The Incidence of Civil War: Theory and Evidence

Timothy Besley*
London School of Economics and CIFAR

Torsten Persson
IIES, Stockholm University and CIFAR

The Suntory Centre
Suntory and Toyota International Centres for
Economics and Related Disciplines
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

EOPP/2009/5

Tel: (020) 7955 6674

* We are grateful to participants in seminars at the LSE, Edinburgh, Warwick, Oxford, and a CIFAR meeting, especially Jim Fearon, and to Paul Collier, Erik Melander, Eric Neumayer, Ragnar Torvik, and Ruixue Xie, for comments, to David Seim and Prakarsh Singh for research assistance, and to CIFAR, the ESRC, and the Swedish Research Council for financial support.

Abstract

This paper studies the incidence of civil war over time. We put forward a canonical model of civil war, which relates the incidence of conflict to circumstances, institutions and features of the underlying economy and polity. We use this model to derive testable predictions and to interpret the cross-sectional and times-series variations in civil conflict. Our most novel empirical finding is that higher world market prices of exported, as well as imported, commodities are strong and significant predictors of higher within-country incidence of civil war.

This series is published by the Economic Organisation and Public Policy Programme (EOPP) located within the Suntory and Toyota International Centres for Economics and Related Disciplines (STICERD) at the London School of Economics and Political Science. This new series is an amalgamation of the Development Economics Discussion Papers and the Political Economy and Public Policy Discussion Papers. The programme was established in October 1998 as a successor to the Development Economics Research Programme. The work of the programme is mainly in the fields of development economics, public economics and political economy. It is directed by Maitreesh Ghatak. Oriana Bandiera, Robin Burgess, and Andrea Prat serve as co-directors, and associated faculty consist of Timothy Besley, Jean-Paul Faguet, Henrik Kleven, Valentino Larcinese, Gerard Padro i Miquel, Torsten Persson, Nicholas Stern, and Daniel M. Sturm. Further details about the programme and its work can be viewed on our web site at http://sticerd.lse.ac.uk/research/eopp.

Our Discussion Paper series is available to download at:
http://sticerd.lse.ac.uk/_new/publications/series.asp?prog=EOPP

For any other information relating to this series please contact Leila Alberici on:

Telephone: UK+20 7955 6674
Fax: UK+20 7955 6951
Email: l.alberici @lse.ac.uk

1 Introduction

Violent internal conflict plagues many states in the world. Counting all countries and years since 1950, the average yearly prevalence of civil conflict is about 7%, with a peak of more than 12% in 1991 and 1992, according to the Correlates of War (COW) data set. Figure 1a shows the variable time trend in the worldwide prevalence of civil war. The cumulated death toll of these conflicts is now approaching 20 million people.[1] It is of first order importance to understand the forces behind this source of human suffering.

The aims of this paper is to develop a theoretical model of the economic and institutional determinants of conflict, and to use this model to interpret the evidence on the prevalence of civil conflict across countries and its incidence within countries over time. This exercise reflects our belief that is hard to investigate the causes of civil war empirically without beginning from an explicit theory. We view the paper as a first step along an iterative path where development of theory and empirical work in this area are joined together. In both the theoretical and empirical sphere, we are fortunate in being able to build on a number of prior contributions.

Classic theoretical models of conflict, such as those suggested by Grossman (1991) and Skaperdas (1992), have been applied to understanding civil war. In common with the model developed here, these authors see conflict as the outcome of an equilibrium process in which the incentives of the various parties are modeled explicitly. Those incentives arise from the technology of conflict, the preferences of the protagonists, and the underlying economic constraints. Much progress has been made on this basis. However, most of the theoretical work has been pursued separately from the empirical literature and the models have not generally been formulated with empirical testing in mind.[2]

The model in this paper begins with a government faced by an opposition that can mount an insurgency aimed at overthrowing the government. While not every incidence of civil war is of this form, many cases are (see Fearon (2007) for discussion). Three mechanisms are key to understanding when an insurgency breaks out. The first is the opportunity cost of fighting: when incomes are higher, the cost of insurgency is higher, as is the cost of defending against it, simply because the recruiting of fighters is more expensive. This

[1] See Lacina and Gledtisch (2005).

[2] Fearon (2007) is an exception. However, he follows a rather different modeling approach to that adopted here.

mechanism is central to earlier models such as Grossman (1991). The second mechanism concerns the nature of the prize that is won by holding office and how this will be distributed given institutional constraints. Better such constraints can limit conflict by reducing the incentive to capture the government, whereas larger natural resource rents appropriable by government increase the gain from fighting. The third mechanism concerns the technology for fighting and the likely allocation of political power in the absence of an insurgency. The model's equilibrium provides a simple characterization of how these three factors interact in determining whether conflict occurs.

In recent years, a large empirical literature has emerged, which looks at conflict and its determinants.[3] A robust finding in this literature is that poor countries are disproportionately involved in civil war, even though the direction of causation may be difficult to establish. The concentration in poor countries is shown in Figure 1b, which plots the country-wise incidence of civil war since 1950 (or independence, if later) against GDP per capita in the year 2000. But the interpretation of this correlation is open to debate. Fearon and Laitin (2003) see it as reflecting limited state capacity to put down rebellions, while Collier and Hoeffler (2004) see it as a reflection of the lower opportunity cost of fighting when incomes are low.

There is also considerable debate about other prospective drivers of civil war, such as ethnic divisions and political institutions. When it comes to natural resources, results diverge as well. While some authors have found natural resources to significantly raise the probability of onset and/or duration of civil war, other researchers have failed to find such an effect (see Ross, 2004 for a review of the research on this topic). Most of these studies measure the influence of natural resources by the *between-country* variation in measures such as primary exports over GDP, however, which makes it hard to rule out alternative interpretations of the findings in terms of reverse causation or omitted variables.[4]

A small emerging literature studies variation in conflict within countries. For example, Deininger (2003) uses community level data from Uganda finding that scarcity of economic opportunities (proxied by infrastructure) and

[3] See Elbadawi and Sambanis (2002) and Blattman and Miguel (2008) for reviews.

[4] Miguel, Satyanath and Sergenti (2004) use weather shocks to instrument for income in African countries from the 1980s and onwards, and find that lower income raises the probability of civil conflict. Related to the approach in this paper, Bruckner and Ciccone (2007) show that an export price index also predicts growth and that the relationship between growth and civil war is heterogeneous across democracies and non-democracies.

the presence of cash crops are correlated with the civil strife. Most related to this paper is Dube and Vargas (2008), who exploit variation in coffee and oil prices to model the incidence of conflict within Colombian municipalities.

The main empirical contribution of the paper is to look at the incidence of conflict, controlling for unobserved causes behind the uneven incidence of civil war across countries and time by fixed country effects and fixed year effects. We show that country-specific price indexes constructed for agricultural products, minerals and oils (using 1980 as a base year) have considerable explanatory power in predicting the *within-country* variation of conflict. Specifically, higher prices of exported commodities raise the probability of observing conflict – in terms of our model, such prices hikes raise the gain from holding power by boosting natural resource rents. Higher prices of imported commodities also raise the probability of civil war – in terms of our model, higher prices of imported inputs reduce wages, and hence the cost of conflict, by reducing the demand for labor (on top of this, lower wages also raise resource rents).

The fact that we identify these effects from time variation in world market prices for commodities makes it implausible to argue that long-run aspects of political, economic, cultural or social structure are driving the results. We also show that the effects of commodity prices are heterogeneous across political institutions, in a way that is consistent with the theory. In particular, the international price effects are only present where political institutions are weak, but absent (or opposite in sign) where political institutions are strong.

The remainder of the paper is organized as follows. The next section develops our model. Section 3 discusses some preliminaries needed to go from model to empirical implementation, while Section 4 describes the data used in our empirical work. Section 5 discusses the empirical results in two parts: we first look entirely at cross-sectional differences, and then move along to longitudinal results exploiting within-country variation. Section 6 concludes.

2 Basic Model

Our aim is to build a model that is simple and tractable and, at the same time, serves as a useful guide for how observable economic and political factors determine the probability of violent domestic conflict.

Models that generate conflict as an equilibrium outcome rely on either imperfect information or inability of the parties to commit to (post-conflict) strategies. The key friction in our model is of the second type: the inability of any prospective government to credibly offer post-conflict transfers, and the inability of potential insurgents to commit not to use their capacity to engage in conflict.

There are two groups: A and B. Each group makes up one half of the population. Time is infinite and denoted by $t = 1, ...$, although we will drop the time index in much of the theoretical section. One generation is alive at each date and is labelled according to the date at which it lives. There are no state variables in the model. The dynamics come from two stochastic variables – the value of public goods and natural resources – whose values are determined afresh each period. At the beginning of each period, members of the group that held power at the end of the previous period inherit a hold on the incumbent government, denoted by $I \in \{A, B\}$. The other group makes up the opposition, denoted by $O \in \{A, B\}$. The incumbent group can mount an army, denoted by L^I, and financed out of the public purse. Power can be transferred by peaceful means, but the opposition can also mount an insurgency with armed forces L^O and try to take over the government. The winner of armed conflict becomes the new incumbent and the loser the new opposition, denoted by $I' \in \{A, B\}$ and $O' \in \{A, B\}$.

The new incumbent gets access to existing government revenue, from taxes and natural resources, which is denoted by R. The revenue is divided between spending on general public goods G and transfers to the incumbent $T^{I'}$ and the opposition $T^{O'}$. Revenues are stochastic and drawn afresh each period from a known distribution function $D(R)$ on finite support $R \in [R_L, R_H]$. The precise timing of these different events/decisions are spelled out below.

Individual incomes and utility Individuals supply labor in a common labor market to earn an exogenous wage w. We assume that individuals have utility functions

$$\alpha H(G_s) + c^J \ , \tag{1}$$

where c^J is private consumption by group $J \in \{I', O'\}$ and G_s is the level of public goods provided, with the parameter α reflecting the value of public goods. The function $H(\cdot)$ is increasing and concave and α is distributed identically and independently over time on finite support $[\alpha_L, \alpha_H]$.

The government budget constraint in any period can be written

$$R - \sum_{J \in \{I', O'\}} \frac{T^J}{2} - G - wL^I \geq 0 \ , \tag{2}$$

where L^I denotes the size of the army chosen by the incumbent.

Institutions As mentioned above, power can be transferred between groups according to democratic principles, or by a violent conflict in which each group raises armed forces L^J to fight. The probability that group O wins power and becomes the new incumbent I' is

$$\gamma\left(L^O, L^I\right) \ , \tag{3}$$

which depends on the resources devoted to fighting – function γ is increasing in its first argument and decreasing in the second. In this formulation, $\gamma\left(0,0\right)$ is the probability of a peaceful transition of power between the groups.[5] Below we make a specific assumption on the functional form of (3).

Each group (when in opposition) has the power to tax/conscript its own citizens to finance a private militia in order to mount an insurgency. We denote this capacity by ν so $L^{O_{s-1}} \leq \nu$ which is common to the two groups so that neither has a greater intrinsic capability to fight. This formulation sweeps aside the interesting issue of how it is that an opposition can solve the collective action problem in organizing violence.

Political institutions are assumed to constrain the possibilities for incumbents to make transfers to their own group. To capture this as simply as possible, assume that a politician must give $\sigma \in [0,1]$ to the the opposition group, when it makes a transfer of 1 to its own group implying that $T^{O'} = \sigma T^{I'}$. Given this assumption, we use the government budget constraint (assuming that it holds with equality) to obtain:

$$T^{I'} = 2\left(1-\theta\right)\left[R - G - wL^I\right] \ , \tag{4}$$

where $\theta = \frac{\sigma}{1+\sigma} \in [0, 1/2]$. Throughout, we interpret a higher value of the opposition's share of transfers, θ, as reflecting more representative, or consensual, political institutions. The real-world counterparts of a high θ may be

[5] This follows the symmetry of the model in giving neither of the groups an intrinsic advantage of gaining power peacfully. But the model could be extended to allow for this. However, the model does allow for a pro-incumbent bias, when $\gamma\left(0,0\right) < 1/2$, perhaps due to party recognition or media control: .

a more proportional electoral system, or more minority protection through a system of constitutional checks and balances. If $\theta = 1/2$, then transfers are shared equally across the two groups.

Timing The following timing applies to each generation t:

1. The value of public goods α and natural resource rents R are realized.
2. Group O chooses the level of any insurgency L^O.
3. The incumbent government chooses the size of its army L^I.
4. Group I remains in office with probability $1 - \gamma\left(L^I, L^O\right)$.
5. The winning group becomes the new incumbent I' and determines policies, i.e., spending on transfers $\left\{T^J\right\}_{J\in\{I',O'\}}$ and public goods G.
6. Payoffs are realized, consumption takes place, and the currently alive generation dies.

We next solve the model by working backwards to derive a sub-game perfect equilibrium.

Equilibrium Policies Suppose now that we have a new incumbent determined at stage 4 above. Then, using (4), the optimal level of public goods is determined as:

$$G = \arg\max_{G\geq 0}\left\{\alpha H\left(G\right) + 2\left(1-\theta\right)\left[R - G - wL^I\right] + w\right\} \ . \tag{5}$$

Define $\widehat{G}\left(z\right)$ by

$$H_G\left(\widehat{G}\left(z\right)\right) = \frac{1}{z} \ .$$

We record the policy solution as:

Lemma 1 *For given R and α, public goods are provided as:*

$$G = \min\left\{\widehat{G}\left(\frac{\alpha}{2\left(1-\theta\right)}\right), R - wL^I\right\} \ .$$

There are two cases. If α is large enough and/or R small enough, all public spending goes on public goods with any incremental revenues also spent on public goods. Otherwise, the optimal level of public goods is interior and increasing in α and θ. Intuitively, transfers to the incumbent's own group become more expensive as θ increases. In the special case when $\theta = 1/2$, we get the same amount of spending on public goods as the amount that would be chosen by a Utilitarian planner, namely $\widehat{G}(\alpha)$. With an interior solution for G, any residual revenue is spent on transfers which are distributed according to the θ-sharing rule.

The Strategy of Conflict We now study the process of conflict looking for an equilibrium in which the opposition first decides whether to mount an insurgency and then the incumbent government chooses how to respond. As we show below, the equilibrium has three possible regimes. In the first, no resources are committed to conflict by either side, i.e. peace prevails. In the second, there is no insurgency, but the government uses armed forces to repress the opposition and increase its chances of remaining in power. In the third case, there is outright conflict where both sides are committing military resources to a civil war.

Using the results in the last subsection, it is easy to check that the expected payoff of the incumbent is:

$$\hat{V}^I\left(\alpha, R; L^O, L^I\right) = \alpha H\left(G\right) + w \tag{6}$$

$$+[(1-\theta) - \gamma\left(L^O, L^I\right)(1-2\theta)]2\left[R - G - wL^I\right] \ .$$

The key term is $[(1-\theta) - \gamma\left(L^O, L^I\right)(1-2\theta)] > 1/2$, which is the weight the incumbent attaches to end-of period transfers. This includes the average share of the incumbent, $(1-\theta)$, given the institutional restriction on transfers, as well as (minus) the probability that the opposition takes over times the "extra" share $(1-2\theta)$ the policy-making incumbent captures of the redistributive pie.

For the opposition group, we have

$$\hat{V}^O\left(\alpha, R; L^O, L^I\right) = \alpha H\left(G\right) + w\left(1 - L^O\right) \tag{7}$$

$$+[\theta + \gamma\left(L^O, L^I\right)(1-2\theta)]2\left[R - G - wL^I\right] \ ,$$

where $[\theta + \gamma\left(L^O, L^I\right)(1-2\theta)] \leq 1/2$ is the opposition's expected weight on transfers.

These payoff functions expose a key asymmetry in the model between the incumbent and opposition in terms of financing the army. The incumbent's army is publicly financed and increasing the size of it reduces future transfers. For the opposition, any insurgency must be financed out of the group's own private labor endowment given the power to tax its own citizens.

The two payoff functions also express the basic trade-off facing the two parties. On the one hand, higher armed forces have an opportunity cost. On the other hand, for given armed forces of the other party, they raise the probability of capturing or maintaining power and take advantage of the monopoly on allocating government revenue. To study the resolution of these countervailing incentives, we make the following assumptions:

Assumption 1

(*a*) *The technology for conflict is:* $\gamma\left(L^O, L^I\right) = \mu\left[L^O - \xi L^I\right] + \gamma^O$

(b) $\xi \geq 1$

(c) $\mu\xi \leq \gamma^O \leq 1 - \mu\nu$.

Part (a) assumes that a "linear probability model" governs the outcome of conflict. This particular conflict function is chosen mainly for analytic tractability – specifically, it gives a simple closed-form solution to the conflict stage of the model.[6] Part (b) says that the government has an advantage in fighting. Restriction (c) on parameters guarantees that the probability of turnover stays strictly between 0 and 1, and will hold if μ is small enough. Under these assumptions, we get a straightforward characterization of conflict regimes in terms of the size of the public revenues. This will enable us to generate specific predictions to take to the data.

To solve for the equilibrium level of conflict, define $Z = R - G$ as the level of "uncommitted" government revenues, i.e., the maximal redistributive "pie", the amount that can be spent on transfers (given equilibrium public-goods provision). The equilibrium can then be described in terms of two threshold values for Z which describe the size of the redistributive cake above which the incumbent and opposition find it worthwhile to expend positive

[6] The linear conflict model is also exploited in Azam (2005). This is different from the standard model from the literature which would be:

$$\gamma\left(L^O, L^I\right) = \frac{\gamma^O + L^O}{L^O + \xi L^I}.$$

Many of qualitative predictions would still hold for this model.

resources to fighting. Specifically, we have:

$$Z^I = \frac{w}{\mu\left(1-2\theta\right)}\left[\frac{1-\theta-\gamma^O\left(1-2\theta\right)}{\xi}\right] \tag{8}$$

and

$$Z^O = \frac{w}{\mu\left(1-2\theta\right)}\left[1+\frac{\theta+\gamma^O\left(1-2\theta\right)}{\xi}\right] . \tag{9}$$

It is straightforward to check that Assumption 1(b) implies $Z^O > Z^I$. Note that both threshold values are increasing in the level of wage income.

Under Assumption 1, we have the following result (which is proved in the Appendix):

Lemma 2 *There are three possible regimes:*

1. *If $Z < Z^I$, the outcome is peaceful with $\widehat{L}^O = \widehat{L}^I = 0$.*
2. *If $Z \in \left[Z^I, Z^O\right]$, there is no insurgency $\widehat{L}^O = 0$, but the incumbent government chooses armed forces to repress the opposition such that:*

$$\widehat{L}^I = \frac{1}{2}\frac{\left(Z-Z^I\right)}{w} .$$

3. *If $Z > Z^O$, there is civil war where the opposition mounts armed forces*

$$\widehat{L}^O = \frac{\xi\left(Z-Z^O\right)}{w} ,$$

and the government chooses an army:

$$\widehat{L}^I = \frac{1}{w}\left[Z-\frac{Z^O+Z^I}{2}\right] .$$

The Lemma describes three cases. When Z is below Z^I, no conflict erupts as both the incumbent and the opposition accept the (probabilistic) peaceful allocation of power, where the opposition takes over with probability γ^O. For $Z \in \left[Z^I, Z^O\right]$, the government invests in armed forces to increase its survival probability, but the opposition does not invest in conflict. Finally, when $Z > Z^O$, the opposition mounts an insurgency, which is met with force by the government.

Two sources of government advantage lie behind these results. On the one hand, the government can fund its army out of public revenues. On the other hand, we have assumed that $\xi \geq 1$, which reflects a comparative advantage of government forces.

Equilibrium implications It is straightforward to compute the equilibrium probability that the opposition wins office as:

$$\hat{\Gamma}^O(Z) = \begin{cases} \gamma^O & Z \leq Z^I \\ \gamma^O - \frac{\mu\xi}{2w}\left[Z - Z^I\right] & Z \in \left[Z^I, Z^O\right] \\ \gamma^O - \frac{\mu\xi}{2w}\left[Z^O - Z^I\right] & Z \geq Z^O \ . \end{cases}$$

As Z increases, the probability of the incumbent losing office diminishes when the government represses the opposition. However, once a civil war breaks out, additional increases in Z do not change the expected outcome of the conflict even though both groups commit more resources to fighting.

The result in Lemma 2 also allows us to derive the size of the transfers received by the winning group as a function of the level of tax revenues. To this end, define

$$\hat{T}(Z) = \begin{cases} Z & Z \leq Z^I \\ \frac{\left[Z+Z^I\right]}{2} & Z \in \left[Z^I, Z^O\right] \\ \frac{\left[Z^O+Z^I\right]}{2} & Z \geq Z^O \ . \end{cases}$$

as the net revenue function. Equilibrium transfers are thus:

$$T^{I'} = (1-\theta)\, 2\hat{T}(Z) \text{ and } T^{O'} = \theta 2\hat{T}(Z) \ .$$

While the transfers are weakly monotonic in Z, it is easy to see that under civil war (where $Z \geq Z^O$), there is super crowding out of additional public revenue. The incumbent government's marginal propensity to spend on the army out of additional resources is unity, while the opposition continues to spend more of its resources on its insurgency in an effort to capture the government. This implies that additional resources above Z^O lead to a Pareto inferior outcome.[7]

To unpack the implications of the model for the incidence of conflict, it is necessary to understand what determines the distribution of Z and the threshold values given by (8) and (9), in particular the way in which they depend upon the parameters of the model. Such knowledge will allow us to match the predictions of the model to the cross-sectional and longitudinal patterns in the data.

[7] Observe also that our model does not deliver the paradox of power result from Hirschleifer (1991). Because of the symmetry in the model, none of the parties has a systematically weaker incentive to invest in an army. This would not be true in a model like the one in Besley and Persson (2008b), where the incumbent internalizes the preference of the opposition more or less depending on political institutions.

3 From Theory to Evidence

In this section, we discuss how our proposed theory can inform empirical studies of the incidence of civil war. Although the model is extremely simple, it gives a transparent set of predictions on how parameters of the economy and the polity affect the incidence and severity of conflict. A clear advantage of beginning from the theory is that it gives us an explicit framework, in which we can discuss which parameters are country specific and time specific, which are observable, and which are unobservable.

We begin by defining the level of "equilibrium" non-committed government revenue for country c at date t as:

$$Z_{c,t}\left(\alpha_{c,t}, R_{c,t}; \theta_c\right) = R_{c,t} - \hat{G}\left(\frac{\alpha_{c,t}}{2\left(1-\theta_c\right)}\right) \ . \tag{10}$$

The two main stochastic variables in the model that drive the within-country variation in conflict are $\alpha_{c,t}$ and $R_{c,t}$.

The *incidence* of conflict in country c at date t is then characterized by the *probability* that:

$$Z_{c,t}\left(\alpha_{c,t}, R_{c,t}; \theta_c\right) > Z_{c,t}^{O} = \psi\left(\theta_c, \mu_c, \xi_c, \gamma_c^{O}\right) w_{c,t} = \psi_c w_{c,t} \ , \tag{11}$$

where the country-specific multiplier of the wage is a function $\psi\left(\cdot\right)$ defined by

$$\psi\left(\theta, \mu, \xi, \gamma^{O}\right) = \frac{\xi+\theta}{\xi\mu\left(1-2\theta\right)} + \frac{\gamma^{O}}{\mu\xi} \ .$$

Condition (11) illustrates the basic trade-off mentioned above between the opportunity cost of fighting and the probability of winning the redistributive cake.

We also note that in a richer model, where the government raised some of its revenue by taxing wage income, the critical condition could be written in terms of the ratio between $R_{c,t}$ and $w_{c,t}$, and would thus involve the *share* of resource rents in total income (see Besley and Persson, 2008b).[8]

To operationalize an empirical model based on (11), three issues must be dealt with. First, one has to make decisions on measurement of the key parameters. Second, it is necessary to take a stance on what is fixed (at the country level) and what is time varying. Third, one needs to specify what is

[8] See also Aslaksen and Torvik (2006) for a model along these lines.

plausibly exogenous and what is endogenous to the process generating civil conflict.

Beginning with measurement, decent empirical proxies can be found for $w_{c,t}$, $R_{c,t}$, and θ_c. There are readily observable sources of data on whether a country is in civil war, but we have no clear-cut indicator for whether it is in a repression regime. Hence, we follow earlier literature in focusing on modeling the probability of civil war. The other determinants of civil war are unobservable (or very hard to measure). Among these unobservables, we treat the conflict technology parameters μ_c, ξ_c and γ_c^O as fixed, but allow the demand for general interest public goods α_s to vary over time, as it does in the model. In all cases, these unobservables become part of the error process assumed to generate the data.

Moving further towards empirical specification, consider country c at date t. By (10), we can let $\varepsilon_{c,t} = \widehat{G}(\frac{\alpha_{c,t}}{2(1-\theta_c)})$ denote the randomness in $Z_{c,t}$ induced by fluctuations in the demand for public goods. Now, $\varepsilon_{c,t}$ will have a c.d.f. $X^c(\varepsilon - A_c)$ on the finite support $[\widehat{G}(\frac{\alpha_L}{2(1-\theta_c)}), \widehat{G}(\frac{\alpha_H}{2(1-\theta_c)})]$ where A_c is the country specific mean of $\varepsilon_{c,t}$. Using conditions (10) and (11), we can define the conditional probability that a researcher observes conflict in country c at date s as

$$X^c(R_{c,t} - \psi\left(\theta_c; \mu_c, \xi_c, \gamma_c^O\right) w_{c,t} - A_c) \ . \tag{12}$$

It follows that an increase in $R_{c,t}$ or a decrease in $w_{c,t}$ in a given period t raises the probability of observing civil war, unless θ is not to close to its maximum value. The reason for the qualification is that when $\theta \to \frac{1}{2}$, $\psi \to \infty$. Because $R_{c,t}$ has finite support, $R_{c,t} - \psi\left(\theta_c; \mu_c, \xi_c, \gamma_c^O\right) w_{c,t} < 0$, which is below the support of $\varepsilon_{c,t}$. By continuity, X^c is thus increasing in $R_{c,t}$ and decreasing in $w_{c,t}$ only as long as θ_c is below some upper bound $\overline{\theta}_c < \frac{1}{2}$.

In similar vein, we can also consider the *intensity of conflict*, which we take to be a monotonic function of the total amount of resources devoted to fighting conditional on being in conflict, and is given by:

$$w_{c,t}\left(L_{c,t}^O + L_{c,t}^I\right) = \left[\left(Z_{c,t} - Z_{c,t}^O\right)\xi_c + Z_{c,t} - \frac{Z_{c,t}^O + Z_{c,t}^I}{2}\right] \ . \tag{13}$$

This too depends on the underlying institutional determinants and economic conditions. In particular, intensity of conflict increases monotonically in $Z_{c,t}$.

We also note that changes in most of these parameters do not give us unambiguous predictions about the probability of observing repression (without

further assumptions). For instance, an increase in $w_{c,t}$ or θ_c drives up both the lower bound Z^I and the upper bound Z^O for the repression regime, such that the probability of observing a repression equilibrium can go either way, depending on the form of the distribution X^c. For this reason, we do not try to investigate the incidence of repression in the empirical section of this paper. Still, the possibility of a repression equilibrium is an interesting implication of our model and, at the same time, repressive political regimes appear to be an important empirical phenomenon, especially in poor and weakly institutionalized countries. This aspect of the model is taken up in Besley and Persson (2009).

Based on the insights from this section, we study the empirical determinants of civil war in two steps. We begin (in Section 4) by considering what can be learned solely from between-country variation, looking at cross-section evidence on the prevalence of conflict across countries. Then (in Section 5), we look at within country-variation which only exploits the variation of conflict over time. In this second step, we will also flesh out the economic model to make explicit which role commodity-price fluctuations might play in affecting civil war.

4 Between-Country Variation

In this section, we discuss the variation of civil war across countries. We begin with some preliminaries, spell out the relevant predictions of our model, and briefly discuss econometric specification. After a presentation of the data, we present the results of some cross-sectional regressions.

Preliminaries Consider the cross-sectional implications implied by the average value of (12) over some portion of each country's history. The average incidence of civil war in our model can be derived from the unconditional probability of observing conflict in country c, viz.

$$E\{X^c(R_{c,t} - \psi\left(\theta_c; \mu_c, \xi_c, \gamma_c^O\right) w_{c,t} - A^c); \overline{R}_c, \overline{w}_c\} \ , \tag{14}$$

where $\overline{R_c}$ is the country-specific mean of resource rents $R_{c,t}$ and $\overline{w}_c$ is the country-specific mean of wages.$w_{c,t}$. The model gives a series of predictions about how changes in parameters affects the cross-country pattern of conflict.

In a panel of countries of length T, the unconditional probability of civil war converges to the sample average in country c of a binary civil war indi-

cator (which takes a value of 1 when the country is in civil war and a value of 0 otherwise), as $T \to \infty$. The data points in Figure 1b display precisely such sample averages.

Predictions We collect the predictions from our model about the unconditional probability of civil war in the following proposition.

Proposition 1

(*a*) *An increase the average value of general public goods expenditures* A^c *reduces the cross-sectional incidence of conflict.*

(*b*) *An increase in average wages* $\overline{w}_c$ *reduces the incidence of conflict.*

(*c*) *More consensual political institutions, an increase in the value of* θ_c, *reduce the cross-sectional incidence of conflict.*

(*d*) *An increase in the average level of natural resource rents* $\overline{R}_c$ *increases the cross-sectional incidence of conflict.*

To understand prediction (a) in terms of the theory, observe that an increase in $\alpha_{c,t}$, reduces $Z(\alpha_{c,t}, R_t; \theta)$ because $\widehat{G}(\cdot)$ is an increasing function. In fact, for large enough $\alpha_{c,t}$, we have $Z(\alpha_{c,t}, R_{c,t}; \theta) = 0$, which guarantees a peaceful outcome. By reducing the conflict over redistributive transfers, demand for public goods also reduces conflict over the state. This finding is quite difficult to test in the data. However, one crude fact in support of this finding is that there is a strong negative correlation in the data between the incidence of external wars and civil conflict.[9]

To see where (b) comes from, note that by (11) an increase in $w_{c,t}$ raises the critical bound $Z^O_{c,t}$ for civil war. Intuitively, higher real incomes raises the opportunity cost of raising an army and hence reduces the likelihood that the opposition (and the incumbent) will wish to fight. It also reduces the intensity of conflict, since both groups find it more costly to fight when the opportunity cost is higher.

The prediction in (c) arises through several channels. More consensual institutions increase spending on public goods via the function $\widehat{G}(\cdot)$ and thereby decreases the *size* of the redistributive cake. They also raise the

[9] Of the total country-years in our panel data set, only a share 0.0018 have simultaneous extranal and internal conflict.

lower bound for conflict as $\psi\left(\theta, \mu, \xi, \gamma^O\right)$ is increasing in θ. This captures the fact that consensual institutions reduce the value of holding power since the incumbent now captures a smaller *share* of the redistributive cake. The total resources expended on conflict are also lower when institutions improve.

Finally, the prediction in (d) about the impact of government revenue triggered by higher natural resource rents works by increasing $Z_{c,t}$ and hence the likelihood that $R_{c,t}$ lies above the conflict threshold. For a given opportunity cost of armed forces, the redistributive prize of winning becomes higher. It also clear from (13) that, as $Z_{c,t}$ goes up, so do the resources devoted to conflict.

Econometric specification Now let $civ_{c,t}$ be a dummy variable denoting whether country c is in civil conflict at date t. Then in a cross-sectional setting we can average this variable over some time period and then run regressions of the form:

$$\overline{civ}_c = a + by_c + \kappa_c \ ,$$

where y_c is a vector including measures of average wages and resource rents, $\overline{w}_c$ and $\overline{R}_c$, and political institutions θ^c. We discuss in greater detail below how to find proxies for these variables.

Note, however, that this procedure entails a difficult identification problem. To obtain unbiased estimates of vector b, the parameters of interest, we have to assume that the the country specific vector y_c is uncorrelated with the country-specific error term κ_c and thus with unobserved determinants of conflict, such as $\theta_c, \mu_c, \xi_c, \gamma_c^O, A_c$ in the model. This is a restrictive and implausible assumption. For example, the same forces that lead to a high level of income $\overline{w}_c$ are likely to lead to a high value of public goods A_c in the model. This would thus result in a positive correlation between $\overline{w}_c$ and κ_c and biased estimates of parameters of interest.

Data We explore the incidence of civil war in a panel data set where each observation is a country year for the period 1960-2005, subject to data availability.

Different data sources have been used in the empirical literature to identify the incidence of civil conflict.[10] One of our main dependent variables is

[10]There are a number of issues involved in the coding of conflicts into civil wars. See

whether a given country has a civil war in a given year. This indicator variable is obtained from the Correlates of War (COW) data set, which provides annual data on conflicts (from 1816) up to 1997. The COW *intrastatewar* indicator takes a value of 1 if a given country in a given year is involved in a violent conflict which claims a (cumulated) death toll of more than 1000 people. Because our theory is developed to shed light on a purely domestic conflict, we only include conflicts between a country's government and a domestic insurgent, and remove conflicts that involve interventions by another state. For the same reason, we neither include any so-called extra-systemic wars.

Another commonly used civil-war indicator is compiled by the peace research institutes in Uppsala (UCDP) and Oslo (PRIO). Their data set goes up to 2005, and also includes detailed data on the number of battle deaths in each conflict, which can be used as a proxy for the intensity of conflict. There are some differences in the classifications of wars between the two data sets – the correlation at the country-year level is 0.73. Of the 5279 possible country-year pairs in our period where both data sets are available, there is disagreement in only 292 cases – in 43 of these the COW data classifies a country as being in conflict when UCDP/PRIO does not; the opposite is true in 259 country-year observations (the larger number of mismatches in this direction largely reflects that UCDP/PRIO include conflicts with foreign intervention). For example, Turkey is classified as being in conflict between 1984 and 1990 by the UCDP/PRIO data, but not by the COW data. On the other hand, Thailand is viewed as being in conflict between 1970 an 1973 by COW, but not by UCDP/PRIO. While we check the robustness of our results to using both classifications of conflict, our main results are based on the COW data.

The means of the main cross-sectional variables are given in Table 1. The table displays summary statistics for three classifications. In the first column, we look at the means (standard deviations in brackets) for all 124 countries for which the main variables are available between 1960 and 2000. We then disaggregate into the 39 countries that have had a civil conflict over this period and those that have not. This gives us a feel for how these two groups vary. Table 1 shows that the overall incidence of conflict during this period is 8%. However, among the countries with any conflict, 27% of

Sambanis (2004) for a thorough discussion about different definitions that appear in the empirical literature.

the country-year observations are in conflict. A more continuous measure of civil conflict uses battle deaths.[11] However, this is available only for a more limited sample of countries. Unsurprisingly, given the 1000-death threshold, average battle deaths in the non-conflict sample is a tenth of the level among the conflict countries.

Considering background characteristics of countries, the level of income per capita (from the Maddison data set) is higher among non-conflict states (around three times higher). States having experienced civil wars are also more likely to be oil dependent, with more than 10% of their GDP being generated by oil exports according to the NBER-UN trade data set. The same broad pattern is found when we consider primary products more generally, including minerals and agricultural products.

Table 1 also shows that around 37% of conflict states are democracies, as measured by having a *polity2* variable in the Polity IV data set exceeding zero, compared to 49% of non-conflict states. We also measure parliamentary democracy by a dummy variable. This is set equal to 1 if the country is democratic according to the *polity2* definition and, at the same time, has a parliamentary form of government (defined as a confidence requirement of the executive vs. the legislature, as in Persson and Tabellini, 2003). Only 15% of country-year observations in conflict states are in parliamentary democracies, as against 28% of those in the non-conflict state sample. We also construct a measure of high constraints on the executive, exploiting the *xconst* variable in Polity IV data. This latter variable takes on integer values from 1 to 7 and captures various checks and balances on the executive. We set our indicator equal to 1, when *xconst* takes on its maximum value of 7, and 0 otherwise. Table 1 shows that 31% of country-year observations have high executive constraints among states that did not have a civil war, compared to only 12% among those that did.

Results We now consider some basic cross-sectional patterns in the incidence of civil war. These parallel the findings that have been discussed in the previous literature. However, it is useful to anchor these cross-sectional facts and to assess their robustness in the context of our model.

To this end, Table 2 presents results from a few cross-sectional regressions. Our basic specification uses the prevalence of conflict (the average number of years in which a specific country has been in conflict between 1960 and

[11] See http://www.prio.no/CSCW/Datasets/Armed-Conflict/Battle-Deaths/

1997) as our dependent variable. All specifications include the log of GDP per capita as a right hand side variable. This serves as a proxy for the average value of the wage for country c, $\overline{w}_c$. In column (1), we find that richer countries are less likely to be involved in conflict than poorer ones – a basic finding of the literature. We also include a dummy variable for whether a country is democratic. Somewhat surprisingly, this turns out to be *positively* correlated with the prevalence of civil war. This suggests either that democracy is correlated with unobservables in the cross-section, that democracy is a poor proxy for consensual institutions as measured by θ_c, or that the correlation between democracy and civil war is more subtle and not well captured by a linear model.[12] Turning to economic structure, we find no evidence, in the cross section, that large oil exporters are more often in civil conflict. However, large (non-oil) primary goods exporters are, *ceteris paribus*, less likely to be involved in a civil conflict. While these results are all interesting, it is quite difficult to interpret them in terms of the theory outlined above.

In column (2), we repeat the specification from column (1) including a dummy variable capturing whether the country is a parliamentary democracy. Arguably, this is a better proxy for θ_c. While this variable is negatively correlated with civil-war prevalence, the correlation is not statistically significant. In column (3), we include an interaction term between parliamentary democracy and whether a country is a large oil or primary products producer. Here, there is some evidence that civil war is more prevalent among large oil producers that are not parliamentary democracies.[13]

While these results are interesting and serve to breath some life into the predictions of the model, the results in Table 2 cannot be given a causal interpretation. The main problem is the likelihood of biases due to unobserved heterogeneity across countries discussed at the end of the econometric specification. Many of our right-hand side variables are likely to be correlated with unobservable features of countries such as culture, institutions and history. Moreover, as has been widely recognized in previous work, using purely cross-sectional data throws away important information about the factors that shape the timing of the onset of civil war and its duration once it begins.

[12] For the latter possibility, see Collier and Rohner (2008).

[13] Although a closer look at the data suggests that this is basically a Trinidad and Tobago effect.

5 Within-Country Variation

In an effort to deal with the many unobserved determinants of civil war, we now turn to the within-country variation in the data. It is of particular interest to use time variation in $w_{c,t}$ and $R_{c,t}$ to explain the time-varying incidence of civil conflict. To isolate plausibly exogenous variation in these two variables, we exploit the time variation in import and export prices determined in world markets.[14] We therefore begin this section by developing a simple micro-founded model to illustrate how prices of importable and exportable commodities affect wages and natural resources rents, and hence the incidence of civil war over time. We then discuss the econometric specification and the additional data that we use before presenting the main empirical results.

A simple two sector trade model To motivate the role of commodity prices in determining conflict, suppose that a small open economy produces a primary export product, the price of which in period t, p_t is determined in a global market and is exogenous at the country level. This export good is produced using a fixed factor k_c which varies by country and can be thought of as land, mines, or oil wells (measured in efficiency units). Since we are interested in the short-run effect of raw materials prices, we assume that the production function has fixed coefficients, i.e.:

$$Y_{c,t}^x = \min\left\{l_{c,t}^x, k_c\right\} \ ,$$

where $l_{c,t}^x$ is the quantity of labor used in producing the export good in country c in year t. As long as $p_t > w_{c,t}$, then $l_{c,t}^x = k_c$, and

$$R_{c,t} = k_c \left(p_t - w_{c,t}\right)$$

are the rents earned on the fixed factor which we assume accrue to government as in the model above.

Another sector produces a (tradeable or non-tradeable) consumption good from labor and an imported raw material, which is denoted by $m_{c,t}$ with (given) price q_t also determined at the global level. The price of the good produced in this second sector is set equal to one (i.e., we let it be the numeraire). Production in this sector also uses fixed coefficients so that:

$$Y_{c,t}^m = \min\left\{\zeta_c l_{c,t}^m, m_{c,t}\right\} \ .$$

[14] This implicitly assumes that each country is small relative to world markets.

We assume that:

$$\zeta_c < k_c < 1 \text{ and } \zeta_c (1 - q_t) < p_t \ ,$$

which guarantee that both sectors produce.

The equilibrium demand for raw material inputs is:

$$m_{c,t} = \zeta_c l^m_{c,t} = \zeta_c (1 - l^x_{c,t}) = \zeta_c [1 - k_c] \ .$$

We assume that production in the importables sector is competitive and, because of constant returns, leads to zero profits. The equilibrium wage is then determined from

$$[1 - k_c] [\zeta_c (1 - q_t) - w_{c,t}] = 0 \ ,$$

or

$$w_{c,t} = \zeta_c (1 - q_t) \ .$$

In this case:

$$\frac{\partial w_{c,t}}{\partial q_t} = -\zeta_c \ ,$$

i.e., the wage is decreasing in the price of importable raw materials.

Predictions Using this simple model, we get the following prediction on the impact of prices of primary products on the incidence of civil war.

Proposition 2

The likelihood of observing civil war is increasing in raw material import prices, q_t and export prices p_t, provided that the inclusiveness of political institutions θ_c fall below some upper bound $\overline{\theta}_c$.

By (12) we want to investigate the impact of commodity prices on $Z_{c,t} - Z^O_{c,t}$. Now observe that:

$$\frac{d(Z_{c,t} - Z^O_{c,t})}{dp_t} = \frac{dR_{c,t}}{dp_t} = k_c > 0 \ .$$

A higher price of exported commodities thus raises the probability of observing conflict, since the latter is increasing in $Z_{c,t} - Z^O_{c,t}$. For changes in the price of imported raw materials, we have:

$$\frac{d(Z_{c,t} - Z^O_{c,t})}{dq_t} = \left(\frac{dR_{c,t}}{dw_{c,t}} - \frac{dZ^O_{c,t}}{dw_{c,t}} \right) \frac{dw_{c,t}}{dq_t} = \zeta_c (k_c + \psi_c) > 0 \ .$$

Intuitively, a higher price of the imported raw material lowers the wage, which raises rents in the export sector and, hence, the prize for winning ($Z_{c,t}$). The lower wage also has a direct positive effect on the probability of observing conflict, by lowering the opportunity cost of fighting and hence the conflict threshold ($Z^O_{c,t}$). The qualification in the later part of the proposition follows from the argument right below (12).

While this simple two-sector model is special in having fixed coefficients, the mechanism it describes would hold with the possibility of factor substitution, as long as this is not too great.[15] The basic economics behind the results are clear. Higher prices for exported commodities has a direct effect on civil war by increasing rents. The effect of higher imported commodity prices comes from the fact that they reduce the demand for labor in the importables sector and hence puts downward pressure on the wage.

We have picked this micro-foundation as it fits well with the rest of the structure of the model that we have developed. However, it is not the only possibility. For example, Dal Bo and Dal Bo (2006) suggest an alternative model of how commodity export prices might affect the incidence of conflict, which motivates the empirical work in Dube and Vargas (2008). We could allow some of the resource rents to be controlled by the opposition, in which case higher export prices may also lead to higher intensity of conflict, as has been emphasized by e.g., Collier, Hoeffler and Söderbom (2004).[16] When it comes to import prices, an alternative mechanism that could provide a link to the incidence of conflict would arise if the opposition's willingness to fight is increasing in their (relative) poverty. In such a "grievance" model of conflict, higher prices of imported commodities, including food, would raise the probability of conflict by cutting real incomes.

Econometric specification We will estimate panel regressions with a binary civil-war indicator as the dependent variable and with fixed country effects. This is equivalent to considering

$$X^c(R_{c,t} - \psi\left(\theta_c; \mu_c, \xi_c, \gamma_c^O\right) w_{c,t}) - E\{X^c(R_{c,t} - \psi\left(\theta_c; \mu_c, \xi_c, \gamma_c^O\right) w_{c,t})\}\ , \quad (15)$$

[15] With subsitution possibilities between land and labor in the export sector, an increase in the prices of resource exports would also drive up the wage through a higher demand for labor. Such a "Dutch disease" effect would likely dampen, but not eliminate, the effect on the probability of civil war.

[16] In terms of our model, we could let parameter ν, which limits the insurgents' capability of fighting, depend positively on R.

i.e., the difference between the conditional and the unconditional probability of civil war. Proceeding in this way identifies the effect of resource rents and real incomes on the incidence of civil war exclusively from the within-country variation of these variables, because the impact of their average values and of the time-invariant parameters in each country will be absorbed by the country fixed effect. This stands in marked contrast to the existing empirical literature, which typically does not include country fixed effects letting the estimates rely on the cross-country variation in the data.

The heterogeneity in the incidence of conflict at different dates is thus mainly attributed to time variation in factors that affect wages, $w_{c,t}$ and resource rents $R_{c,t}$. We can also allow for macro shocks in the global economy that hit all countries in a common way through year fixed effects (time indicator variables), which pick up (in a non-parametric fashion) any general trends in the prevalence of civil war such as the important trend displayed in Figure 1a. Thus, the simplest baseline model emerging from (a linear approximation of) (15) is a linear probability model with:

$$civ_{c,t} = a_c + a_t + by_{c,t} + \kappa_{c,t} \ , \tag{16}$$

where a_c are country fixed effects, a_t are year fixed effects. and where $y_{c,t}$ is a suitably defined vector of time-varying regressors, including export and import price indexes for primary commodities. Since the crucial parameter is the share of resource income in total income, we always include GDP in $y_{c,t}$. Concerns about potential endogeneity of this variable are addressed below. To test the auxiliary prediction that $y_{c,t}$ only has an effect for non-inclusive political institutions (where $\theta_c < \overline{\theta}_c$), we estimate (16) in different samples defined by the political institutions in place.

To take account of country-specific variance in the error term, we always estimate with robust standard errors. While (16) allows for heterogeneity in a flexible way, a remaining econometric concern is that the fraction of countries in civil war is low, which may bias linear probability estimates. To diagnose such bias, we also estimate a conditional (fixed effects) logit model.

Data We want exploit changes in commodity prices in world markets to generate exogenous time variation in resource rents and real incomes.[17] Using trade volume data from the NBER-UN Trade data set, and international

[17] The method that we follow is similar to Deaton and Miller (1996).

price data for about 45 commodities from UNCTAD, we construct country-specific export price and import price indexes. Although these go back as far as 1960, they are the data constraining length of the panel that we study. The price indexes for a given country have fixed weights, computed as the share of exports and imports of each commodity in the country's GDP in a given base year (1980). Given the predictions from two-sector model in this section, we interpret a higher export price index as a positive shock to natural resource rents $R_{c,t}$, and a higher import price index as a negative shock to (real) income $w_{c,t}$.

To get another source of exogenous time variation in income, we use data on natural disasters from the EM-DAT data set. Specifically, we construct an indicator variable that adds together the number of floods and heat-waves in a given country and year, assuming that both act as a negative shock to real incomes.

Empirical results Table 3 gives the results from estimating the linear probability specification in (16) on our data. In column (1), we run our basic specification on the whole panel with 124 countries. The estimates show that income per capita is negatively correlated with civil war incidence, in conformity with the cross-sectional results of Table 2. In contrast to the cross-sectional result, being democratic is now negatively to incidence of civil war. This confirms the difficulty of drawing inference from cross-sectional variation in the presence of considerable cross-country heterogeneity.

Both export and import price indexes for agricultural and mineral products are positively and significantly correlated with the incidence of civil war. Moreover, it seems plausible to argue that both of these indexes provide a source of exogenous variation. The country-specific oil export price does not explain civil war, while the oil import price is negatively correlated with civil war.

Stepping outside of the theoretical model, both GDP per capita and democracy may be determined simultaneously with the incidence of civil war. It is therefore worth noting that the results on import and export prices are robust to excluding democracy from the regression. While including a measure of GDP per capita is important for these results to hold, the results are robust when we include up to a ten year lag of the level of GDP per capita suggesting that they are unlikely to be a symptom of reverse causation.

As well as being statistically significant, the basic results are also quan-

titatively important. The results in column (1) of Table 2 imply that a one standard deviation (of the within-country variation) increase in the non-oil export price index raises the probability of civil war by about 1 percentage point. This is a sizeable effect, about 11% of the mean probability of civil war in the sample (0.087). The non-oil import price effect is larger, with a one standard-deviation hike mapping into a 15% higher probability of conflict. These are all average effects. However, the fact that we have constructed country-specific price indexes implies that the effect of any given price change will be heterogeneous across countries according to the weights used for constructing the price index. Thus, a change in the world price of a specific commodity will affect the probability of civil war differently across countries given common coefficients of the kind that we have estimated.

Our theory also implies a second kind of heterogeneity. Any given change in resource rents or real incomes will only affect the probability of civil war when political institutions are non-inclusive (do not protect minorities) – i.e., when $\theta_c < \overline{\theta}_c$. In columns (2) and (3) of Table 3, we therefore split the sample between parliamentary democracies and non-parliamentary democracies. The pattern for export and import prices differ starkly across these subsamples. Non-oil primary export and import prices are positively correlated with civil war in the non-parliamentary democracies sample, but negatively correlated in the parliamentary democracies sample. (Also, GDP per capita and oil import prices are no longer significantly related to civil war in the latter group.) This conforms to the prediction in Proposition 7, which gives a key role to θ_c by determining in which equilibrium we expect a particular country to be.

Column (4) of Table 3 further disaggregates the export and import prices into agricultural products and minerals. The data suggest that it is agricultural import and export prices and mineral import prices drive the positive correlation with civil war. In column (5), we add in the weathershock variable, which is available only for a more restricted sample of countries and time periods. As expected, more extreme temperatures and more flooding are positively correlated with the incidence of civil war. In this sample, oil export prices continue to be statistically insignificant, while oil import prices now have the expected (positive) sign. For the sake of comparison with the above results, a one standard deviation increase in non-oil export prices, non-oil import prices and oil import prices raises the probability of civil war by, respectively, 14%, 15% and 7%.

Table 4 considers the robustness of this last set of the results to the

econometric specification and the estimation sample. In column (1), we report estimates from a conditional (fixed effects) logit model. Since this method effectively drops all countries and years in which there is no civil war, the sample is more restricted (to the 38 countries that have time-series variation in the left-hand side variable). These results confirm the findings of the model in column (5) of Table 3. That is, primary (non-oil) import and export prices are positively correlated with the incidence of civil war, as is the oil-import price index. Within this restricted sample, being democratic has no explanatory power, whereas a higher GDP per capita remains negatively correlated with civil war incidence. In column (2) of Table 4, we estimate a linear probability model on the same sample as the one used in the conditional logit. This is a useful cross-check that the econometric specification is not driving the results, as the results in columns (1) and (2) are essentially similar in economic terms.[18] In columns (3) and (4), we repeat the same exercise on the sample of non-parliamentary democracies that have had a civil war during our time period. The results are again consistent with those presented in Table 3.

The results in column (2) of Table 4 can be used to reassess the economic significance of the findings in column (5) of Table 3, given the different estimation method on a smaller sample of countries. Now, a one standard deviation increase in non-oil export prices, non-oil import prices, and oil import prices raise the probability of civil war (relative to the mean of the sub-sample) by, respectively, 20%, 11% and 14%. Note, however, that the sub-sample mean of conflict is as high as 0.28, i.e., more than one country year out of four is a conflict year. Evidently, this sub-group of countries is generally susceptible to conflicts, and particularly so when commodity prices are on the rise.

Table 5 instead assesses the robustness of the results to alternative measurement. Column (1) uses the UCDP/PRIO civil war incidence measure. Again, the results are quite similar even though the commodity import price index is no longer significant.

Column (2) looks at the onset of civil war, which has been extensively

[18] As a further check, note that the size of the coefficients in columns (1) and (2) are quite similar when adjusted appropriately, i.e. by multiplying the logit estimates by $\hat{p}\,(1-\hat{p})$ where $\hat{p}$ is the average predicted probability. Since $\hat{p}$ is on the order of 0.3, this means that the cofficients in column (1) should be multiplied by about 0.2 to make them comparable to those in column (2).

studied in the earlier literature.[19] The various ambiguities and difficulties in the coding of civil wars are also likely to imply considerably more measurement error for the onset than for the duration of any multi-year conflict (see Sambanis, 2004). Our theoretical model also does not give a specific prediction for onset apart from incidence – this would require having some explicit source of state dependence in the model. The results in column (2) suggest that our empirical model offers little explanatory power for war onset. This suggests that our time varying regressors are doing a better job at picking out periods with conditions for a civil war to be sustained over time, rather than conditions which are relevant only in periods when a civil war begins.

In column (3), we consider a more continuous measure of conflict – battle deaths. Again, the basic results from Table 3 remain robust: export and import prices are positively correlated with battle deaths. In columns (4) and (5), we assess the robustness of the results to splitting the sample according to whether the country has weak or strong executive constraints. In line with our findings in Table 3, it is only countries with weak executive constraints where civil war incidence is higher in the wake of higher non-oil primary export and import prices.

6 Concluding Comments

We have put forward a theoretical model to analyze the incidence of civil war. We have used this to interpret the data and to identify factors that affect the time-series and cross-sectional patterns of conflict. Our main empirical innovation has been to show that increases in the prices of exported and imported primary commodities have statistically and quantitatively significant positive effects on the incidence of civil conflict. The fact that we control for fixed country and year effects gets around one of the key worries in the literature, namely that unobserved characteristics of institutions, culture and economic structure are the primary drivers of civil war. Motivated by the theory, we have also shown that the effects of world-market prices are heterogeneous, depending on whether or not a country is a parliamentary democracy, or has a system of strong checks and balances, which we interpret as proxies for a key model parameter reflecting how consensual are political institutions.

The findings in this paper resonate with prior contributions emphasizing the role of institutions, economic development and natural resources in

[19] See, for example, Fearon and Laitin (2003).

affecting conflict. Much work remains, however, to complete our agenda geared towards interpreting empirical results on conflict through the lens of theoretical models. One helpful, but limiting, feature of the current model is the symmetry between incumbent and opposition groups. The model can be extended to incorporate income inequality so that wage rates are heterogenous. It can also be extended so that groups vary their weighting of national interests (national public goods) and private interests (transfers). Preliminary investigations in this direction suggest that the impact of such heterogeneity on conflict turns out to be subtle and less clear-cut than is often claimed based on intuitive reasoning.

Our empirical analysis has only superficially engaged with the distinction between onset and duration of civil war. To make further progress based on an underlying theoretical structure would require introducing an underlying source of state dependence so that the model is genuinely dynamic. This could be achieved by introducing group heterogeneity. The state variable would then be the group in power making the equilibrium in any given period state-dependent. This would lead naturally towards an empirical model where civil war incidence and political turnover are jointly determined.

Richer dynamics could also be introduced by expanding the model to include stocks of public and private capital. This would allow the joint evolution of conflict and economic development to be studied. A preliminary step in this direction is taken in Besley and Persson (2008b) which develops a model related to this one to analyze how state capacities evolve in response to the prospect of conflict. That paper shows how incentives to invest in institutions for raising tax revenues and supporting private markets may boost productivity. It would also be interesting to study how civil conflict shapes private incentives to invest in physical and human capital. It is clear, therefore, that much remains to be done to integrate the study of civil war with the study of economic growth.

References

[1] Aslaksen, Silje and Ragnar Torvik (2006), "A Theory of Civil Conflict and Democracy in Rentier States," *Scandinavian Journal of Economics*, 108, 571-585.

[2] Azam, Jean-Paul (2005), "The Paradox of Power Reconsidered: A Theory of Political Regimes in Africa," *Journal of African Economies* 15, 26-58.

[3] Besley, Timothy and Torsten Persson (2008a), "The Origins of State Capacity: Property Rights, Taxation and Politics", forthcoming in the *American Economic Review*.

[4] Besley, Timothy and Torsten Persson (2008b), "State Capacity, Conflict and Development", paper underlying Persson's 2008 Presidential address to the Econometric Society.

[5] Besley, Timothy and Torsten Persson (2009), "Repression or Civil War?", forthcoming in *American Economic Review*, Papers and Proceedings.

[6] Blattman, Christopher and Edward Miguel (2008), "Civil War," forthcoming in *Journal of Economic Literature*.

[7] Bruckner, Markus and Antonio Ciccone (2007), "Growth, Democracy, and Civil War", CEPR Discussion Paper No. 6568.

[8] Caselli, Francesco (2006), "Power Struggles and the Natural-Resource Curse," unpublished typescript, LSE.

[9] Chassang, Sylvain and Gerard Padro i Miquel (2006), "Strategic Risk, Civil War and Intervention", unpublished typescript, Princeton and LSE.

[10] Collier, Paul and Anke Hoeffler (2004), "Greed and Grievance in Civil War," *Oxford Economic Papers* 56, 563-595.

[11] Collier, Paul, Anke Hoeffler, and Måns Söderbom (2004), "On the Duration of Civil War," *Journal of Peace Research* 41, 253-273.

[12] Collier, Paul and Dominic Rohner (2008), "Democracy, Development and Conflict," *Journal of the European Economic Association* 6, 531-540.

[13] Dal Bó, Ernesto and Pedro Dal Bó (2006), "Workers, Warriors and Criminals: Social Conflict in General Equilibrium," mimeo, Brown University.

[14] Deaton, Angus and Ron Miller (1996) "International Commodity Prices, Macroeconomic Performance and Politics in Sub-Saharan Africa," Princeton Studies in International Finance, No. 79, Princeton, NJ, Princeton University, International Finance Section.

[15] Deininger, Klaus, (2003) "Causes and Consequences of Civil Strife: Micro-Level Evidence from Uganda." *Oxford Economic Papers* 55, 579-606.

[16] Dube, Oeindrila, and Juan Vargas (2008), "Commodity Price Shocks and Civil Conflict: Evidence from Columbia," unpublished manuscript.

[17] Elbadawi, Ibrahim and Nicholas Sambanis (2002). "How Much Civil War Will We See? Explaining the Prevalence of Civil War", *Journal of Conflict Resolution* 46, 307-334.

[18] Fearon, James (2005), "Primary Commodity Exports and Civil War " *Journal of Conflict Resolution* 49, 483-507.

[19] Fearon, James (2008), "Economic Development, Insurgency and Civil War," in Helpman, Elhanan (ed.), *Institutions and Economic Performance*, Harvard Economic Press.

[20] Fearon, James and David Laitin (2003). "Ethnicity, Insurgency and Civil War", *American Political Science Review* 97, 75-90.

[21] Garfinkel, Michelle R. and Stergios Skaperdas (2007), "Economics of Conflict: An Overview," in Todd Sandler and Keith Hartley (eds.), *Handbook of Defense Economics*, Vol. II, Elsevier.

[22] Grossman, Herschel (1991) "A General Equilibrium Model of Insurrection," *American Economic Review* 81, 912-921.

[23] Hirshleifer, Jack (1991) "The Paradox of Power", *Economics and Politics* 3, 177-200.

[24] Humphreys, Macartan (2005), "Natural Resources, Conflict, and Conflict Resolution: Uncovering the Mechanisms," *Journal of Conflict Resolution* 49, 508-537.

[25] Lacina, Bethany Ann and Nils Petter Gleditsch (2005), "Monitoring Trends in Global Combat: A New Dataset of Battle Deaths", *European Journal of Population* 21, 145–165.

[26] Miguel, Edward, Satyanath, Shanker, and Ernest Sergenti (2004), "Economic Shocks and Civil Conflict: An Instrumental Variables Approach", *Journal of Political Economy* 112, 725-753.

[27] Persson, Torsten and Guido Tabellini (2003), *The Economic Effects of Constitutions*, MIT Press.

[28] Ross, Michael (2004) "What Do We Know about Natural Resources and Civil War?", *Journal of Peace Research* 41, 337-356.

[29] Sambanis, Nicholas (2004), "What is Civil War. Conceptual and Empirical Complexities of an Operational Definition", *Journal of Conflict Resolution* 48, 814-858.

[30] Skaperdas, Stergios (1992), "Cooperation, Conflict, and Power in the Absence of Property Rights," *American Economic Review* 82, 720-39.

7 Proof of Lemma 2

To solve for the sun-game perfect equilibrium, we begin by deriving the reaction function of the incumbent to some fixed level of L^O. Maximizing (6), the first-order condition for the choice of L^I is

$$-\left[1-\theta-\gamma\left(L^O,L^I\right)(1-2\theta)\right]w+(1-2\theta)\,\mu\xi\left[Z-wL^I\right]\leq 0.$$

Solving for an interior solution, we obtain:

$$wL^I=\frac{1}{2}\left[L^O\frac{w}{\xi}+Z-Z^I\right]\ . \tag{17}$$

Thus L^I is strictly positive for all $Z>Z^I-L^O\frac{w}{\xi}$, making $Z<Z^I$ a necessary condition for $L^I=0$. Below, we will show that this is also sufficient.

Now consider the first-order condition to (7) for the opposition's choice of army, assuming that $L^I>0$. This is given by:

$$-w+\mu\left(1-\xi\frac{\partial L^I}{\partial L^O}\right)(1-2\theta)\,2[Z-wL^I]$$
$$-2w[\theta+\gamma\left(L^O,L^I\right)(1-2\theta)]\frac{\partial L^I}{\partial L^O}\leq 0\ .$$

We can solve this, using Assumption $1(a)$ and observing that $\frac{\partial L^I}{\partial L^O}=\frac{1}{2\xi}$, to obtain:

$$-w+\mu(1-2\theta)Z-\mu w\frac{L^O}{\xi}-w\frac{\theta+\gamma^O\,(1-2\theta)}{\xi}\leq 0\ . \tag{18}$$

We now prove the result. By the definition of Z^O, a sufficient condition for $L^O>0$ is $Z\geq Z^O$. Observe also that since $Z^O>Z^I$, $L^O=0$ for $Z<Z^I$, which makes $Z<Z^I$ necessary and sufficient for a peaceful equilibrium.

Hence for $Z\in\left[Z^I,Z^O\right]$ we have $L^I>0$ with the level in part 2 of the Lemma given from (17). Finally, for $Z>Z^O$, we find that:

$$\frac{L^Ow}{\xi}=Z-Z^O\ , \tag{19}$$

where Z^O is defined in (9) as long as $L^O<\nu$, so the opposition is not constrained by its revenue raising capacity. Plugging (19) into (17) gives wL^I as stated in the Lemma. ■