Primary Commodities Exports and Civil War*

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Abstract

Collier and Hoeffler (2002) reported that countries with a higher percentage of national income from primary commodity exports have been more prone to civil war, an interesting finding that has received much attention from policy-makers and the media. I show that this result is quite fragile, even using Collier and Hoeffler's data. Minor changes in the sample framing and the recovery of missing data undermine it. To the extent that there is an association, it is likely because oil is a major component of primary commodity exports and substantial oil production does associate with civil war risk. I argue that oil predicts civil war risk not because it provides an easy source of rebel start-up finance, but probably because oil producers have relatively low state capabilities given their level of per capita income. An analysis of data on government observance of contracts and investor-perceived expropriation risk is consistent with this hypothesis.

1 Introduction

Paul Collier and Anke Hoeffler's paper "Greed and Grievance in Civil War" has had a major impact on both public debate and social science research on contemporary civil wars. First

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posted to a World Bank website in early 2000,[1] Collier and Hoeffler undertook a cross-national statistical analysis of civil war onset in 161 countries since 1960, and found that "the extent of primary commodity exports is the strongest single influence on the risk of conflict" (Collier and Hoeffler 2000, 25). By way of explanation, they argue that primary commodity dependence creates better opportunities to finance rebel groups and so enables rebellion.

This finding received widespread press coverage, garnering articles and editorial comment in *The Economist*, *The New York Times*, *The Washington Post*, and *The Financial Times*, among many other newspapers and magazines. Indeed, the study's main finding and the authors' interpretation of it may be the most widely reported result of any cross-national statistical study of civil conflict, *ever*.[2]

As *The New York Times* summarized the first version of the paper, the Bank

> found that the single biggest risk factor for the outbreak of war was a nation's economic dependence on commodities. Eagerness to profit from coffee, narcotics, diamonds and other gemstones both prompts outbreaks of violence and determines their strength over time, says the study. 'Diamonds are the guerrilla's best friend,' said Paul Collier, the author of the study and director of research at the Washington-based World Bank's economics department. 'Civil wars are far more

[1]The earliest draft I have is dated April 26, 2000. Several subsequent versions were posted to the Bank's "Economics of Civil War, Crime, and Violence" website (`http://econ.worldbank.org/programs/conflict`), and the most recent is forthcoming in *Oxford Economic Papers* (see Anke Hoeffler's website `http://users.ox.ac.uk/~ball0144/research.htm`). The core statistical model for the "Greed and Grievance" paper is presented in Collier and Hoeffler (2002*b*), and the data used for that article is available at Hoeffler's website. Collier et al (2003) report some of the main results of the "Greed and Grievance" paper along with many others in book form.

[2]See, for examples, Sathnam Sanghera, "Rebels Fight for Loot Not Causes," *Financial Times*, June 16, 2000, London Edition, p. 12; John Burgess, "Civil Wars Linked to Certain Economies; World Bank Cites Commodities' Role," *The Washington Post*, June 16, 2000, Final Edition, p. E03; Joseph Kahn, "World Bank Blames Diamonds and Drugs for Many Wars," *The New York Times* June 16, 2000, Late Edition, p. A14; G. Pascal Zachary, "Market Forces Add Ammunition to Civil Wars — Research Suggests Rebels Have 'Greed' as Motive; Primary Exports Count," *Wall Street Journal* (Eastern edition), June 12, 2000, p. A21;Martin Wolf, "How Civil War Plagues the Poor," *Financial Times*, December 27, 2000, London Edition, p. 13; Paul Cullen, "Money is Still at the Root of War Worldwide," *The Irish Times*, May 11, 2001, p. 55; Sebastian Mallaby, "A J.F.K. Approach to Terrorism," *The Washington Post*, November 26, 2001, Final Edition, p. A25; Tina Rosenberg, "To Prevent Conflicts, Look to Commodities Like Diamonds," *The New York Times*, July 15, 2002, Late Edition, p. A6; Tina Rosenberg, "The Year in Ideas; Peace Through Embargo," *The New York Times*, December 15, 2002, Late Edition, Section 6, p. 108; "The Global Menace of Local Strife - Civil Wars," *The Economist*, May 24, 2003, U.S. Edition; Daphne Eviatar, "How to Save Africa," *Newsweek*, September 22, 2003, Atlantic Edition, p. 44.

likely to be caused by economic opportunities than by grievance.'[3]

Collier and the media drew major policy implications from the finding. For example, "To reduce the occurrence of these wars, [Collier] suggests, countries should diversify their economies and visibly channel commodity income into social service programs, to undermine public support for rebels who seize the mines and farmlands. The world community, meanwhile, can help by refusing to do business with rebel groups."[4] In December 2002, *The New York Times* listed policy implications of the Collier and Hoeffler paper in its "The Year in Ideas" section: "Throughout Africa and in parts of Asia and Latin America, guerrillas finance their armies through the illegal export of commodities: timber, diamonds, oil and coca. Policy makers are now trying to encourage guerrillas to give up their fight by cutting off the money spigot. An embargo, they believe, can put rebels out of business or drive them to the negotiating table."[5] Begun in May 2000 and endorsed by the United Nations, the Kimberley Process to end trade in "conflict diamonds" is an important policy initiative consistent with Collier and Hoeffler's argument.[6]

For academic research agendas, Collier and Hoeffler's work has brought the question of rebel financing to the fore, a highly valuable contribution. In the literature on "contentious politics" and social movements, the idea that the "opportunity structures" facing would-be rebels are at least as important for explaining rebellion as relative deprivation or social grievances has been common for some time (Eisinger 1973; McCarthy and Zald 1977; Tilly 1978). But "opportunity structures" were never clearly specified for empirical examination in the case of civil war. Collier and Hoeffler took an important step forward by proposing to examine rebel organizations as businesses of a sort, and to measure possible determinants of their financial viability.[7]

In this paper I use the data from Collier and Hoeffler (2002*b*) to reassess the impact of primary commodity exports on the probability that a country has a civil war. Despite the claims made on behalf of this proxy for rebel "opportunity," other cross-national statistical studies have not noted a similarly strong relationship. In particular, Fearon and Laitin (2003) find no support for an independent effect of primary commodity export dependence on civil

[3]Kahn, "World Bank Blames Diamonds and Drugs for Many Wars."

[4]John Burgess, "Civil Wars Linked to Certain Economies."

[5]Tina Rosenberg, "The Year in Ideas; Peace through Embargo," citing Collier and Hoeffler's study directly.

[6]See `www.kimberleyprocess.com`.

[7]The "greed versus grievance" contrast has also framed discussion at a number of academic/policy-maker conferences on civil war. For example, the International Peace Academy-sponsored conference that produced Berdal and Malone (2000), and Sherman (2001). The Berdal and Malone project, which includes an earlier paper by Collier (1999), reflects parallel but more case-study based research by Keen (1998) and Reno (1998), among others. See also Ballentine and Nitzschke (2003).

war onset, despite using the same measure of commodity exports as Collier and Hoeffler and a fairly similar list of civil wars.

What accounts for the different results? Because so many things can vary across two statistical studies with "the same" dependent variable – such as specifics of the sample, model specification (which variables are included and how), measures, and estimation methods – it can be difficult to identify the reasons for conflicting findings. My procedure is to start by replicating the main regression results in Collier and Hoeffler (2002*b*). I then examine the impact of changing minor aspects of the sample frame and the model specification, one aspect at a time.

I find that one does not have to depart much from Collier and Hoeffler (2002*b*) before primary commodity exports cease to matter in statistical terms. Collier and Hoeffler group their data in five-year intervals, asking whether characteristics of a country at the start of the five-year period predict whether a civil war began during the period. Since the dependent variable, civil war onset, is measured at least annually, and because the choice of five-year periods is arbitrary, there is a strong case for using the country-year as the unit of observation rather than the country-five-year-period (for instance, Kenya in 1980 rather than Kenya from 1980 through 1984). Even without such an argument, the results on primary commodity exports should not depend on this choice of sample framing. But when the data are analyzed in a country-year format, the apparent impact of primary commodity exports largely evaporates.

There appear to be two main reasons. First, the country-year format makes lag times for several independent variables more consistent, and allows more consistent treatment of quickly renewed wars (see below). Second, the country-year format is less subject to "list-wise deletion" of civil war onsets due to missing data. Although there are 79 civil war starts in Collier and Hoeffler's civil war list, 27 of these, or about one third, are not used in their analysis due to missing data on an independent variable. When I reformat the data, 16 war starts return to the estimation sample, mainly because there is less missing data on prior economic growth rates when we use country years as observations. With these wars in the sample, primary commodity exports no longer significantly improve the model's ability to predict civil war onsets. In addition, the estimates for other independent variables change markedly. The effect of "social fractionalization" disappears,[8] and the estimated effect for primary commodities becomes smaller and more dubious when fractionalization or other statistically insignificant variables are dropped from the model.

A more systematic way of assessing the impact of list-wise deletion on Collier and Hoeffler's estimates is to use multiple imputation, a procedure developed by Donald Rubin (1987) that allows one to use all the information in a data set, including cases that have some

[8] A measure of the combination of ethnic and religious heterogeneity, discussed below.

missing data. With Collier and Hoeffler's five-year sample framing, the estimates for primary commodity exports weaken considerably when multiple imputation is used. They become insignificant by conventional standards when multiple imputation is used in the country-year framing.

Another finding is that the data do not support the proposition that civil war risk increases as primary commodity exports increase to about 35% of GDP, and declines thereafter. Collier and Hoeffler use such a parabolic specification, noting that few countries have more than 35% of GDP in primary commodity exports, so the relationship between civil war risk and commodity dependence is mainly positive. I use non-parametric methods to examine what the data themselves "say" about the functional form of the relationship, and find almost no support for an increasing-then-decreasing pattern. Rather, it looks as if primary commodity exports increase civil war risk at a decreasing rate, so that using the logarithm is better justified than fitting a upside-down "U." This also requires fewer contortions in the theoretical argument advanced to rationalize the impact of primary commodity exports. Nonetheless, the log of primary commodity exports remains an insignificant influence on civil war outbreak in the country-year model.

What should we make of all this? Despite the lack of a sharp relationship between primary commodity exports and civil war outbreak, I believe that the main theoretical claim that Collier and Hoeffler sought to support is most likely correct. Better rebel funding opportunities probably do imply a greater the risk of civil war, other things equal. But there is little reason to expect that primary commodity exports as a percentage of GDP are a good measure of rebel financing potential.

Contrary to the implication of the World Bank's press releases summarizing "Greed and Grievance," the World Bank measure used by Collier and Hoeffler does not include diamonds and other gems, and of course it does not reflect drug production. Instead, the measure seems to pick up mainly cash crops (like coffee or wheat) and oil exports.

Large profits from cash crops or oil require control of a national distribution or production system, which rebels lack.[9] To profit substantially from these sources of income, rebels must turn to smaller-time extortion, or to what Michael Ross (2004) calls "booty futures" (rebels selling future resource exploitation rights to foreign companies or states).

Small-time extortion (from the rebels' perspective, taxation) of local agricultural producers certainly does occur. But my own reading of the case literature, for what it is worth, does not suggest that cash crops or oil production are critical for this.[10] And looking at a set

[9]On this point see also Snyder and Bhavnani (2005) in this volume.

[10]In none of Michael Ross' 13 "most likely" cases was there evidence that rebel "looting" based on legal agricultural commodities or oil helped finance rebel start-up costs.

of 13 "most likely cases," Ross finds only one in which booty futures in oil helped finance a rebel group's start up costs (Congo Republic in 1997); it seems unlikely that this mechanism is very common. There is, then, little reason to think that cash crops or oil production are good measures of the availability of rebel financing. In addition, at least one theoretical consideration cuts the other way: primary commodity exports provide *governments* with a relatively easy source of tax revenue, which may counterbalance or offset increased extortion possibilities for rebels.

I argue that an empirically more plausible and internally consistent explanation is that oil exporters are more prone to civil war because they tend to have weaker state institutions than other countries with the same per capita income (Fearon and Laitin 2003). States with high oil revenues have less incentive to develop administrative competence and control throughout their territory. So while oil revenues help a state against insurgents by providing more financial resources, compared to other countries with the same per capita income they should tend to have markedly less administrative and bureaucratic capacity. In addition, easy riches from oil make the state a more tempting prize relative to working in the regular economy.

Empirically, I show that it is difficult to distinguish the apparent impact of primary commodity exports from oil exports, and that oil exports are somewhat more strongly related to civil war risk than other primary commodity exports in the country-year framing. A similar theoretical argument may apply for non-fuel primary commodities – heavy dependence on taxation of primary commodities at the border may associate with weaker state institutions, on average. Using a measure of investor perceptions of the risk of different governments' reneging on contracts, I find that oil producers are indeed seen as having less reliable state institutions given their incomes, while the effect of other primary commodities is marginal but in the right direction.

The article is structured as follows. In the second section, I introduce the Collier-Hoeffler data set (from Collier and Hoeffler 2002*b*) and its measure of primary commodity exports, known for short as *sxp*. The third section compares the results with five-year periods to country years, and undertakes several other robustness checks. The fourth section considers results when missing values are multiply imputed, and the fifth looks at the effect of controlling for oil exports in addition to primary commodities in general. The sixth section develops the alternative hypothesis mentioned above: the (weak) relationship between primary commodity exports and civil war onset may be due to primary commodity exports being a noisy measure of low state capability given income, especially via fuel exports. A brief conclusion considers policy implications.

2 *sxp* and Collier and Hoeffler's data set

2.1 The sample and the dependent variable

Collier and Hoeffler (2002*b*) employ a data set consisting of 161 countries observed for each of the eight five-year periods beginning in 1960-64 and ending in 1995-99. This makes for a "potential sample" of $161 \times 8 = 1288$ observations. The 161 countries are 150 of the 152 countries from the Penn World Tables (PWT) economic data base,[11] plus 11 additional countries for which Collier and Hoeffler coded a civil war beginning at some point in 1960-99. These latter cases do not appear in the estimation sample (the cases with complete data used in the statistical analysis) because they lack economic data. There is some reason to worry about the implicit selection rule here. Big civil wars cause states to have trouble collecting economic data, which in turns lowers the odds that the country will appear in PWT. Thus, the cases are partly selected on the dependent variable, which will tend to bias effect estimates.

The potential sample also contains 151 observations such as "Azerbaijan 1960-64" – country five-year periods during which the "country" was not an independent state. It is difficult to imagine a good rationale for including such territories separately from the states that had sovereignty over them at the time, and doing so raises questions about why include these territories and not others (for instance, why not California, or Chechnya?). Fortunately, the question is largely moot since all but 15 of these cases are dropped from the estimation sample due to missing economic or other data.[12]

Collier and Hoeffler wish to examine the determinants of civil war *onset*, and thus code a dependent variable that equals "1" if a civil war started in the country-five-year-period in question. They drop from the sample country-periods in which a civil war was ongoing, *provided that no new war started in the same five-year period*. For example, Afghanistan 1990-94 is coded as having a civil war start, due to the post-Soviet war for Kabul that began in 1992. If, however, this war had not occurred, Collier and Hoeffler would have coded Afghanistan 1990-94 as missing data, since the anti-Soviet-backed-regime war that ends in 1992 was ongoing during part of 1990-94, and this is the rule they apply otherwise for country-periods in which a civil war is ongoing. For instance, the war in Cambodia is coded as ending in 1991, and Cambodia 1990-94 is coded as missing data due to the ongoing war at the start of the period. This procedure removes from the potential sample the 66

[11] East Germany and Dominica were dropped.

[12] The non-independent territories that appear in the estimation sample are Cape Verde 1965-74, Fiji 1965-69, Namibia 1965-89, Papua New Guinea 1965-74, Reunion 1975-89, and Suriname 1965-74. All 15 of these cases are coded as "at peace," although Correlates of War codes an "extra-state" war that started in 1975 in Namibia. Since other "extra-state wars" are included, this may be a coding error.

country periods with a somewhat durable post-war peace, while 12 country periods with a quickly renewed (or new) war are included. It is difficult to say what kind of bias this procedure might introduce, if any.[13] But it is worth noting that the treatment of periods with an ongoing civil war is not symmetric and depends on whether peace prevailed for one to five years after the war's conclusion.[14]

The estimation sample consists of only 750 out of the 1288 country periods that make up the potential sample – forty two percent of the "potential sample" is lost due to "list-wise deletion" of cases that are missing data on one or more independent variables (31% if we consider only post-independence country periods). The main source is missing economic data, and particularly that needed to estimate the average growth rate in per capita income in the previous five-year period (the period 1960-64 disappears from the estimation sample for this reason).[15] As Rubin (1987), and more recently in political science King, Honaker, Joseph and Scheve (2001) have stressed, list-wise deletion is always inefficient and causes biased estimates except in the unlikely event that the missingness is "completely at random." Twenty-six of the 78 civil war onsets in the potential sample (33%) are missing cases, which is worrisome given that civil war onsets are relatively rare in these data and thus have a greater impact on the estimates than "zero" cases do.[16] Twenty-four of the 26 cases lack data on economic growth in the previous five-year period.

[13]Dropping periods of ongoing war artificially increases the mean of the dependent variable (onset) for countries that had a war, and especially for countries with multiple onsets. The experience of countries that had at least one civil war onset may thus be overweighted in the logit analyses.

[14]Why drop the 80-odd periods with an ongoing civil war at all? A natural alternative is to code these as zeros, since no new civil war started although one could have. Concurrent civil wars in a single country appear in most civil war lists, though not in the COW-based list used by Collier and Hoeffler. (They would occur in this list if anticolonial wars were coded in the colonial empire rather than in the colony.) Of course, if one civil war is already in progress in a country, the risk of another one starting will probably be lower. But if so, why not estimate this effect rather than drop the cases (as in Fearon and Laitin (2003))? This happens to be impossible with the COW-based list used by Collier and Hoeffler because "civil war in progress" would perfectly predict the lack of onset of a new war, which causes a problem for the maximum-likelihood methods of logit or probit. So this is perhaps a pragmatic argument for Collier and Hoeffler's coding procedure given the absence of concurrent wars in their war list.

[15]Note also that the five-year period design also implies that the "lagged" growth rate can be rather far from the war start in question, for instance if the war starts in 1994 the growth rate estimate comes from 1985-89.

[16]King and Zeng (2001) note that with a "rare event" such as a civil war onsets (relative to periods without onset), additional events are more statistically informative in that they have a bigger impact on the estimated variance-covariance matrix.

2.2 *sxp*

The main independent variable of interest in "Greed and Grievance" is a World Bank measure of primary commodity exports as proportion of GDP, known as *sxp*. Measured at five-year intervals starting in 1960 and missing for only 125 of the 1288 potential cases, *sxp* has a mean of .16 and a median of .11, indicating the highly skewed distribution shown in Figure 1.[17] Most of the variation in *sxp* (75%) is due to different average levels of primary commodity exports across countries. The remaining quarter is due to variation over time within countries.

The measure covers exports of goods classified in five categories of the Standard International Trade Classification, listed in Table 1, which also gives examples of goods found in each category. The measure does not include precious gems such as diamonds (which are found in SITC 66, Non-metallic mineral manufactures), or, of necessity, contraband narcotics, both of which have been noted as sources of rebel funding in the case-study literature.

2.3 *sxp* and fuel exports

An oil exporting country's per capita income does not reflect its level of bureaucratic development as well as would the same income level for a non-oil country. Fearon and Laitin (2003) argue that if per capita income is related to civil peace because it is mainly a measure of state police and bureaucratic capability, this implies that oil exporters should have a higher civil war risk than one would expect on the basis of income. Additionally, oil exports are an easy source of huge revenues for whoever controls the state (in contrast to, say, developing an effective income tax apparatus). This increases the value of the "prize" of controlling the state.[18] Fearon and Laitin (2003) find that countries with more than one third of their export revenues from fuels have roughly twice as great an annual risk of civil war onset (controlling for income and other covariates). Using new data on oil production and reserves (versus oil export revenues), Humphreys (2005) likewise finds strong link. Similarly, Collier and Hoeffler (2002*a*, 12) note that "Of the many potential disaggregations of primary commodity exports permitted by [their] data, only one was significant when introduced into our baseline regression, namely oil versus non-oil."

Perhaps primary commodity exports appear to matter not because they indicate rebel

[17]Six country-periods have an *sxp* estimate greater than 1 (Bahamas 1960-80 and Bahrain 1980). The Bahamas' values are probably a World Bank coding error, as the values go from 2.16 in 1980 to .26 in 1985, and stay below .26 afterwards; possibly before 1985 the decimal point is one space too far to the right. In any event, all six cases are dropped from the estimation sample due to missing data on other variables.

[18]Humphreys (2005) discusses a number of other hypothetically possible mechanisms.

financing potential but because they correlate with oil production, which marks state weakness conditional on income, or affects civil war risk via some other mechanism. Alternatively or in addition, the same mechanism may operate for primary commodity exports that Fearon and Laitin (2003) postulate for oil. Conditional on per capita income, a country that derives a greater share of national income from primary commodity exports may have a relatively weak state apparatus. High dependence on primary commodity exports may associate with the thin "extractive institutions" that Acemoglu, Johnson and Robinson (2001) argue explain poor economic growth performance. Collier and Hoeffler (2002*a*) find that *sxp* seems to matter even when they control for the fuel export component of *sxp*, an issue I consider below in the context of different sample framings.

The bivariate relationship between primary commodity exports as a percentage of GDP and fuel exports as a percentage of GDP is fairly strong. For the 632 cases in the Collier and Hoeffler potential sample with data on both variables, the correlation is .79; see Figure 2 for the scatterplot.[19] As Figure 2 suggests, this fairly strong correlation is due to the fact that both variables are skewed and the countries that score highest on both measures are major oil producers. However, the correlation remains non-trivial even if we restrict attention to countries with less than, say, 40% of their GDP from fuel exports (the correlation is then .43). As I argue further below, in so far as *sxp* appears related to civil war onset, this may be because of its relationship to oil production.

3 Primary commodity exports and civil war onset

Model 1 in Table 2 replicates the main model in Collier and Hoeffler (2002*b*). The control variables are the log of per capita income in the first year of the five-year period; average annual growth rate of income for the prior five-year period; "social fractionalization," a combination of two measures of ethnic and religious heterogeneity;[20] "ethnic dominance," a dummy variable marking states whose largest ethnic group is between 45 and 90% of total population; peace years, the number of months since any prior civil war ended (begun at 172

[19]I constructed fuel exports as a percentage of GDP by multiplying fuel as a percentage of export revenues by exports as a percentage of GDP, both from the World Bank's World Development Indicators. Notice that a number of observations lie below the 45 degree line in Figure 2, which should be impossible since fuel exports should be a component of total primary commodity exports (*sxp*). Evidently there are some discrepancies in the fuel export revenue data used for *sxp* and for the published fuel export measure.

[20]Collier and Hoeffler (2002*b*, 26-27) construct this measure by multiplying together two 0-to-100 scales of ethnic and religious heterogeneity, and then adding the maximum of the two scales. They argue for this functional form on the grounds that they found it to be (empirically) "superior to variants" in an early version of the "Greed and Grievance" paper. I divide by 100^2 so that the estimated coefficient is more readable.

in 1962 for states with no prior war, this being the number of months since the end of World War II); the log of total population in the first year of the five-year period; and a 0-to-1 measure of the geographic dispersion of the population within the country, higher values of which indicate more concentrated settlement patterns. See Collier and Hoeffler (2002*a*) for details on the sources and construction of these variables, and arguments for why they should be in the model as predictors of civil war onset.

The main concern here is with the results for the primary commodity measures, *sxp* and its square. A likelihood ratio test confirms what the individual p-values suggest: the odds that adding primary commodity exports to the model in this manner has improved the fit of the model by chance are estimated at less than one in a thousand. The coefficients attenuate a bit more than 20% if we drop ethnic dominance and geographic dispersion from the model, though statistical significance remains. If we have only *sxp* and its square in the model and nothing else, the estimated relationship appears considerably weaker, though still quite unlikely to be due to chance. When the log of country population is added, the estimated coefficients on primary commodity exports come close to their values in Model 1. This is because larger countries tend to have low commodity exports as a percentage of GDP, but a greater civil war risk. Table 3 takes a less parametric approach, showing the proportion of country five-year-periods that had a civil war start, by treciles on both country population and primary commodity exports as a share of GDP. It shows that the association between commodity exports and civil war onset holds only for larger countries.

The implied substantive impact of primary commodity exports based on Model 1 is considerable. Holding other variables at their median values, the estimated probability of civil war onset rises from .011 at the 10th percentile of *sxp*, to .031 at the median, to .11 at the 90th percentile. The slight decline at high levels of *sxp* implied by the squared term only begins around the 90th percentile of *sxp*, which is 39% of GDP from primary commodity exports.

3.1 Do very high levels of commodity exports lower civil war risk?

Although Collier and Hoeffler's parabolic specification of the impact of primary commodity exports on the log odds of civil war produces statistically significant results, so does using, for example, the log of *sxp*. Statisticians have developed less parametric methods that enable us to examine what the data themselves "say" about the form of the relationship between civil war risk and primary commodity exports.[21] Figure 3 plots the results of a generalized additive model (GAM) version of Collier and Hoeffler's core specification, in which we estimate the form of the effect of *sxp* on the log-odds of civil war directly.

[21]Conditional, of course, on the rest of the model. See Beck and Jackman (1998) for an introduction written for political scientists.

Given the size of the 95% confidence interval above 50% of GDP from primary commodity exports, there is scarcely any indication of a parabolic, increasing-then-decreasing relationship. Figure 3 also makes clear why adding squared *sxp* improves the fit of the model. A straight line fit to the data would average across the steep part where most of the cases are, and the flat part where the small number of extremely high *sxp* cases are. Figure 3 suggests that, based on the Collier and Hoeffler model, the probability of civil war is increasing in *sxp* up to about 20 or 25% of national income, and then essentially flat above this. So the actual relationship in the data is better approximated by the log of *sxp*. Model 2 in Table 2 shows the relevant results. A one percent increase in primary commodity exports in GDP is estimated to associate with a one percent increase in the odds of civil war outbreak.[22]

Collier and Hoeffler suggested that the increasing-then-decreasing pattern was due to higher primary commodity export shares initially favoring rebels, but ultimately favoring the state due to higher tax revenues. While one can propose a model that makes functional form assumptions to rationalize this pattern, one can also easily design a model in which the two effects simply offset each other, yielding no correlation. If one thinks primary commodity exports indicate an economy that more easily supports rebel financing, then it is easier to explain a logarithmic relationship. Still, if one also thinks that primary commodity exports increase resources available to governments, then we still need an explanation for why this wouldn't offset the additional support provided to rebels.

3.2 Country years versus five-year periods

Why choose five-year periods starting in 1960 rather than 1961, or 1962 (etc.)? Are the results sensitive to this arbitrary choice? Civil war onset, the dependent variable, is measured at least annually in this and most other civil war lists, as are income, income growth, population, and peace years. The available measures of social fractionalization, ethnic dominance, and geographic dispersion are time invariant or close to it. Thus using country years as the unit of analysis would seem more appropriate. In addition, a country-year framing avoids the problems with coding quickly renewed wars discussed in section 2.1 above, and allows consistent and brief lag times for income per capita, economic growth, population, and peace years.[23]

The one consideration that arguably favors using five-year periods is that *sxp* is measured at five-year intervals beginning in 1960. However, as noted above, three quarters of the variation in *sxp* is across countries, and *sxp* in year t is well correlated with *sxp* in year $t-5$

[22]The overall fit of the model is better as well, as judged by the Akaike Information Criterion.

[23]Seventeen wars in the Collier and Hoeffler list start in a year that is divisible by five. For these, there is no lag at all in the five-year set up for income per capita and population, which raises a mild concern about endogeneity.

($r = .85$). Thus filling in the missing years with a linear interpolation or spline is certainly a defensible approach to dealing with the missing data.

I constructed a country-year version of the Collier and Hoeffler data, interpolating values for primary commodity exports.[24] Model 3 in Table 2 shows the results using the country-year framing and the same set of independent variables as in Collier and Hoeffler (2002*b*). The estimated coefficients cannot be directly compared to those reported in the five-year period design, since the dependent variable is different (log odds of war onset in the next year versus in the next five years). The changed significance levels, however, suggest that the model may fit the data less well. Note that the estimated coefficient for fractionalization falls by a factor of three and is no longer remotely significant, and the estimated coefficient for geographic dispersion is now much closer to zero. The p values for *sxp* and its square have increased, and the relevant likelihood ratio test fails to reject the null hypothesis that their contribution to the model is due to chance at the 5% level ($p = .081$).

Also worrisome is that the estimated coefficients for *sxp* and sxp^2 are now quite sensitive to minor changes in the model's specification. Models 4, 5, and 6 in Table 2 drop, in succession, the fractionalization, ethnic dominance, and geographic dispersion variables, which showed little or no sign of a statistically significant relationship to civil war onset in Models 1 or 3. In fact, dropping *any* of these three variables, singly or in any combination, leaves a model in which we cannot reject the null hypothesis that primary commodity exports and their square are statistically unrelated to civil war risk (using the likelihood ratio test and a 10% threshold). As Models 5 and 6 in Table 2 illustrate, the lack of statistical significance can be substantial.

Table 4 presents models using the logarithm of *sxp* rather than the parabolic specification adopted by Collier and Hoeffler. Primary commodity exports now cease to show a statistically significant effect at the 5% level even when all control variables are included (Model 1), with even smaller coefficients and significance levels when we drop the more dubious of the controls (Models 2 and 3).

[24] To avoid implausible extrapolations, I extended the first or last measured value forward or backward as appropriate. With few exceptions, this means using the *sxp* value for 1995 for years after 1995. When I tried extrapolating for these years, the results are less favorable to primary commodity exports. Following Collier and Hoeffler, I replicated or interpolated the values for social fractionalization, ethnic dominance, and geographic dispersion into missing years, since these either do not vary in time or vary only in one year (geographic dispersion). For missing income, growth, and population data, I employed the same procedure as Collier and Hoeffler, using World Bank-estimated growth rates to extend Penn World Tables income data forward past 1992 (see Fearon and Laitin (2003) for a discussion of the income and population sources used here). In constructing the new data set, I found some coding errors in the Collier and Hoeffler data, particularly in the "peace years" variable. It appears that no consistent rule is applied for whether peace years should be counted to the start of the five-year period or the start of a war that begins during the five-year period. I did not correct these errors in the country-year version to ensure comparability. I also doubt that doing so would have much effect.

These results do not rule out the possibility that higher levels of primary commodity exports (at least up to a point) cause a country to have a higher risk of civil war onset. However, the strength of the observed association depends heavily on the choice of sample framing and control variables, something that is far less true of other variables in the model, such as per capita income, country population, years of peace, and economic growth rate. Given the great uncertainty about what variables should be included in a statistical model of civil war risk in principle, we can say that higher primary commodity exports are not robustly associated with higher risks of civil war, even in Collier and Hoeffler's own data.[25]

4 Multiply imputing missing data

What accounts for the weaker results in the country-year framing of the data set? One possibility is that merely by making the lag times and treatment of successive wars consistent, we have gotten rid of accidents that produced apparent "significance" in the five-year period set up. Another possibility is that the country-year framing allows more efficient use of the data (that is, fewer missing observations). Notice that the number of wars in the estimation sample rises from 52 in the five-year period analysis to as many as 73 (of 78) in the country-year analysis. This is largely because the latter loses fewer cases due to missing data on the lagged economic growth rate.

By using multiple imputation we can gain insight into how much of the "significance" of primary commodity exports is due to list-wise deletion of observations due to missing data. Table 5, Model 1, uses the five-year period framing and the same specification as in Table 2, Model 1, but multiply imputes missing values so that information from all 1,288 cases in the "potential sample" can be used.[26] The dependent variable – the log odds of civil war outbreak in the next five years – is the same, so the coefficients may be directly compared. (The percentage of cases with a civil war outbreak is also very similar for the observed and imputed data, at about 7%.)

[25]It is particularly striking that it is only by including controls that do not themselves appear strongly or at all related to civil war risk that primary commodity exports begin to appear to have a consistent impact. Another sharp difference between results for the five-year-period and country-year framings concerns the application of conditional fixed effects: *sxp* and sxp^2 are strongly significant even with fixed effects in the five-year period set up, but not at all with fixed effects and country years.

[26]Only 1,063 cases are used in the logit. Before making the data sets with imputed values, I dropped the 121 pre-independence country periods and the three countries that were never formally independent. I also drop from the estimation the country periods during which a war is in progress, since they are "missing in principle" in Collier and Hoeffler's set up rather than for lack of information. I think these are the most justifiable decisions, but in any event, the results were slightly worse for primary commodity exports when I imputed on the basis of all 1,288 cases in the potential sample. See the Appendix for details on the imputation model.

Overall, the Collier-Hoeffler statistical model performs worse when all cases with some data are used in the estimation. Several of the coefficient estimates move noticeably towards zero, although standard errors also fall a bit, reflecting the efficiency gains from using more data. Among the initially "significant" variables, primary commodity exports and their square show the largest percentage changes – the estimates for the effect of primary commodity exports drop a factor of two when we avoid list-wise deletion.[27] Substantively, whereas going from the 10th to 90th percentile on *sxp* associates with a change in risks from 1.1% to 11% in Collier and Hoeffler's set up, with the missing data model the corresponding spread is 2.3% to 7.4%. Statistical significance also weakens somewhat, especially for sxp^2. Model 2 in Table 5 shows further deterioration in the estimated effects for primary commodity exports when we drop statistically the insignificant measures for fractionalization, ethnic dominance, and geographic dispersion.

Models 3 and 4 in Table 5 show the analogous logits for multiply imputed data in country-year format. Here we see a more marked reduction in the significance levels of the primary commodity export variables. It appears that both list-wise deletion and idiosyncracies of the five-year period format, contributed to the apparent strength of the association between primary commodity exports and civil war risk in Collier and Hoeffler's analysis.

5 Oil or primary commodity exports?

As discussed above, oil exports are a major component of primary commodity exports for a number of countries, and the two variables are moderately well correlated. Collier and Hoeffler (2002*a*) report that high oil dependence associates with higher civil war risk than one would expect on the basis of other primary commodity exports alone, although the effect for the other commodities persists. Using the data from Collier and Hoeffler (2002*b*) in the five-year period format, I find that the measures of primary commodity exports remain reasonably stable when I add a variable for fuel exports as a percentage of total exports (see Table 6, Model 1). This result depends to some extent on having the statistically insignificant variables coding geographic dispersion of population and ethnic dominance in the model, as shown in Table 6, Model 2.

In the country-year framing, however, oil and primary commodity exports trade places. Table 6, Model 3 shows that neither oil nor *sxp* and its square are particularly impressive when all three included in the country year set up; Model 4 shows a similar result when I use the log of *sxp*. Table 6, Model 5 shows that when we drop the more marginal variables, primary commodity exports are statistically insignificant while there is stronger support for

[27]The marginal effect of *sxp* on the log odds of civil war outbreak at the median level of *sxp* (.11) reduces from 11.54 (Table 2, Model 1) to 5.72 (Table 5, Model 1).

a non-random association between high oil exports and civil war risk.

6 Primary commodity exports and state strength

Collier and Hoeffler's theoretical argument for expecting a strong relationship between primary commodity exports and civil war risk is that primary commodity exports measure rebel financing opportunity. This argument is problematic for two main reasons. First, *sxp* is comprised mainly of cash crops and fuel exports. Both require control of a national distribution system to exploit, which rebel groups almost never have (Fearon and Laitin 2003, 87). It is conceivable that cash crop and oil exports happen to be correlated with the presence of drugs and precious gems that have been observed to finance rebel groups in a number of conflicts around the world. But we have no good reason to expect that this is the case.[28]

Second, even if production of primary commodity exports does raise opportunities for "war taxation" by rebel groups, it also provides the government with a relatively easy source of tax revenue. Why should rebels be more favored by this source of revenue than the government? There may be an argument here for drugs or alluvial diamonds, but if anything it would seem to work the other way for cash crops and fuel exports.

An alternative hypothesis is that higher dependence on primary commodity exports for national income marks weaker state institutions, on average, for a given level of income. This argument has often been made with respect to oil producers (Karl 1997; Fearon and Laitin 2003; Wantchekon 2000). As Terry Karl (1997, 61) writes, "Given their access to easy revenues from petroleum, few [oil exporters] sought to supplement state income through substantial increases in domestic taxation. ... high stateness in this arena [running the oil industry] occurred at the long-term expense of their capacity to build extensive, penetrating, and coherent bureaucracies that could successfully formulate and implement policies."

The same general argument might extend, with less force, to non-fuel primary commodities. As with oil, other primary commodity exports require national collection and marketing systems that make state taxation relatively easy. Acemoglu, Johnson and Robinson (2001) argue that where settlement was not a good option due to disease, colonial regimes set up "extractive institutions" designed to do little more than tax commodity exports. Robert Bates (1981) describes how the commodity marketing boards designed by the

[28]Moreover, recent work by Lujala, Gleditsch and Gilmore (2005) and Humphreys (2005) casts doubt on the strength and nature of the link between diamonds and civil war. Lujala et al. find little evidence that diamond deposits are systematically associated with an elevated risk of onset (although alluvial diamonds may be related to higher risks of "ethnic" war onset). Humphreys finds a strong relationship both in Africa and globally between level of diamond *production* and civil war risk, though he argues that the data do not support the mechanism suggested by Collier and Hoeffler (easier rebel finance).

colonial regimes in Africa were often the sole basis for state revenue and patronage after independence, and provided little incentive for urban-based elites to pursue constructive rural development strategies. Although the institutional infrastructure required for cash crops is more extensive and socially penetrating than for "enclave" mining industries, it could be that high dependence on primary commodity exports marks states with less developed administrative capacities given their income.

Unfortunately, we lack good direct measures of a state's administrative capability and integrity. Acemoglu, Johnson and Robinson (2001) and others have used information from surveys of investors on the risk of expropriation and repudiation of government contracts in different countries (Knack and Keefer 1995). These are measured for about 120 countries between 1981 and 1994 on a scale of 0 to 10, with higher values indicating *lower* risks of expropriation or repudiation of contracts. Not surprisingly, these measures are highly correlated with per capita income. If, for a given level of income, primary commodity exports associate with weaker states, then we would expect the partial correlation (controlling for income) between the contract repudiation or expropriation measures and *sxp* to be negative.

Table 7, Model 1 reports the regression of the measure of contract observance on logged primary commodity exports and logged per capita income for the 115 countries with data.[29] As expected, for a given level of income, states with greater primary commodity dependence are perceived as less reliable by investors, on average, although the substantive impact is not large.[30] When we add fuel exports as another measure of state weakness conditional on income (see Table 7, Model 2), the estimated coefficient for primary commodity exports more than halves, and becomes statistically insignificant.

So oil exporters have significantly weaker states given income per capita, according to this measure of state weakness. But while exporters of other primary commodities have marginally less reliable governments on average, the effect is not very consistent.

[29]Contract observance is averaged for each country over the available data from 1982 to 1995; there is very little variation over time within countries, and there is no theoretical reason to expect that short-term fluctuations in primary commodity exports measure changes in state capacity in the sense described. Log of income is averaged over post-1979 values for each country, and log of *sxp* is averaged over all values. I also considered the measure of risk of expropriation, which gives nearly identical results.

[30]Moving from the 10th to the 90th percentile on *sxp* is estimated to associate with a drop of .75 on the 10-point scale for contract repudiation risk, or about half of one standard deviation.

7 Conclusions and policy implications

Four main conclusions emerge from the preceding analysis. First, the empirical association between primary commodity exports and civil war outbreak is neither strong nor robust, even using Collier and Hoeffler's (2002a, 2002b) civil war codings and model specifications. Second, in so far as there is some association, this is due in part to the inclusion of fuel exports in the primary commodity measure, which are more robustly related to conflict onset. Third, it seems unlikely that oil exports (or cash crops) predict higher civil war risk because oil provides better financing opportunities for would-be rebels. It seems more likely that high oil exports indicate a weaker state given the level of per capita income, and possibly a greater "prize" for state capture, both of which might favor civil war. Similar considerations may apply for non-fuel commodity exports.

Fourth, there is direct evidence that oil exporters have less reliable and competent states given their income levels, and weaker evidence that this is true on average for exporters of other primary commodities.

What implications do these findings have for policy? We should begin by distinguishing two questions. First, do natural resource rents help finance rebel groups who are *already engaged* in fighting a civil war? Second, does the availability of natural resources rents increase the odds that a civil war *will begin* in a country?

Regarding the first question, it is just common sense that if, in a particular civil conflict, a rebel group is financed by the "looting" of natural resource rents, then a plausible policy option for helping to end the war is to try to cut off this source.[31] From case studies it is clear that rebels sometimes do obtain finance this way, and Fearon (2004) finds that rebel finance from contraband is strongly associated with longer civil war duration. So policies to eliminate the sale of "conflict diamonds," to secure oil pipelines, or to reduce demand and supply of narcotics are natural possibilities for such cases.

Regarding the second question, oil exporters do seem to have been more disposed to civil war outbreaks, but the evidence that the same is true for countries highly dependent on other primary commodities (including gems) is weak. Further, it is not clear what mechanisms underlie the oil-conflict nexus (Humphreys 2005). If, as argued here, oil proxies for weak state administrative capabilities at a given level of income, or if oil makes for trouble by raising the "prize" value of state control, then policies to involve international institutions in the monitoring and management of weak states' oil revenues could help break the link. The World Bank has recently attempted to negotiate monitoring and management arrangements as a condition for supporting pipeline development in southern Chad. Outside experts are

[31] Of course, one also needs to assess whether the rebel group offers less prospect of good governance than the government in power, which is not always the case.

skeptical that this specific deal will work, but the general idea seems worth pursuing based on the empirical findings about oil and conflict.[32] For weak states that are already exporting large amounts of oil, the IMF, World Bank, or a new international institution could offer a standardized external monitoring and management service that the state could publicly commit to. If a weak-state oil producer holds elections, the existence of such an option could inspire or drive candidates to compete for voter support by declaring a willingness to commit to the international package.[33]

It remains reasonable, on both theoretical and anecdotal grounds, to think that the availability of finance for would-be rebels affects a country's prospects for civil war. We still do not know, however, if rebel finance is a "critical constraint" that varies a great deal from place to place, or if it is easily satisfied provided other conditions are satisfied (e.g., weak central government with little rural presence, a sudden increase in grievances due to changed government policy, or a prevalence of unemployed young males). Indeed, we still know little about the sources of rebel groups' incomes. How much comes from local donations and "revolutionary taxes," how much from foreign governments or companies, how much from diasporas? This is difficult information to gather, although interesting work by Weinstein (2005) and Humphreys and Weinstein (2004) is beginning to explore the effect of different income sources on rebel organization and strategies. While Collier and Hoeffler's proposal that the availability of rebel finance is a key determinant of the prospects for civil war remains to be demonstrated, it has without doubt helped to generate an important research agenda.

8 Appendix: The imputation model

I used J. L. Schafer's software, NORM, for producing multiple imputations based on a multivariate normal model of the data (Schafer 2000). The central idea is that the variables in the imputation model are assumed to have a multivariate normal distribution, the parameters of which are estimated from the observed data. Imputed values for missing data are drawn from the relevant conditional distribution, to make a set of n imputed data sets. Coefficient estimates based on these n data sets are then combined using "Rubin's rules" to yield the numbers reported in Table 5.

[32] On the Chad project, see for example Daphne Evitar, "Striking It Poor: Oil as a Curse," *New York Times* 7 June 2003, B9, and Krasner (2004). Jeffrey Sachs and a team from Columbia University's Earth Institute have been involved in helping to design institutions for the management of oil revenues in São Tomé e Príncipe. See `http://www.earthinstitute.columbia.edu/cgsd/STP/`.

[33] Krasner (2004) proposes this and several other "shared sovereignty" mechanisms to make weak state oil revenues less easily appropriable by corrupt politicians.

I limited the variables in the imputation model to the variables in Collier and Hoeffler's main specification: civil war onset, primary commodity exports, the log of per capita income, the log of population, fractionalization, ethnic dominance, years of peace, and geographic dispersion. To make the multivariate normal assumptions more accurate, primary commodity exports and fractionalization were logged for use in the imputation model. Imputed values for peace years were rounded to the nearest integer, and imputed values for the dichotomous variables civil war onset and ethnic dominance were rounded to zero or one, whichever was closer.

The 16 imputed data sets were created by saving the estimates from every 5,000th round of 80,000 rounds of data augmentation. Auto-correlation plots suggested strongly that 5,000 rounds was far more than enough to ensure that convergence in distribution had occurred (the EI algorithm for estimating means and covariances of the imputation model data converged in less 24 iterations for both the country year and five year period versions).

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Table 1: sxp components

SITC 0	Food and live animals
e.g.	all foodstuffs such as wheat, coffee, sugar, livestock
SITC 1	Beverages and tobacco
e.g.	self-explanatory
SITC 2	Crude materials, inedible, except fuels
e.g.	textiles, rubber, wood products
SITC 3	Mineral fuels, lubricants and related materials
e.g.	oil, coal, natural gas
SITC 4	Animal and vegetable oils, fats and waxes
e.g.	self-explanatory
SITC 68	Non-ferrous metals
e.g.	silver, copper, nickel, alumninum, lead, tin

Table 2. *sxp* and civil war onset in two different sample frames

Model #	(1) 5-year periods	(2) 5-year periods	(3) country years	(4) country years	(5) country years	(6) country years
sxp	16.773**		8.225*	6.827	6.154	5.870
	(.001)		(.035)	(.062)	(.091)	(.091)
sxp^2	-23.800*		-14.307	-12.528	-11.531	-10.993
	(.018)		(.075)	(.104)	(.132)	(.132)
log(sxp)		1.033**				
		(.000)				
log(income)	-.950**	-.991**	-.535**	-.432**	-.409**	-.441**
	(.000)	(.000)	(.003)	(.005)	(.007)	(.002)
growth	-.098*	-.102*	-.146**	-.147**	-.130**	-.132**
	(.018)	(.014)	(.000)	(.000)	(.000)	(.000)
peace years	-.004**	-.004**	-.004**	-.004**	-.004**	-.004**
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
log(population)	.510**	.591**	.311**	.281**	.253**	.258**
	(.000)	(.000)	(.001)	(.001)	(.003)	(.001)
fractionalization	-2.479**	-2.629**	-.822			
	(.007)	(.005)	(.244)			
ethnic dominance	.480	.513	.396	.398		
	(.144)	(.120)	(.122)	(.120)		
geo. dispersion	-.992	-1.120	-.167	-.017	.170	
	(.275)	(.216)	(.820)	(.982)	(.815)	
constant	-3.437	-.473	-2.502	-3.091*	-2.846*	-2.567
	(.167)	(.842)	(.097)	(.028)	(.039)	(.052)
N	750	750	4466	4515	4605	5008
N (wars)	52	52	69	70	70	73
Likelihood ratio test for joint significance of *sxp* and sxp^2:						
$\chi^2_{df=2}$	16.56		5.05	3.82	3.15	3.31
Prob $> \chi^2$	.000		.081	.148	.207	.192

Notes: Logit estimates with civil war onset as the dependent variable; observations are country five-year periods in models 1 and 2, and country years in models 3-6. Income and population are lagged; income growth is for the prior five-year period or five years. p-values are in parentheses. $^{*}p < .05$; $^{**}p < .01$.

Table 3:
Proportion of five-year periods with civil war onset
by population and commodity exports (treciles)

Population (millions)	Primary commodity exports/GDP			
	Low	Medium	High	Total
less than 3.5	.043 69	.020 100	.029 172	.029 341
3.5 to 12.2	.032 94	.081 135	.090 100	.070 329
more than 12.2	.057 174	.160 100	.178 45	.107 319
Total	.047 337	.087 335	.069 317	.068 989

Table 4. log(*sxp*) and civil war onset in the country-year framing

Model #	(1) country years	(2) country years	(3) country years
log(sxp)	.290	.202	.159
	(.111)	(.218)	(.303)
log(income)	-.549**	-.457**	-.471**
	(.002)	(.002)	(.001)
growth	-.146**	-.146**	-.133**
	(.000)	(.000)	(.000)
peace years	-.004**	-.004**	-.004**
	(.000)	(.000)	(.000)
log(population)	.309**	.278**	.258**
	(.001)	(.002)	(.002)
fractionalization	-.772		
	(.274)		
ethnic dominance	.387	.384	
	(.131)	(.135)	
geo. dispersion	-.082	.065	
	(.909)	(.928)	
constant	-1.074	-1.900	-1.523
	(.479)	(.144)	(.203)
N	4466	4515	5008
N (wars)	69	69	73

Notes: Logit models with civil war onset as the dependent variable and country years as observations. Income and population are lagged one year; income growth is for the prior five years. p-values are in parentheses. $^{*}p < .05$; $^{**}p < .01$.

Table 5. Multiply imputed missing data models

Model #	(1) 5-year periods	(2) 5-year periods	(3) country years	(4) country years
sxp	8.320*	7.156*	6.088	5.195
	(.033)	(.049)	(.104)	(.142)
sxp^2	-11.775	-10.319	-9.965	-8.789
	(.120)	(.155)	(.195)	(.233)
log(income)	-.581**	-.477**	-.509**	-.424**
	(.002)	(.004)	(.001)	(.002)
growth	-.091**	-.087**	-.085**	-.080**
	(.006)	(.007)	(.000)	(.000)
peace years	-.003**	-.003**	-.003**	-.003**
	(.002)	(.001)	(.001)	(.000)
log(population)	.387**	.354**	.291**	.265**
	(.000)	(.000)	(.001)	(.001)
fractionalization	-.626		-.554	
	(.436)		(.409)	
ethnic dominance	.432		.395	
	(.118)		(.116)	
geo. dispersion	.060		.073	
	(.937)		(.922)	
constant	-4.500*	-4.502*	-2.859*	-3.040*
	(.022)	(.017)	(.040)	(.020)
N	1063	1063	5168	5168
N (wars)	75	75	76	76

Notes: Combined logit estimates from 16 multiply imputed data sets with civil war onset as the dependent variable; observations are five-year periods in models 1 and 2, and country years in models 3 and 4. Income and population are lagged one year; income growth is for the prior five year period or five years. p-values are in parentheses. $^{*}p < .05$; $^{**}p < .01$.

Table 6. Oil vs. primary commodity exports

Model #	(1)	(2)	(3)	(4)	(5)
	5-year periods	5-year periods	country years	country years	country years
sxp	13.652*	7.237	7.121		3.510
	(.012)	(.108)	(.099)		(.357)
sxp^2	-19.526	-11.229	-13.927		-9.087
	(.051)	(.173)	(.095)		(.221)
log(sxp)				.228	
				(.319)	
fuel exports	.007	.008	.011	.009	.012*
	(.336)	(.235)	(.073)	(.100)	(.033)
log(income)	-1.020**	-.631**	-.671**	-.699**	-.528**
	(.000)	(.002)	(.001)	(.000)	(.001)
growth	-.084*	-.090*	-.143**	-.143**	-.127**
	(.045)	(.026)	(.000)	(.000)	(.000)
peace years	-.003**	-.003**	-.003**	-.003**	-.003**
	(.001)	(.001)	(.000)	(.000)	(.000)
log(population)	.398**	.240	.246*	.260*	.154
	(.007)	(.058)	(.030)	(.031)	(.120)
fractionalization	-.000*		-1.124	-1.141	
	(.011)		(.126)	(.122)	
ethnic dominance	.544		.485	.476	
	(.097)		(.067)	(.072)	
geo. dispersion	-1.138		-.373	-.264	
	(.217)		(.624)	(.724)	
constant	-.908	-1.462	-.934	.185	-1.019
	(.771)	(.601)	(.620)	(.915)	(.533)
N	674	724	3987	3987	4354
N (wars)	52	53	65	65	69

Notes: Logit estimates with civil war onset as the dependent variable; observations are five-year periods in models 1 and 2, and country years in models 3, 4, and 5. Income and population are lagged one year; income growth is for the prior five year period or five years. Fuel exports are as a percentage of total exports. p-values are in parentheses. $^{*}p < .05$; $^{**}p < .01$.

Table 7. Government observance of contracts and *sxp*

Model #	(1)	(2)
log(sxp)	-0.351**	-0.161
	(2.64)	(1.13)
log(income)	1.361**	1.429**
	(12.28)	(13.04)
fuel exports		-0.014**
		(2.98)
constant	-5.558**	-5.435**
	(6.19)	(6.25)
N	115	115
R^2	0.604	0.633

Notes: Ordinary least squares with a 0-to-10 measure of perceived government observance of contracts as the dependent variable, averaged for each country over available data from 1982 to 1995. Log(*sxp*) is averaged for each country over available data from 1960 to 1995, and log(income) and fuel exports likewise for data from 1980 to 1999. t-statistics are in parentheses. $^{*}p < .05$; $^{**}p < .01$.

Figure 1. Histograms of sxp and log(sxp)

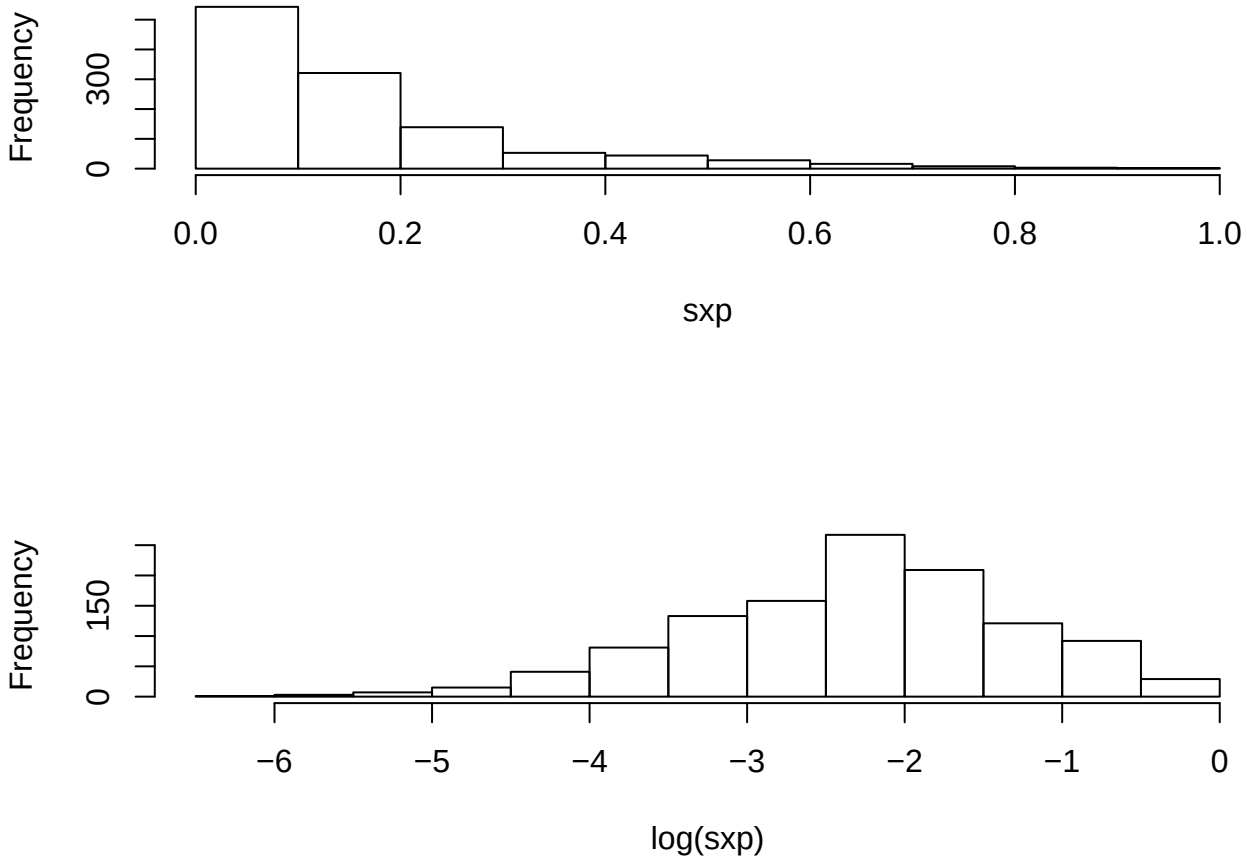

Figure 2: Fuel exports and sxp

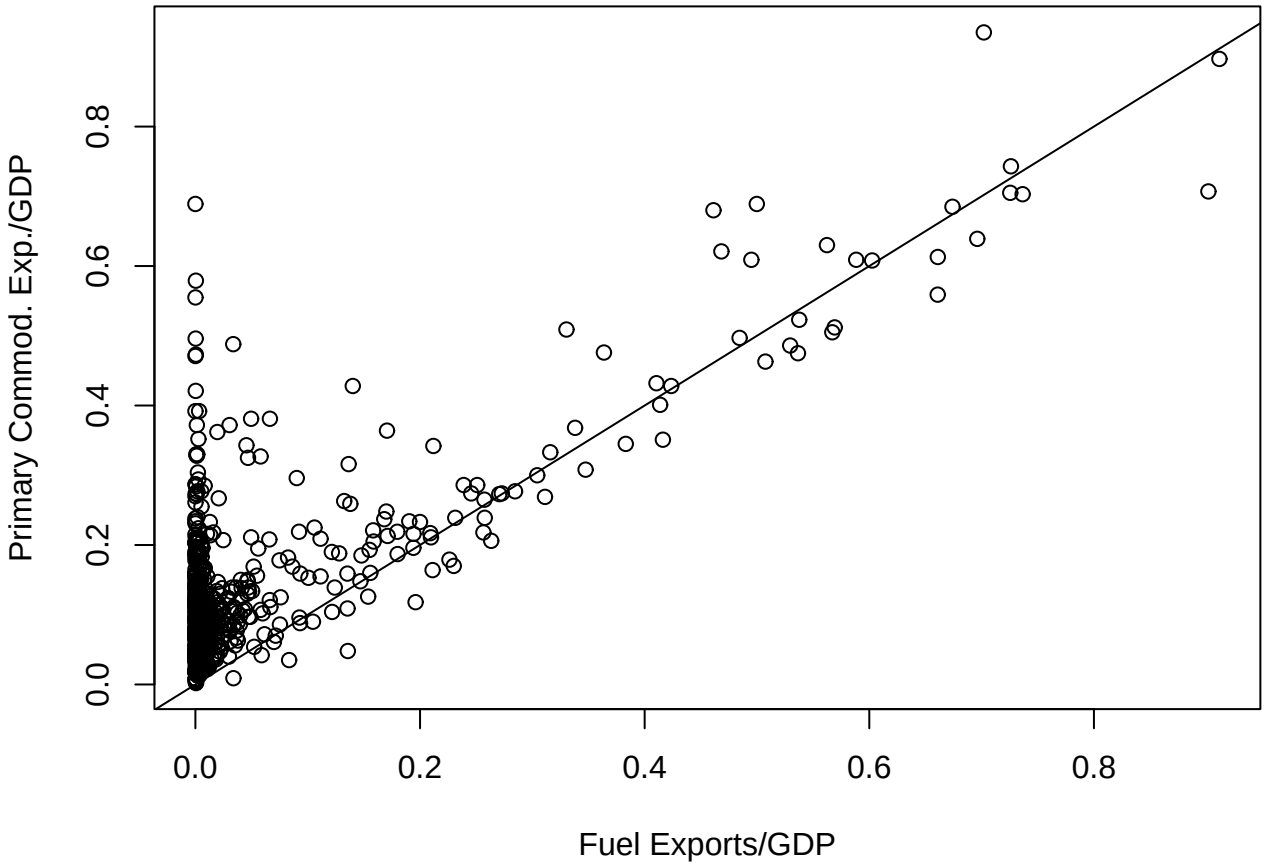

Figure 3. Change in log(odds) of civil war as a function of sxp