

Faulty fighting

Misinterpretations of the gains from conflict

Tarjei Havnes*

October 11, 2007

Work in progress. Please do not distribute or quote.

Abstract

This paper considers how rational groups may come to misperceive the gains from conflict. It is shown how experiences of public policies may differ from actual policies, and at the extreme may lead to revolts on false premises. The aim is to give a first idea of how misperceptions and overambitions are formed, and how rational groups may act upon them. Bayesian updating is employed to form group perceptions. Increasing transparency may not solve the problem in the short run.

The framework is applied to show how misperceptions may increase the likelihood of conflict particularly in poor countries with low levels of education. Intragroup inequality in wages or education is shown to increase the probability of revolt.

1 Introduction

The division of resources, and the implementation of policies, are often solved in untraditional ways; through theft, coercion or violent conflicts. One of the main arguments why wasteful conflicts occur, even when settling should be

*Department of economics, University of Oslo. Contact: tarjei.havnes@econ.uio.no

pareto improving, has been that parties in a conflict have imperfect information: They believe themselves stronger and with a better chance in an outright struggle, or they overestimate the potential gains from fighting directly. In this paper, the aim is to study how misperceptions may form rationally, and under what circumstances they may be likely to generate conflict.

In the literature, conflicts are roughly thought to be fueled by an exceedingly wide gap between aspirations and accomplishments (Pruitt et al., 2003). Many authors in economics and other disciplines have shown why the standard coasian approach (Coase, 1960) may not be suitable in the context of civil conflict (see for instance Acemoglu (2003)).

The main argument revolves around enforcement problems: Contracts cannot be implemented, due to particularly incomplete information, bounded rationality or transactions costs, and a lack of efficient institutional infrastructure (for surveys of the literature, see e.g Collier and Hoeffler (2006), Sambanis (2002) or Fearon (1995)). Skaperdas (2007) considers all eruptions of conflicts to be the result of problems of incomplete contracting.

A main strand of the literature, considers imperfect information (e.g. Brito and Intriligator (1985); Esteban and Ray (2001); Bester and Warneryd (2006)). Parties may be overambitious with regards to the outcome of a conflict, or underestimate their costs, leading them to become too demanding in the bargaining process. In fact, there may not be any pareto improving alternatives to conflict. Esteban and Ray (2001) show that this may be the case with as little as four players, when information is incomplete.

Previous literature has taken the misperceptions for granted, attributing them loosely to some notion of asymmetric information or bounded rationality. Bester and Warneryd (2006) for instance, let two parties in a conflict draw a random fighting efficiency, and show that sharing arrangements must give positive probability on conflicts that are not too wasteful.

The aim of this paper, however, is to model *how* parties become overambitious, in an effort to shed light on the characteristics that facilitate or deter this. A main point is to create a framework for uncovering when overambition is likely to occur. This could guide policy makers, and would make for better specifications in the empirical literature. Collier and Hoeffler (2004), for instance claim that greed and motives are “observationally equivalent since we cannot observe motives”. While this is certainly true, the purpose of the current paper is to tickle out when misperceptions are likely to be important. That is, when the motives for conflict might be a result of process more than of policies.

To fix ideas, I have chosen a setting which I hope will make immediate sense to the reader: Parties choose whether or not to oppose an incumbent regime on the basis of their perceptions about discrimination against their members on the labor market.

This situation seems fitting for many real world conflicts: In the Kurdish conflict in Turkey, for instance, this argument is omnipresent in the discourse from leaders and followers alike. Since official statistics do not report ancestry, the assessment of actual discrimination may be difficult, and the claims, even if made honestly, may miss the mark.

In Turkey, economic disparities can cause people to develop a heightened awareness of their class or regional identity. But because the southeast of Turkey is both the poorest region and the only predominantly Kurdish part of the country, economic disparities lend themselves particularly well to heightened, politicized ethnic identity formation. Poverty in the southeast comes to be blamed on central government's neglect of or discrimination towards the Kurdish minority. (Icduygu et al., 1999, p. 998.)

Whether the perception of discrimination in this particular conflict is exaggerated or not, is a minefield that I aim to avoid. Rather, the question is under what circumstances such exaggerations may be likely, a precursor to answer how they may most efficiently be avoided.¹

It should be emphasized, however, that other cases than labor market discrimination could easily be accommodated within the framework presented. Discrimination may, for instance, take place in education or elsewhere, or the parties may disagree over the division of the public budget. What is crucial is that the process is stochastic to some extent and that there is some lack of commitment, such that misperceptions may form. In the case of the division of the public budget, for instance, we may think of a situation in which short term or long term budgets are (perhaps heavily) constrained and investment or spending is discrete. This would imply some sequencing of spending, which could potentially be diverted more towards some groups in early stages. If the parties find reason to suspect such diversion, and

¹To be quite clear: While conflicts may be more likely when parties overestimate their grievances, the present paper makes no presumptions about whether miscalculations will tend to go up or down. In the model developed below, a group will be equally likely to overestimate as they will be to do the opposite.

the regime cannot credibly commit to an investment plan, then even a random selection of projects might ignite (rational) claims of discrimination and potentially lead to conflict.

Another case the model (with minor modifications) should be able to cover is discrimination of minorities in criminal courts, if the public can only observe high profile proceedings (e.g. murder cases). Here, the premise of the case, the actual guilt or innocence of the defendant, may not be verified, and there are only a few cases each year. Thus the public may mistake a freak strain of guilty verdicts against their own group, due to above-average prosecution accuracy, for a discriminatory court system. Similarly, even when no discrimination is in place, a random sequence of controversial acquittals may cause the victims group to believe they are discriminated against. An investigation within this framework of racial riots in the US, for instance, would be very interesting.²

Robinson and Torvik (2005) give examples of how regimes may implement suboptimal policies to secure political advantage. Among others, they cite Weingrod (1977, p. 42, cited on p. 201) claiming that

[p]atrons are powerful since they can tap and distribute tangibles—government contracts, jobs, loans and the like—and it is through the shrewd investment of these resources that they build and maintain their personal clientele.

The model proposed takes as its starting point that incumbent regimes may influence the employment process in 'good' jobs—in the below jobs with a high wage (think of these as government jobs). This may particularly be the case in some poor countries, where group ties may be strong, institutions weak and where cultural norms may be especially stringent on intra-group generosity.

My approach is not as stark as Weingrod's. The regime is not able to simply distribute jobs at will (which would push us back to a standard conflict model with exogenous gains), but are rather able to influence the employment process to secure a less than fair chance to some groups. Because a bad outcome may derive either from discrimination or simply from bad luck, parties may rationally overestimate discrimination. Obviously, this implies that in the extreme they may revolt on false premises.

²A basic premise here, as in most of the conflict literature, is that ordinary political process is constrained in some sense (or at least conceived to be). If not, then standard models of political economy may be more appropriate.

The key distinction that will drive the results is the one between *actual* and *perceived* public policy—in the context applied, the actual and perceived level of discrimination against the individual groups. I am not concerned about the political process or strategic considerations that leads to the implementation of regime policy. The groups in the model will therefore not fight to become the incumbent. Instead, groups will have the possibility to topple the regime, in which case a new one will be drawn according to a prescribed rule. This simplification ensures that groups revolt only due to perceived discrimination. Actual discrimination is in general assumed to be sufficiently low that the group would not want to revolt if it had perfect information.

Among other things, the results show that groups will tend to revolt more often when they are large, patient and powerful. On the country level, revolts are more likely when the incumbent regime is recently established, and when the population is larger. Higher transparency does not necessarily solve the problem in the short run.

The framework is finally applied to study the relationship between conflict and affluence and inequality. The results show that poor uneducated groups with high intragroup inequality in education or wages are most exposed to overambitions. We find no effect of the wage level or of intergroup inequality.

The paper proceeds as follows. Section 2 describes the basic model and derives the individual group probabilities of revolt and the probability of revolt on the country level. To illustrate the model, a numerical example is presented in section 3. Section 4 considers how increased transparency may not always alleviate the problem in the short run, and shows that it may even make matters worse. Section 5 finally applies results to study the effects of affluence and inequality in wages, income and education. Section 6 concludes.

2 The basic model

Say there are m groups in an economy, and that group i consists of N_i individuals. Groups may differ in their attractiveness on the labor market, and in the actual and perceived intensity of discrimination against them, at time t denoted D_i and δ_{it} respectively. There are two types of jobs available, the 'good' job that pays a high wage $\bar{w}$, and the 'bad' job that pays a low wage $\underline{w}$. Individuals from group i have an average attractiveness on the

labor market indexed by $\gamma_i \in (0, 1)$ (section 5.2 considers how this may be a function of education). Given actual discrimination D_i , this in turn determines their likelihood of getting a good job ψ_i .

The actual intensity of discrimination is assumed to be unknown, though the groups have priors about it, given the current regime, denoted δ_{i0} . In this paper, the focus is on the response of the groups to their perceptions about discrimination against them. The regime and the potential strategic choice of discrimination is therefore disregarded.³

Throughout the model, the regime will establish an actual level of discrimination D_i and a given 'regime prior' δ_{i0} . The regime policy may not be changed unless a revolt is staged and successful, in which case a new regime takes office. The expected discrimination from installing a new regime—that is the groups' outside option—will be fixed and generally different from the regime prior. We denote this by δ_i , suppressing the time subscript for obvious reasons.

The individual thus receives a stochastic wage given by the system below.

$$w_{ij} = \begin{cases} \bar{w}, & \text{with probability } \psi_i = (1 - D_i)\gamma_i \\ \underline{w}, & \text{otherwise} \end{cases} \quad (1)$$

$$\bar{w} > \underline{w}, \quad D_i \in [0, 1] \quad (2)$$

When wages are determined, a benevolent group leader may verify the outcome for a specified number of affiliates, k_i . Given this observation, the group leader updates her beliefs using bayesian updating. On the basis of her update she then chooses whether or not to revolt against the current regime, giving a fixed probability of regime change ρ_i . This probability can for instance be increasing in group size, to reflect that small groups should have a smaller chance at challenging stability.

To sharpen the focus, what regime is actually installed after a successful revolt, should *not* depend on which group that toppled the previous. This implies that, from the point of view of the revolting group, the new regime may well be even worse than the previous. This may seem strange at first, but is not entirely unreasonable, since it is certainly not clear that a revolutionary group that successfully topples the government, will be awarded with a more amicable regime.⁴

³This is the focus of current research.

⁴In principle, we could allow for this, but I have not found a satisfactory approach

We will also assume that all jobs are reallocated every period. Potentially, one could imagine that the group builds up a stock of members with good jobs, and that revolting only influences the employment process of those who have not yet been allocated to a job. In this case, the model would hold if those who are already employed are not influenced by the revolt, or if the effect on these is completely exogenous. What qualifications must be taken if this is not true, and how profound these changes would be, is not considered here.

Before we consider the decision process and the probability of revolt, let's sum up and clarify the dynamics of the game by listing the stages.

1. A regime is installed, giving actual discrimination levels D_i and priors δ_{i0} .
2. Group leaders update using Bayes' rule, and choose whether to oppose the regime or not. If some group opposes, return to stage 1. Else, go to stage 3.⁵
3. Jobs and wages w_{ij} are drawn.
4. End of time period; Go to stage 2.

The group leader is risk neutral, and considers her expectation about group utility in the two cases, using the simple social utility function

$$U_{it} = \frac{1}{N_i^\alpha} \sum_{j=1}^{N_i} w_{ijt} = \underline{w} + \frac{N_{it}^{\bar{w}}}{N_i^\alpha} (\bar{w} - \underline{w}), \quad \alpha \in (0, 1) \quad (3)$$

where $0 \leq \alpha \leq 1$, and $N_{it}^{\bar{w}}$ is the number of the observed individuals that actually have a good job.

that would provide reasonable intuition, and not just clutter up the argument. This is particularly true in the current model, where several groups could potentially revolt successfully at the same time.

⁵One might argue that groups should update and choose whether to revolt in the final stage. However, this would imply that groups were willing to let a regime set up office, even if they are almost sure that they will revolt at the end of the period. Placing the decision to revolt at the start of the periods thus in a sense takes into account the outright or implicit bargaining process prior to a government taking office. (It also might account for any depreciation that is not included in this analysis.) If the reader prefers, she might well move the updating/revolting stage to the end while adding an assumption on the formation of regime. This would be essentially equivalent.

The choice of a utility function without concavity simplifies the analysis considerably. Meanwhile, the effect that decreased risk would have on utility (over time through a higher number of observations) should be rather obvious: Initially, the group may buy another signal by waiting one more period. Since this makes the posterior more precise, revolts will be less likely given perceived discrimination. This tendency should be stronger the shorter is the history of the current regime (see Meyer and Zweibel (2006) for an explicit modelling of a somewhat similar mechanism). Therefore, the assumption does not seem too restrictive.

If the group leader chooses to revolt, then the payoff if she succeeds is fixed, given by the expected discrimination unconditional of regime, δ_i . If the revolt is successful or not, we subtract some fixed cost of revolting C_i . The costs may well be a function of group characteristics, such as size, wage level or average talent. However, they should be independent of actual and perceived discrimination, as well as of the (actual and perceived) share with a good job.

If the leader chooses not to revolt, then the expected outcome depends on her perceptions about the current level of discrimination against the group. For simplicity, assume that she expects a zero probability of any other group revolting.⁶ Using that the assignment to jobs is binomial such that $EN_i^{\bar{w}} = N_i\psi_i$, and letting the depreciation rate be fixed at $\beta \in (0, 1)$, the group leader at any time has the outside and inside option given in equations 5 and 7 respectively.

$$E\left(\sum_{t=0}^{\infty} \beta^t U_{i,t} \middle| \delta_i\right) - C_i = \frac{\bar{U}_i}{1 - \beta} - C_i \quad (4)$$

$$= \frac{1}{1 - \beta} [\underline{w} + (\bar{w} - \underline{w})N_i^{1-\alpha}\gamma_i(1 - \delta_i)] - C_i \quad (5)$$

$$E\left(\sum_{t=0}^{\infty} \beta^t U_{i,t} \middle| \delta_{i,t-1}\right) = \frac{V_{it}}{1 - \beta} \quad (6)$$

$$= \frac{1}{1 - \beta} [\underline{w} + (\bar{w} - \underline{w})N_i^{1-\alpha}\gamma_i(1 - \delta_{i,t-1})] \quad (7)$$

The probability of revolt may now be expressed simply as the probability of

⁶The effect of inclusion being exogenous, this can essentially just be considered a normalization on the revolt cost.

the expected gain from revolting being positive.⁷

$$Pr \left[\frac{(1 - \rho_i)V_{it} + \rho_i\bar{U}_i}{1 - \beta} - C_i > \frac{V_{it}}{1 - \beta} \right] = Pr \left(\delta_{it} > \delta_i + \tilde{C}_i \right) \quad (8)$$

where the effective real cost in discrimination units $\tilde{C}_i$, is just the flow equivalent of the revolt cost, scaled down by the expected gain from revolting.

$$\tilde{C}_i = \frac{(1 - \beta)C_i}{\rho_i(\bar{w} - \underline{w})N_i^{1-\alpha}\gamma_i} \quad (9)$$

To ease the exposition, let $\psi_i = \gamma_i(1 - D_i)$ signify the probability of a good job given actual discrimination, while $\psi_{it} = \gamma_i(1 - \delta_{it})$ indicates the expectation at time t given the group leaders expectation about discrimination. Notice that δ_{it} in equation 8 is just a fixed transformation of the binomial variable K_{it} , given the prior δ_{i0} .

$$\delta_{it} = 1 - \frac{\psi_{it}}{\gamma_i} \quad (10)$$

Solving the model is in general hard, since there may not be a simple relationship between the prior and the posterior beliefs. However, we can use the fact that the beta distribution is a *conjugate prior* of the binomial distribution (see Diaconis and Ylvisaker (1979) or Rice (2001)). Since the leader is using bayesian updating, this implies that if the prior distribution is beta, and the signal is binomial, then the posterior is also beta. This in turn means that the updating problem takes on a recursive structure that makes it convenient to work with.

The beta distribution also has characteristics that makes it well suited for our purpose: It is confined to the unit interval, and highly flexible: it may be uniform, bell shaped, exponential, or right- or leftskewed. (For more on the distribution, see for instance Rice (2001).) Finally, the beta is in fact the only conjugate prior of the binomial distribution (Diaconis and Ylvisaker, 1979). Allowing for a beta prior thus seems to be the only viable route for solving the model.⁸ This yields a simple recursive linear form for the posterior ψ_{it}

⁷By a slight abuse of notation, I let δ_{it} indicate both the stochastic variable and its realization.

⁸In general, we might approximate the binomial with the normal distribution and then use standard gaussian updating, or to preserve precision, approximate with the poisson and use a gamma prior. However, it is crucial to the paper that the number of observations (signals) is not too large, and these approximations will hence not do (not even with many observations if ψ_i is too small or large (Rice, 2001, p. ?)).

over time.⁹

$$\psi_{it} = \frac{(a_{i,t-1} + b_{i,t-1})\psi_{i,t-1} + K_{it}}{a_{i,t-1} + b_{i,t-1} + k_i} \quad (11)$$

where $t > 0$ and $\psi_{i0} = (1 - \delta_{i0})\gamma_i$, and a_{i0} and b_{i0} are exogenous. As should be expected, the prior declines in importance when the signal gets more precise (here when the number of confirmed observations k_i becomes large, and/or when the regime history t becomes long).¹⁰

We may now rephrase the probability of revolt into the conditional probability of a 'sufficiently low' share of the observed workers that have a good job, given history under the regime. Following equation 8 and inserting from 10 and 11,

$$Pr(\delta_{it} > \delta_i + \tilde{C}_i) = Pr(K_{it} < \bar{K}_{it}) \equiv p_{it} \quad (12)$$

where $\bar{K}_{it}$ is defined below.¹¹

$$\bar{K}_{it} = \gamma_i \left[k_i(1 - \delta_i - \tilde{C}_i) - \frac{a_{i,t-1}}{\delta_{i,t-1}}(\delta_i + \tilde{C}_i - \delta_{i,t-1}) \right] \quad (13)$$

By simply employing the binomial distribution and the definition of a discrete cumulative distribution function, we can now show that the probability of group i revolting at time t is given by equation 14.

$$p_{it} = \sum_{r=0}^{\bar{K}_{it}} \binom{k_i}{r} (1 - D_i)^r \gamma_i^r (1 - (1 - D_i)\gamma_i)^{k_i - r} \quad (14)$$

$$= \sum_{r=0}^{\bar{K}_{it}} \binom{k_i}{r} \psi_i^r (1 - \psi_i)^{k_i - r} \quad (15)$$

$$\equiv p\left(\begin{matrix} k_i & \gamma_i & \tilde{C}_i & \delta_i & \delta_{it} & D_i & \delta_{i0} \\ +/- & +/- & - & - & + & + & + \end{matrix} \right) \quad (16)$$

Having determined the probability of any individual group revolting, aggregating to the country level should be straight-forward. We say that a revolt

⁹The updated parameters are $a_t = a_{t-1} + K_{it}$ and $b_t = b_{t-1} + k_i - K_{it}$.

¹⁰Simply notice that $K_{it} = k_i K_{it}/k_i$, which is an unbiased and consistent estimator of ψ_i

¹¹Since the parameters of the beta distribution are merely technical, and to clarify the effect of δ_{it} (which cannot change independently of both a_{it} and b_{it}), I substitute $1/\delta_{i,t-1} = (a_{i,t-1} + b_{i,t-1})/a_{i,t-1}$ to get the fractions in equation 13.

occurs in a country if at least one of the m groups present within it chooses to revolt. The probability that this happens P_t is thus simply the joint probability that none of the groups revolt, or just the inverse of the probability of peace.

$$P_t = 1 - Pr(\text{no revolt}) \quad (17)$$

$$= 1 - Pr\left(\bigcap_{i=1}^m K_{it} > \bar{K}_{it}\right) \quad (18)$$

$$= 1 - \prod_{i=1}^m (1 - p_{it}) \quad (19)$$

$$\equiv P\left(\begin{matrix} m \\ +/- \end{matrix}, \begin{matrix} \mathbf{k} \\ +/- \end{matrix}, \begin{matrix} \gamma \\ +/- \end{matrix}, \begin{matrix} \tilde{\mathbf{C}} \\ - \end{matrix}, \begin{matrix} \delta \\ - \end{matrix}, \begin{matrix} \delta_{\mathbf{t}} \\ + \end{matrix}, \begin{matrix} \mathbf{D} \\ + \end{matrix}, \begin{matrix} \delta_0 \\ + \end{matrix}\right) \quad (20)$$

where the third equality follows from independence of the observations and from equation 14, and bold letters indicate vectors of variables such that $\mathbf{x} = \{x_i\}_{i=1,\dots,m}$.

Consider first the individual groups. It follows immediately from equation 14 that $\partial p_{it}/\partial \tilde{C}_i$ and $\partial p_{it}/\partial \delta_i$ are negative, while $\partial p_{it}/\partial \delta_{it}$, $\partial p_{it}/\partial D_i$ and $\partial p_{it}/\partial \delta_{i0}$ are positive: As costs decrease or the outside option improves, the group gets more likely to revolt, all else given. The same is true if the history under the current regime till now has been unsatisfactory, that is if the group in the past repeatedly has achieved less than it expects or aspires to, such that the belief of significant discrimination is strengthened. Likewise, if actual discrimination is high, or if it is highly prejudiced against the current regime (the prior is higher), then the group will be more likely to revolt.

The effects of the first two arguments, transparency and attractiveness on the labor market are less direct or intuitive. Regarding the former, it would seem that increasing transparency should alleviate the informational problems, and therefore reduce the probability of mistakes, be it postponing revolts when they should be staged, or staging them when you should not. While this by the law of large numbers is clearly true in the limit, as k_i or its accumulation over time becomes large, it turns out that it is not necessarily monotonic; Higher transparency may in some cases increase the probability of mistakes in the short run. This is studied in the next section.

The group's attractiveness on the labor market also has an ambiguous effect, though it may 'normally' be assumed to be negative. This is studied in section 5, when we consider the effect of income on revolt probabilities.

Summing up the effects on groups, several results are straight-forward: Groups are more likely to revolt when

- they are patient; β is large.
- they have many members; n_i is large.
- they are prejudiced against the regime; δ_{io} is large.
- they believe the post-revolt regime would be favorable; δ_i is small.
- they are severely discriminated against; D_i is large.
- they are powerful such that a revolt is likely to succeed; ρ_i is large.

Turning to the country level, countries where groups are more likely to stage revolts should obviously experience them more often. More specifically, we may also deduce that revolts are likely in countries where

- the regime is recently established; t is small.¹²
- there is a large population; $N = \sum_i N_i$ is large.

To illustrate the potential explanatory power of the model, the next section considers a numerical example. In section 4, we then address the more general question of when reducing the informational constraint, that is increasing transparency k_i , may reduce the risk of mistakes.

Finally, in section 5, we apply the model to study the relationship between revolt probabilities and affluence, on the one hand, and inequality on the other. Both wages, income and education are considered.

3 Numerical example

Before turning to the general results, it might be illuminating to illustrate by some numerical examples.

¹²At least when groups have reasonably accurate priors. In the cases where groups are confidently overoptimistic (the prior is way low and very precise; $a_0 \ll b_0$), it may be hard, or indeed impossible, to shift beliefs sufficiently in one or a few periods to generate conflict. This is particularly true when transparency is low. See example in footnote 15 below.

In the simulations below, use the parameters (dropping the group subscript) $k = 10$, $\underline{w} = 1$, $\bar{w} = 10$, $\gamma = .5$, $\beta = .95$, $\alpha = 1$ and $\rho = .5$. Let further the expected option be relatively good $\delta = .1$, and fix the prior at the beginning of the regime at $\delta_0 = .5$.¹³ Finally, let the cost of revolting be relatively high $C = 30$ (notice that this is more than three times the wage gap). We will consider the history of a regime over 100 periods, and draw 10,000 different histories. As soon as a history leads to revolt, we record it and start on the next.

As a benchmark, consider what intensity of discrimination would make the group leader revolt, should he know it perfectly. By substituting perceived for actual discrimination in equation 8, we easily find that the group leader revolts if

$$D_i > \bar{D} \equiv \delta_i + \tilde{C}_i \quad (21)$$

We easily find that groups in our example would revolt under full information if discrimination was higher than .7667. A reasonable experiment then, is to consider if and when revolts are staged in cases where discrimination is above or below this threshold. Obviously, the further from $\bar{D}$ is actual discrimination, the less likely will it be that history randomly causes misperceptions severe enough to cause false judgment.

Consider first the case in which we would expect revolts. Panel (a) in figure 1 gives the simulated distribution for $D = .85$. In this first example, the groups should revolt, and they do: After 100 periods, all 10,000 histories have generated revolts. However, under full information they would do so immediately. The misperceptions generated from the random histories and the overly optimistic prior, postpone revolt: The latest revolt is staged only after 52 periods.

The second case is the one in which discrimination should not be sufficient to cause revolt. In panel (b) of the figure, actual discrimination is set below the threshold at $D = .65$. While no group revolts as the history becomes long and the estimations become more precise, some groups still revolt in early periods. In total, more than 11 percent of histories cause revolts, the latest staged after 32 periods. Inspection reveals that one history in this sample generates revolt (in period 3) even when discrimination is at a low .28.

¹³The parameters are set at $a_0 = b_0 = 2$ to ensure a unique interior peak, and to generate some variance. The variance of the prior is here .05, which is relatively dispersed. As usual, the prior has little or no bearing as the number of observations or periods becomes large.

In both cases, the distributions are clearly right-skewed, illustrating how revolts are more likely in early periods.

Figure 1 about here.

Before we move on, notice that the simulations above omit the fact that some rebels will be unsuccessful. Therefore, the actual number of revolts will likely be higher than indicated, since some unsuccessful groups might revolt more than once.

4 Transparency

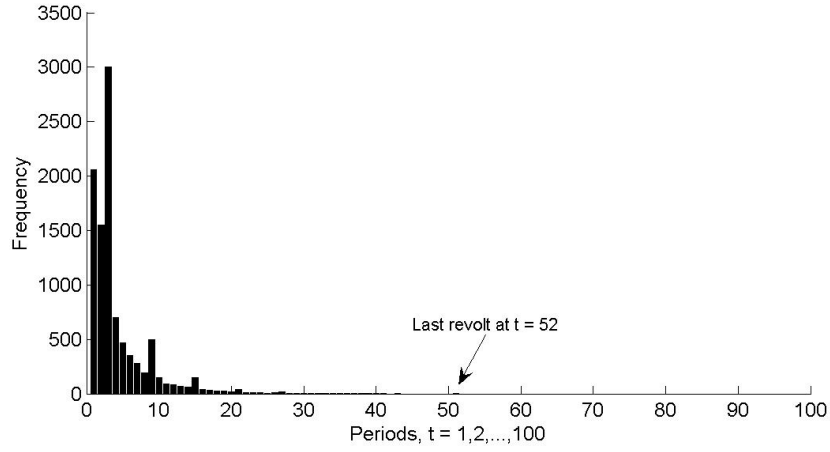
We now address the question of when increased observability may reduce the problems of misperception—i.e. the effect of k_i . Intuition, at least the author’s, suggests that higher transparency helps reduce the probability of revolt. This turns out not to be the case in general, though it will hold in the medium and long run.¹⁴

There are two separate and potentially contravening effects: Firstly, we have what we may call an *aspirations effect*, influencing how the group reacts to observations. Increasing observability makes the signal more precise, and hence more valuable as a decision tool. This implies that the prior decreases in importance, and the group revolts for some observations where it would not in a less transparent setting. The increased precision of the signal makes the group more sensitive to the outcomes.¹⁵

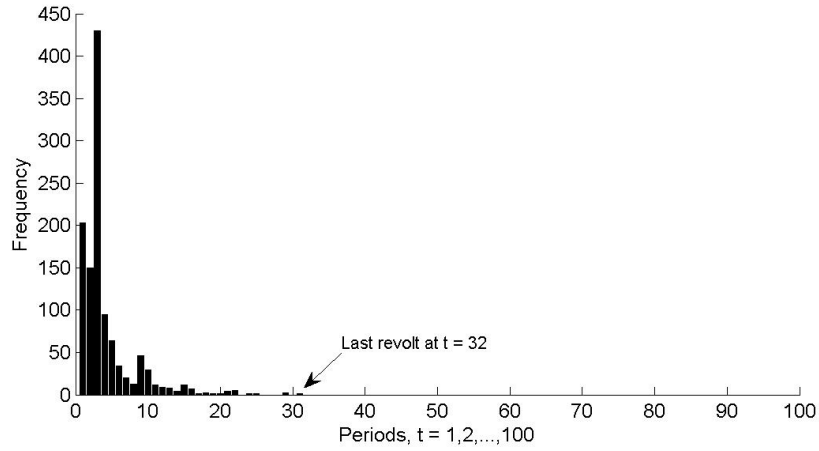
The second effect works through the stochastic process itself, and we might call it an *achievements effect*. When the number of individuals observed is increased, a larger number of events may occur. This decreases the probability of each marginal event (that a given number of good draws is observed). Meanwhile, each marginal event, defined as a fixed number of

¹⁴There are two ways of posing this question: First, if at time t transparency is increased, what is the effect on the probability of revolt in this period? Second, if transparency is higher, how does this change the path of the probability over time? I consider the first of these. The answer to the second should obviously be that over time, the truth is revealed earlier, and action is hence more likely taken according to it.

¹⁵As an example, consider the numerical exercise above, and compare if the number of observations were only four. Then the maximum second period prior may be .75, whereas it is .8571 when $k = 10$. Since, as shown above, a group revolts only if its prior is above .7667, clearly increasing transparency here causes the probability of revolt in the first period to increase (from zero, as it were).



(a) $D = .85 > \bar{D}$. Total revolts: 100%.



(b) $D = .65 < \bar{D}$. Total revolts: 11.55%.

Figure 1: Simulated frequencies of revolts over regime history when informed groups would revolt (panel a) and when they would not (panel b). Assumptions are given in the text. (Pseudo-random draws are generated with `binornd` in Matlab version 4, with the seed set at 220779.)

good draws, must include a higher number of bad draws. This in essence amounts to allowing any of the previous good draws to be bad, given that a new draw is good. As is shown in the proof to proposition 4, when the probability of a good draw is low, the total effect may well be to increase the probability of revolt.

Proposition 1 *Higher transparency k_i may increase the probability of revolt if discrimination is intense (D_i is high), and/or if the group is unattractive on the labor market (γ_i is low). This is true even when $D_i < \bar{D}$.*

Proof. Let $p_{itr} = \Pr(K_{it} = r)$ be the marginal probability of observing r individuals with good jobs. Then

$$\frac{\partial p_{it}}{\partial k_i} = p_{it\bar{K}_{it}} \frac{d\bar{K}_{it}}{dk_i} + \sum_{r=0}^{\bar{K}_{it}} \frac{dp_{itr}}{dk_i} \quad (22)$$

If group i may potentially revolt, then $\delta_i + \tilde{C}_i < 1$, and the effect on the threshold is positive (cf. equation 13).

Meanwhile, the second part of equation 22 turns out to be negative if ψ_i is not too small. This is most easily seen by using the fact that an increase must be discrete. Drop the time subscripts, and define $p_{ir} = \text{bin}(r; k_i, \psi_i) = \binom{k_i}{r} \psi_i^r (1 - \psi_i)^{k_i - r}$. Now let the number of tries increase by Δ ; Define the new marginal probability as

$$p'_{ir} = \text{bin}(r; k_i + \Delta, \psi_i) = \frac{\binom{k_i + \Delta}{r}}{\binom{k_i}{r}} (1 - \psi_i)^\Delta p_{ir} \quad (23)$$

For the effect to be positive, we must have that

$$\frac{p'_{ir}}{p_{ir}} = \frac{\binom{k_i + \Delta}{r}}{\binom{k_i}{r}} (1 - \psi_i)^\Delta > 1 \quad (24)$$

in which case

$$\psi_i < 1 - \left[\frac{\binom{k_i}{r}}{\binom{k_i + \Delta}{r}} \right]^{\frac{1}{\Delta}} \equiv \tilde{\psi} \in (0, 1) \quad (25)$$

■

This shows that higher transparency may well increase the probability of

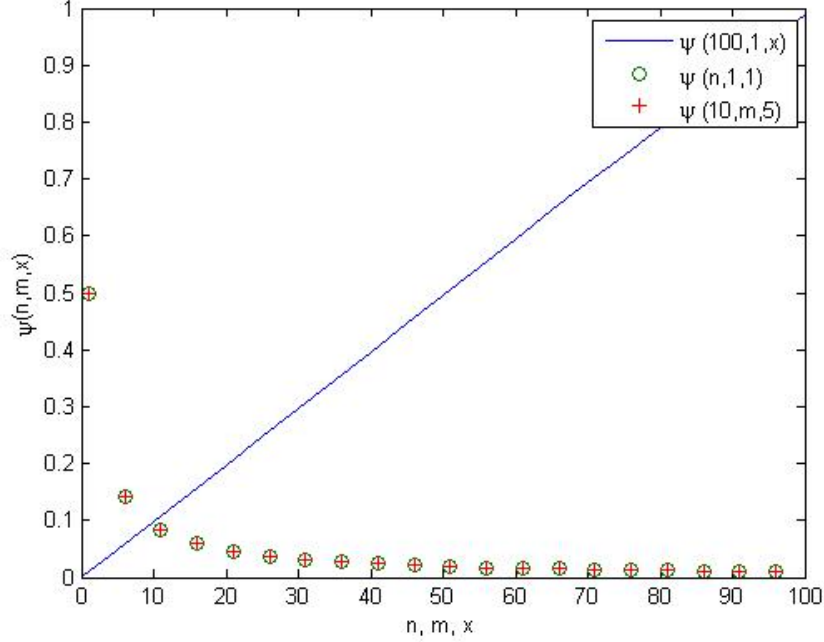


Figure 2: Probability of good jobs necessary to make marginal effect of observability negative.

revolt, particularly if the group is unattractive on the labor market, or discrimination against them is fierce, and transparency is initially low.

That transparency may increase the probability of revolt when there is a lot of discrimination, seems intuitive. That the same might happen if the group is unattractive on the labor market, is perhaps more surprising. The driving force behind this is that the signal gets less informative when it becomes more clustered towards the bad events. Mistakes may therefore happen more often.

We may notice some properties of $\tilde{\psi}$: On the one hand, it goes to zero as the increase in observations or the previous number of draws goes to infinity. On the other hand, since the denominator grows faster than the numerator, it is strictly increasing in $r < k_i$. Figure 2 shows how the cutoff point evolves as we vary n , Δ and r respectively.

Figure 2 about here.

For reference, we may write down the following definition which takes into

account the effect on the entire probability of revolt, and not just the marginal probabilities.

Definition 1 *When $k_i < N_i < \infty$, there exists a $\psi_i > 0$ small enough such that $\partial p_{it}/\partial k_{it} > 0$. Let $\bar{\psi}_i$ be the largest ψ_i such that $\partial p_{it}/\partial k_i \geq 0$.*

Note that there is nothing in definition 1 that precludes $\bar{\psi}_i$ from being above one in a specific application, such that it is not practically attainable. It does however seem reasonable that $\bar{\psi}_i$ is small in most cases.

A word of caution is in order before we move on: Remember that in obtaining this result, the actual discrimination level is held constant. Intuitively, higher transparency will tend to dissuade the regime from pushing discrimination too far, and the total effect may in a richer framework be to decrease the probability of revolt more unambiguously. This is the focus of current work.

4.1 Examples

As an example, consider the numerical exercise above, and compare if the number of observations were only four. Then the maximum second period prior may be .75, whereas it is .8571 when $k = 10$. Since, as shown above, a group revolts only if its prior is above .7667, clearly increasing transparency here causes the probability of revolt in the first period to increase (from zero, as it were).

We may also illustrate by redoing the numerical exercises from section 3 for different levels of transparency, setting $\gamma_i = .1$, and $C_i = 6$ (we reset the costs to ensure that discrimination is not too far above $\bar{D}$). Figures 3 and 4 report the result from these simulations for respectively the total number of revolts and the period in which the latest revolt was staged. Clearly, increasing transparency does not eliminate the problem. It does also seem that the plot in figure 3 is increasing over the first 15–20 periods.

Figures 3 and 4 about here.

5 The effects of affluence and inequality

The purpose of the paper is to explore under what circumstances misperceptions may be a driver of conflict. Section 2 set up a framework in which to

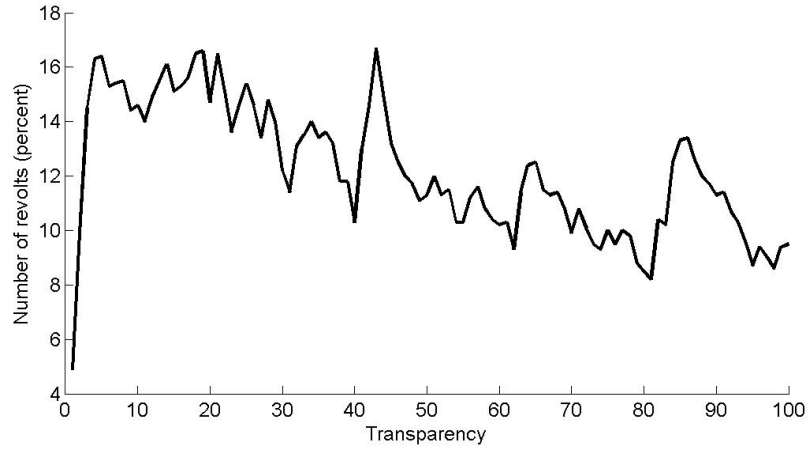


Figure 3: Simulated number of revolts (percent) over 100 regime periods for different levels of transparency. $\gamma = .1$, $D = .65 < \bar{D} = .7667$.

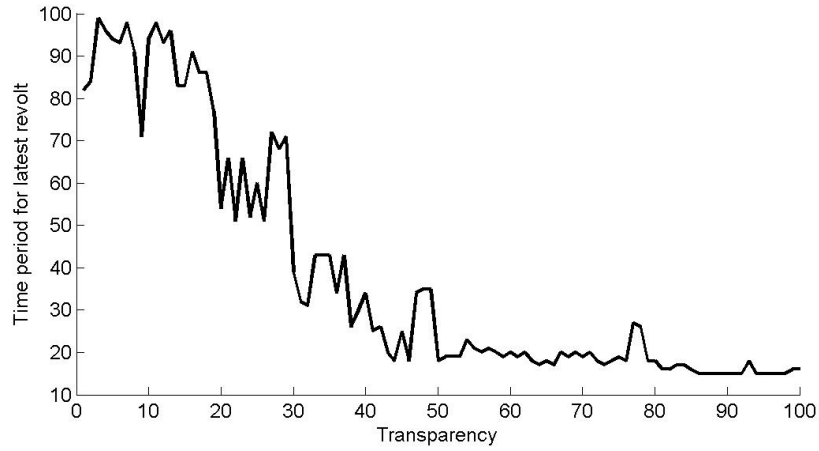


Figure 4: Latest period revolt is staged for different levels of transparency. $\gamma = .1$, $D = .65 < \bar{D} = .7667$.

perform such an analysis, and we now aim to implement this to study how the likelihood of revolt is influenced by the affluence of the country, and the unequal access to it.

We will, more specifically, study if and how regime stability may be challenged by large wealth or inequalities. Unless otherwise stated, we will for the sake of the argument assume that actual discrimination is below $\bar{D}$, such that the group would not revolt if it had full information, though the results hold in any case.

5.1 Income, wages and inequality

Empirical researchers have consistently found that poor countries are more likely to experience conflicts (Collier and Hoeffler, 1998, 2002; Collier et al., 2003; Hegre and Sambanis, 2006). Some have also found that high wage or income inequality has the same effect (Alesina and Perotti, 1996). In their model, Esteban and Ray (2005) find that intragroup inequality increases ethnic conflict. In the present model, the effect of intragroup wage inequality can easily be shown to be positive. The income level is shown to decrease the probability of revolt in intermediately stable economies, whereas no effect of wage level or intergroup inequalities can be identified.

We start by considering inequality in wages. Since all effects from the groups, as mentioned, run through to the country level, it will suffice to consider the effects on individual groups. This has the immediate implication that intergroup inequalities have no effect on the probability of revolt. This is not surprising, since revolts in our model are staged without any reference to the other groups, but are derived purely from the (mis)perceptions of discrimination against their own.

Proposition 2 *Intergroup inequality has no effect on the probability of revolt.*

Intragroup inequality, on the other hand brings down the effective cost, $\tilde{C}_i$. This is due to the fact that increased inequality increases the potential effectiveness of discrimination, and hence the gains from revolt. This lifts the threshold below which the group revolts, and hence makes them more likely to do so.

Proposition 3 *Groups with high intragroup inequality in wages have a higher probability of revolt.*

Proof. From equation 13, increasing inequality raises the threshold, which increases the probability of groups revolting (cf. equation 14). ■

The income level is a function of both how high wages are in the different wage groups, and of how many are in each group. It can easily be seen that the wage level as such plays no part in our story when the difference is held constant. It simply shifts utility up or down, but equally much so for all levels of discrimination. It thus has no effect on the decision to revolt.

Proposition 4 *The wage level has no effect on the probability of revolt.*

The effect of income can therefore be studied entirely through the number or share of workers in high and low wage jobs. This is in principle a stochastic variable, but since groups should generally be thought to be relatively large, the average income in a group should move parallel to their true probability of getting a good job. We therefore consider the effect of group i 's objective attractiveness on the labor market, γ_i , and derive the result from there.

As in section 4 above, we may again separate two effects: an *aspirations effect* and an *achievements effect*: For the former, when the group is more attractive on the labor market, their leader will hold higher aspirations for the group. Any discrimination will have a higher expected effect. Thus the threshold below which the group revolts is elevated, both directly through γ_i and indirectly through a decrease in effective costs $\tilde{C}_i$. This unambiguously increases the probability of the group revolting.

On the other hand, the probability of better outcomes increases. That is, events that involve observing many individuals in good jobs become more likely, and vice versa. The 'good' outcomes that become more likely are the events that are above the expectation under full information. This seems reasonable, since the group should be strengthened in their beliefs of discrimination when observing less than their 'fair' share. Put another way, the expectation in a way balances the mass of the distribution. By increasing the probability of good draws, we shift mass from one side of the expectation to the other. This is what we have called an achievements effect.

The total effect is uncertain, and depends particularly on the current threshold. As stated in proposition 5, the effect is negative when the threshold is intermediate, but may be positive when the threshold is very high or low.

Proposition 5 *Groups that are more attractive on the labor market are less likely to revolt if the threshold $\bar{K}_i$ is intermediate.*

Proof. Follows by differentiation of equation 14.

$$\frac{\partial p_{it}}{\partial \gamma_i} = p_{it\bar{K}_{it}} \frac{d\bar{K}_{it}}{d\gamma_i} + \sum_{r=0}^{\bar{K}_{it}} p_{itr} \left[\frac{r}{\gamma_i} - \frac{(k_i - r)(1 - D_i)}{1 - (1 - D_i)\gamma_i} \right] \quad (26)$$

The first part is the aspirations effect, and since the threshold is non-negative, it is clearly positive. The sum in the second part is the achievement effect which is likely negative. Clearly, if the threshold is very low such that the sum is almost zero, then the aspirations effect dominates, and the probability of revolt increases. It can easily be seen that the effect on any marginal probability p_{itr} is negative if, and only if,

$$\frac{r(1 - (1 - D_i)\gamma_i) - (k_i - r)\gamma_i(1 - D_i)}{(1 - (1 - D_i)\gamma_i)\gamma_i} < 0 \quad (27)$$

$$\Leftrightarrow r - k_i\gamma_i(1 - D_i) < 0 \quad (28)$$

$$\Leftrightarrow r < k_i\psi_i \quad (29)$$

Therefore, when the threshold is very high, relative to the expectation given true discrimination, then the achievement effect might be weak. Again, p_{it} may increase. Finally, if the threshold is intermediate, then the achievement effect should dominate, and p_{it} decreases. ■

We may define the threshold for reference.

Definition 2 Let $\{\underline{\kappa}_i, \bar{\kappa}_i\} \in [0, k_i]^2$ be the lowest and highest threshold $\bar{K}_{it}$ such that $\partial p_{it}/\partial \gamma_i > 0$.

Having determined the effect of attractiveness on the labor market, we can turn back to considering the effect of the income level. Since, as mentioned, the income level moves with the attractiveness on the labor market, the result follows immediately. Notice that the result refers to income *relative to the wage level*.

Proposition 6 Groups with lower average income, relative to the prevailing wage level, are more likely to revolt if $\bar{K}_{it} \in (\underline{K}, \bar{K})$.

This result offers a presumably testable hypothesis which differs from the predictions of the standard theories of conflict. In the standard model (see for instance Haavelmo (1954); Hirshleifer (1991); Skaperdas (1992, 1996)), poor groups have a comparative advantage in fighting precisely because their

wages are low (i.e. they have low labor productivity and hence low alternative costs). According to the current model, one should find a separate effect from the level of income. Though wage data are scarce and often unreliable, an empirical investigation into this seems warranted.

5.2 Education

Due to the strong correlation between poverty and conflict in the empirical literature, it would seem a good idea to initiate policies that improve education. In the current framework, this view is supported, but only when we consider groups that have an intermediate probability of revolting. Also, policies promoting primary education are advised over plans in favor of higher education.

To formally consider the effect of education in our model, add a stage between updating and job matching (stage 2 and 3), and let γ_i in equation 1 be determined here as a function $h(\theta_{ij})$. Let θ_{ij} signify the education level of individual j from group i , while $h(\cdot)$ is an increasing, concave mapping to a probability, reflecting that more educated people should be more attractive on the labor market. Let finally θ_{ij} be distributed according to a density $F_i(\cdot)$.

The effect of education level may now be considered by comparing revolt probabilities for different levels of θ .

Holding inequality constant, it follows immediately that higher education levels increase the average attractiveness of groups in the market. From proposition 5, the probability of revolt will then tend to decrease for groups that are moderately likely to revolt, but increase for groups that are very likely or unlikely to revolt.

Proposition 7 *Groups with higher average education are less aggressive, if $\bar{K}_{it} \in (\underline{\kappa}_i, \bar{\kappa}_i)$*

Proof. Since $h(\cdot)$ is increasing, an inequality preserving increase in θ_i will increase $\gamma_i = Eh(\theta_i)$, which from proposition 5 gives the result. ■

Though offering policy advice from such an admittedly narrow framework may be risky, the one to be extracted from the preceding story is that while an emphasis on education is often stabilizing for a country, governments should be cautious with such a strategy when faced with groups that are very likely to revolt. Further, the most impact can be achieved by focusing on intermediately aggressive groups.

Considering now inequality in education, the opposite result is derived. Larger inequalities in education will, similar to the effect of wage inequality, increase the expected effect of discrimination and thus decrease the effective cost of revolt. This implies that the threshold increases, and the probability of revolt goes up.

To consider inequality in education, we may consider a mean-preserving spread in education. Say that the distribution F_i is more equal than F'_i if it is second order stochastic dominant to it.¹⁶ By definition, the expectations of the distributions are equal, $E\theta = E'\theta$, whereas the expectations of a concave transformation of the variable are unequal,

$$Eh(\theta) = \int_{\theta \in \Theta} h(\theta) dF_i(\theta) \geq \int_{\theta \in \Theta} h(\theta) dF'_i(\theta) = E'h(\theta) \quad (30)$$

This implies that the average attractiveness of the group on the labor market is decreasing in inequality, which by proposition 5 gives the result.

Proposition 8 *Groups with higher intragroup inequality in education are more likely to revolt if returns to education are decreasing, while $\bar{K}_{it} \in (\underline{\kappa}_i, \bar{\kappa}_i)$.*

Thus, continuing down the rickety path of policy advice, to have a decreasing impact on the likelihood of group revolt, the focus in educational policy should be on lower levels of education. When focusing on higher education, one should be cautious in dealing with aggressive groups.

6 Concluding remarks

I have proposed a simple model where groups may rationally misperceive their circumstances, and in a sense mistakenly revolt against the incumbent regime. The model indicates that misperceptions may be important when determining the risk of conflict in a country.

Assuming that discrimination should not be sufficient to induce revolts under perfect information, it is shown that the probability that they do so is generally positive, and may be large. We have further seen that groups become more aggressive, in terms of having a higher probability of revolt,

¹⁶We could also employ the widely used concept of Lorenz dominance. This would yield the same result, though a little more involved (cf. Damjanovic (2005)).

when they are large, prejudiced, powerful and patient. Revolts should also occur more often when the incumbent regime has only recently assumed office, and when the population is large. In the current framework, the former is equivalent to the country being in a post-conflict phase. Increasing transparency alleviates the problem over time or as observability becomes large, but this may not be the case in the short run, when higher transparency may even decrease the stability of the regime.

We finally applied the framework to study the question of how regime instability may be influenced by inequality and affluence. The results show that uneducated groups with low average income relative to the prevailing level of wages, are more likely to revolt. Likewise, groups with high levels of intragroup inequality in wages or education are more inclined to revolt. We identify no effect of intergroup inequality or of the wage level, when we hold the wage difference and the average income fixed.

Future work will address the issue within a framework where the regime is more active, where e.g. policy is influenced by the relative power of the parties.

References

- Acemoglu, D. (2003, December). Why not a political coase theorem? social conflict, commitment, and politics. *Journal of Comparative Economics* 31(4), 620–652.
- Alesina, A. and R. Perotti (1996, June). Income distribution, political instability, and investment. *European Economic Review* 40(6), 1203–1228.
- Bester, H. and K. Warneryd (2006, July). Conflict and the social contract. *Scandinavian Journal of Economics* 108(2), 231–249.
- Brito, D. L. and M. D. Intriligator (1985). Conflict, war, and redistribution. *The American Political Science Review* 79(4), 943–957.
- Coase, R. H. (1960, October). The problem of social cost. *Journal of Law and Economics* 3, 1–40.
- Collier, P., V. L. Elliott, H. Hegre, A. Hoeffler, M. Reynal-Querol, and N. Sambanis (2003, May). Breaking the conflict trap : civil war and development policy, volume 1. *A World Bank policy research report*.

- Collier, P. and A. Hoeffler (1998, October). On economic causes of civil war. *Oxf. Econ. Pap.* 50(4), 563–573.
- Collier, P. and A. Hoeffler (2002, February). On the incidence of civil war in africa. *Journal of Conflict Resolution* 46(1), 13–28.
- Collier, P. and A. Hoeffler (2004). Greed and grievance in civil war. *Oxford Economic Papers* 56(4), 563+.
- Collier, P. and A. Hoeffler (2006, March). Civil war. *Forthcoming in the Handbook of Defence Economics*.
- Damjanovic, T. (2005, September). Lorenz dominance for transformed income distributions: A simple proof. *Mathematical Social Sciences* 50(2), 234–237.
- Diaconis, P. and D. Ylvisaker (1979). Conjugate priors for exponential families. *The Annals of Statistics* 7(2), 269–281.
- Esteban, J. and D. Ray (2001, March). Social decision rules are not immune to conflict. *Economics of Governance* 2(1), 59–67.
- Esteban, J. and D. Ray (2005, September). A model of ethnic conflict. *Working paper*.
- Fearon, J. D. (1995). Rationalist explanations for war. *International Organization* 49(3), 379–414.
- Haavelmo, T. (1954). *The Theory of Economic Evolution*. Amsterdam: North Holland.
- Hegre, H. and N. Sambanis (2006, August). Sensitivity analysis of empirical results on civil war onset. *Journal of Conflict Resolution* 50(4), 508–535.
- Hirshleifer, J. (1991). The technology of conflict as an economic activity. *The American Economic Review* 81(2), 130–134.
- Icduygu, A., D. Romano, and I. Sirkeci (1999). The ethnic question in an environment of insecurity: The kurds in turkey. *Ethnic and Racial Studies* 22(6), 991–1010.

- Meyer, M. A. and J. Zweibel (2006, May). Learning and self-reinforcing behavior. *Working paper*.
- Pruitt, D., J. Z. Rubin, and S. H. Kim (2003, July). *Social Conflict: Escalation, Stalemate, and Settlement (3rd Edition)*. McGraw-Hill Humanities/Social Sciences/Languages.
- Rice, J. A. (2001, April). *Mathematical Statistics and Data Analysis*. Duxbury Press.
- Robinson, J. A. and R. Torvik (2005, February). White elephants. *Journal of Public Economics* 89(2-3), 197–210.
- Sambanis, N. (2002). A review of recent advances and future directions in the quantitative literature on civil war. *Defence and Peace Economics* 13(3), 215–243.
- Skaperdas, S. (1992). Cooperation, conflict, and power in the absence of property rights. *The American Economic Review* 82(4), 720–739.
- Skaperdas, S. (1996, June). Contest success functions. *Economic Theory* 7(2), 283–290.
- Skaperdas, S. (2007). An economic approach to analyzing civil wars. *Economics of Governance*.