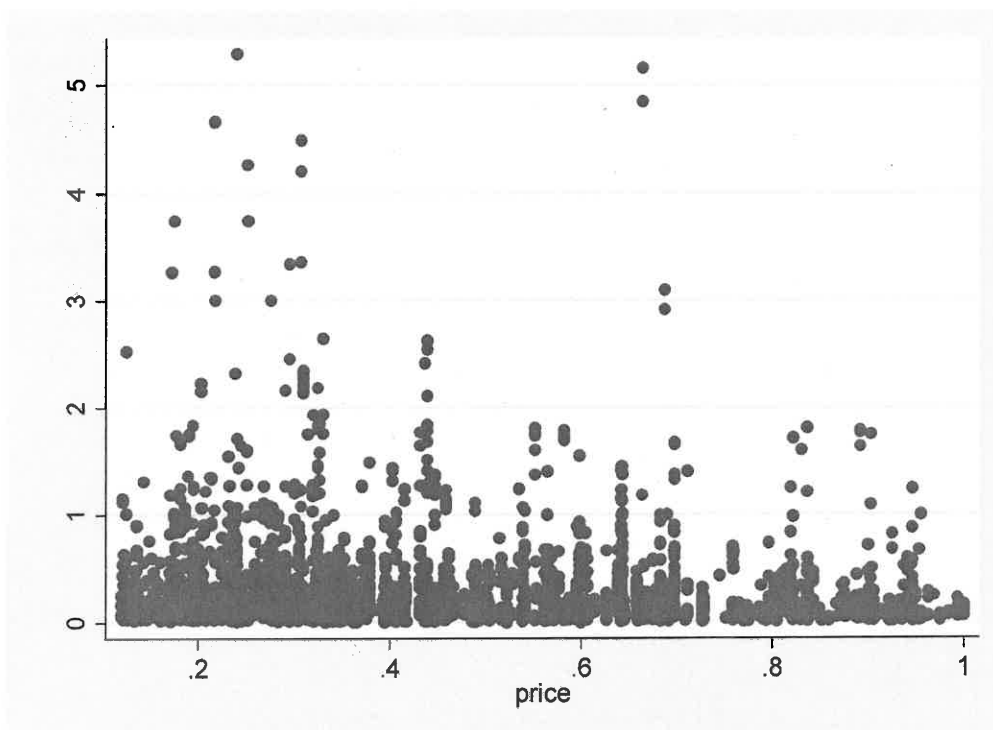
Radius 25

. reg conflict price if radius ==25

Source	SS	df	MS
Model	3.11309595	1	3.11309595
Residual	776.057171	5581	.139053426
Total	779.170267	5582	.139586218

Number of obs = 5583
 F(1, 5581) = 22.39
 Prob > F = 0.0000
 R-squared = 0.0040
 Adj R-squared = 0.0038
 Root MSE = .3729

conflict	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
price	-.11621	.0245606	-4.73	0.000	-.1643583 -.0680618
_cons	.2837868	.0120042	23.64	0.000	.2602539 .3073197



Cumulative Radius

. reg conflict price

Source	SS	df	MS
Model	4.88383843	1	4.88383843
Residual	2850.50875	7717	.369380427
Total	2855.39259	7718	.369965353

Number of obs = 7719
 F(1, 7717) = 13.22
 Prob > F = 0.0003
 R-squared = 0.0017
 Adj R-squared = 0.0016
 Root MSE = .60777

conflict	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
price	-.1239999	.0341018	-3.64	0.000	-.1908487 -.057151
_cons	.3419578	.0167621	20.40	0.000	.3090997 .374816

