Modeling Civil War

Gerard Padró i Miquel

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Introduction

- Within country conflict is the most prevalent form of conflict since WWII
- About one half of countries have experienced some episode of civil war since 1960
- If one is willing to consider violent communal and ethnic conflict it is even more prevalent
- Civil war has killed more than 16.2 million people since 1945
- Prevalence together with its deleterious outcomes has spawned a huge empirical literature on the causes of conflict (see Blattman and Miguel, 2009, for a survey)

Introduction

- There is one robust finding in the literature:
    - Civil War is negatively correlated with income per capita
- This is true in the cross-section, but difficult to interpret in causal terms as war also generates destruction, and countries differ in many respects.
- Interestingly, however, this relationship:
    - Survives the inclusion of fixed effects
    - Also exists when income levels are replaced by income growth

Introduction

- In order to deal with endogeneity, Miguel et al (2004) instrument income with rainfall shocks, and find a relationship between losses in income and civil war
- In a recent paper, Ciccone (2008) reexamines this relationship and confirms the findings
- Finally, in a related paper, Ciccone and Brückner (2007) instrument income with export prices and find a similar relationship for dictatorships
- It should be noted that these papers focus on Sub-Saharan Africa, where the first stage is strong enough

Introduction

Hence, regarding the relationship between civil war onset/incidence and the state of the economy, we have, in fact, two findings

1. Civil war is more prevalent in poor countries
2. Civil war tends to follow negative income shocks

The Opportunity Cost Argument

- The literature has not considered point 2 as a separate point
- Therefore it has tried to argue why civil war is correlated with low income per capita
- Collier and Hoeffler (2004) argue that "recruits must be paid, and their cost may be related to the income foregone by enlisting as a rebel. Rebellions may occur when foregone income is unusually low."
- This, however, forgets that when income is low, there is also very little to fight for!
- This is the basis for Fearon and Laitin (2003) and Fearon (2007) dismissal of opportunity cost arguments in favor of state capacity arguments.

Little Bits of Theory

- Two traditions of modelling conflict in Political Science and Economics
  1. Economics: Contest functions in which actors decide whether to put effort in fighting or producing
  2. Political Science: Focus on the decision to fight as a byproduct of bargaining failure
- In their canonical formulations, none of these models can account for the relationship between income and fighting.
- In both cases, if the costs of fighting are proportional to income, fighting is independent of the size of the pie to be shared.

A Simple Economic Model

- Economics focusses in the use of scarce resources
- Hence the approach to modeling conflict stresses the use of resources (effort) to appropriate production
- It typically posits a **contest function** that determines the probability of prevailing as a function of the fighting effort
- See Skaperdas (1992), Grossman (1991), Hirshleifer (1995), Esteban and Ray (1999) and plenty of follow-up papers by these authors
- Here we will just quickly look at a VERY simple version of these models to see if it can explain the relationship with income

A Simple Economic Model

- Two groups $i \in \{1, 2\}$, fighting for a pie of size θ
- They can devote resources g_i to the fight, and pay linear costs for these resources
- As we will see, the argument does not hinge in linearity, but makes calculations really simple
- Simple contest function:

$$\Pr(1 \text{ wins}) = \frac{g_1}{g_1 + g_2}$$

A Simple Economic Model

- Given this technology, group i maximizes

$$\theta \frac{g_i}{g_i + g_{-i}} - g_i$$

- The first order conditions are simply

$$\theta \frac{g_{-i}}{\left(g_i + g_{-i}\right)^2} - 1 = 0$$

- Adding up you get

$$g_i + g_{-i} = \frac{\theta}{2}$$

A Simple Economic Model

- So the bigger the pie the more resources wasted!
- It seems to predict that we should see more fighting in rich societies
- Obviously, a problem with these models is that they do not distinguish between investing and actual fighting
- If costs were proportional to θ, then there would be no relationship whatosever

Political Science: Why war?

- Fearon (1995) writes a very influential article that casts doubt on many theories of war
- The basic thrust of his argument is: given that war is costly, what prevents parties from signing Pareto improving agreements?
- This paper centered the Political Science literature into models of war as a result of bargaining breakdown
- Fearon (1995) posits three reasons for such breakdown:
  1. Imperfect information together with incentives to misrepresent
  2. Issue indivisibilities
  3. Commitment problems

Political Science: Why war?

- Consider two groups $i \in \{1, 2\}$, fighting for a pie of size θ
- For simplicity, imagine that 1 owns the full pie at the beginning
- If they fight, 1 wins with probability p, and each group i pays c_i
- Therefore, the expected utility of war is

$$\begin{aligned} U_1^W &= p\theta - c_1 \\ U_2^W &= (1-p)\,\theta - c_2 \end{aligned}$$

Political Science: Why war?

- Assume that 1 can offer a sharing of the pie that implies x for 1 and $\theta - x$ for 2
- When will this simple bargaining avoid war?

$$\begin{aligned} x &> p\theta - c_1 \\ \theta - x &> (1-p)\,\theta - c_2 \\ c_1 + c_2 &> 0 \end{aligned}$$

- Answer: always!!
- In particular, 1 can keep

$$x = p\theta + c_2$$

  and offer the rest to 2 who will accept as he is indifferent between the offer and fighting.
- Note that this is true no matter θ

Political Science: Why war?

- However, imagine that c_2 is not known by 1.
- Can this generate fighting?
- If it does, why would 2 not simply say "this is my c_2" and thereby avoid costly fighting?

Political Science: Why war?

- 1 believes that $c_2 \in [\underline{c}, \bar{c}]$ with some cdf $F(c)$
- What is the optimal offer that 1 will make?
- 2 will accept as long as

$$\begin{aligned} \theta - x &> (1-p)\,\theta - c_2 \\ x - p\theta &< c_2 \end{aligned}$$

- Hence, 1's program is

$$\max_x \; [1 - F(x - p\theta)]\, x + F(x - p\theta)\,[p\theta - c_1]$$

Political Science: Why war?

- The first order condition of this program is:

$$1 - F(x - p\theta) + f(x - p\theta)[p\theta - c_1 - x] = 0$$

- For a $\bar{\theta}$ the solution will be interior and hence there is positive probability of fighting.
- However note that the FOC pins down $K \equiv x - p\theta$, so the probability of fighting will simply be $F(K)$ no matter what θ is.
- See Powell (1996, 2004) or Slantchev (2003) and many other papers by these authors and Fearon for other applications of the imperfect information paradigm

Commitment Problems

- The third reason for conflict in Fearon (1995) are commitment problems
- He breaks this item down into three sub-causes:

1. Preventive war
2. Preemptive war (offensive advantage)
3. Bargaining over issues that affect future power

- Powell (2006) presents a great account of these reasons: war always a consequence of rapid shifts in power
- Here we will develop a simple model of offensive advantage

A static model of fighting

- Consider two groups $i \in \{1, 2\}$, on two units of land.
- One group controls $1 + \lambda$ land, the other group controls $1 - \lambda$.
- Each group also has 1 unit of labor.
- Production function:
$$f(L, l) = \theta L l$$
  - where θ is the productivity of land
  - L is the amount of land
  - l is the amount of labor devoted to work

A static model of fighting

- There is a war if any of the groups decides to attack.
- If there is a war, $c \in (0, 1)$ units of labor are diverted from production to fighting.
- There is an offensive advantage in that the group that attacks wins with probability $P \geq \frac{1}{2}$.
- The winner seizes the land of the loser and consumes all production.

A static model of fighting

We allow players to bargain. We leave the bargaining protocol free with the following conditions.

1. Players can commit to peaceful transfers of land
2. Players can commit not to attack in exchange for transfers of land
3. Bargaining is successful if it leaves each contender better off than launching a surprise attack. This captures the fact that a player can launch an attack at any moment
4. If bargaining is not successful, one player is picked at random, and she can launch a surprise attack

A static model of fighting

- Throughout the talk, we will focus on the most peaceful equilibrium attainable.
- Just to quickly summarize, the timing of the game is:

1. Bargaining occurs
2. If bargaining is successful, agreed transfers of land take place, followed by consumption
3. If bargaining is not successful, there is a war where one player (picked at random) wins with probability P

A static model of fighting

- Solving the static model
- Denote by T the agreed amount of land that the rich player transfers to the poor player.
- For bargaining to be successful, there must exist a T such that

$$P2\theta\left(1-c\right) \leq \left(1+\lambda\right)\theta - T\theta \tag{1}$$

and, at the same time

$$P2\theta\left(1-c\right) \leq \left(1-\lambda\right)\theta + T\theta \tag{2}$$

A static model of fighting

Lemma (1)

There exists a T that satisfies both (1) and (2) if and only if peace is sustainable under equal land-holdings, i.e.

$$P2\theta\left(1-c\right)\leq\theta$$

- In this class of models, the role of bargaining is to smooth over inequality by allowing the rich to make transfers to the poor instead of fighting.
- It follows that it is enough to examine the case of equality to determine whether peace is sustainable or not.

A static model of fighting

The condition for war to be inevitable is:

$$P \geq \frac{1}{2}\frac{1}{(1-c)} \tag{3}$$

Note:

1. θ does not appear: since the costs of fighting (labor in this model) are proportional to income, θ drops out
2. For fighting to occur at all P needs to be bounded away from $\frac{1}{2}$

- When the offensive advantage is large enough, no group can credibly commit not to attack.
- But note that as the opportunity cost increases the system is more stable (peace is ensured for $c \geq \frac{1}{2}$).
- Below we will assume that (3) is not satisfied, so that if the model is static, peace is ensured for all θ.

A dynamic model of fighting

- Concern for the future can affect fighting as it increases the stakes in a model where victory is lasting.
- To examine if this is enough to link fighting with income, we consider a model with infinite horizon in which, in every period:

1. Bargaining occurs
2. If bargaining is successful, agreed transfers of land take place, followed by consumption
3. If bargaining is not successful, there is a war where one player (picked at random) wins with probability P

- If there is fighting, the loser is eliminated from the game.

A dynamic model of fighting

- We search for the most peaceful subgame perfect equilibrium of this game.
- Lemma 1 also applies to this game, so we only need to examine the case with equal land holdings.
- Two pieces of notation.

1. The value of the continuation subgame after victory:

$$V^V = \frac{2\theta}{1-\delta}$$

2. The value of the continuation subgame if there is no fighting:

$$V^P$$

A dynamic model of fighting

- The condition for peace to be sustainable is now

$$P\left[2\theta\left(1-c\right)+\delta V^{V}\right]\leq\theta+\delta V^{P}$$

- We want to check if permanent peace is sustainable. This gives us highest value for V^{P}.

$$P\left[2\theta\left(1-c\right)+\delta\frac{2\theta}{1-\delta}\right]\leq\theta+\delta\frac{\theta}{1-\delta}$$

- So permanent peace is sustainable unless

$$P\leq\frac{1}{2}\frac{1}{1-c\left(1-\delta\right)}$$

A dynamic model of fighting

So, we obtain that making the model dynamic implies:

1. Peace is more difficult to obtain as δ increases
2. There is still no dependence on the size of the economy θ because costs are proportional

In particular this means that permanent changes in income do not affect the propensity to fight.

Transitory Shocks

- Consider a time-varying θ_t that is independently drawn every period from $F(\theta)$.
- $F(\theta)$ has full support on $(0, \infty)$.
- We denote by $\bar{\theta} \equiv E(\theta)$.

Interpretation: think of rainfall shocks that change the productivity of land every period but are (pretty much) i.i.d.

Transitory Shocks

Timing:

1. θ_t is revealed and observed by both players
2. Bargaining occurs
3. If bargaining is successful, agreed transfers of land take place, followed by consumption
4. If bargaining is not successful, there is a war where one player (picked at random) wins with probability P

If there is fighting, the loser is eliminated from the game.

Transitory Shocks

- Again, we focus on the most peaceful Subgame Perfect Equilibrium.
- Lemma 1 also applies to this game, so we directly look at a situation of symmetry.
- Denote by V^P the value of the most peaceful Subgame Perfect Equilibrium.
- Given V^P and V^V, peace is sustainable only if

$$P\left[2\theta_t\left(1-c\right)+\delta V^V\right]\leq\theta_t+\delta V^P$$

which is equivalent to

$$\theta_t\left[1-2P\left(1-c\right)\right]\geq\delta\left[PV^V-V^P\right] \tag{4}$$

Transitory Shocks

- Now note the following

$$V^P \leq \frac{\bar{\theta}}{1-\delta} \leq \frac{1}{2} V^V \leq P V^V$$

- Hence, we have

$$P > \frac{1}{2} \rightarrow \delta \left[P V^V - V^P \right] > 0$$

and therefore permanent peace is impossible: there is a state of the world bad enough that players prefer to fight.

Transitory Shocks

- The highest V^V must then be attained by a strategy that only prescribes fighting when it is inevitable: in low states of the world.
- This is a simple stationary threshold strategy.
- Denote by $\tilde{\theta}$ the threshold. We then have:

$$
\begin{aligned}
V^P &= F(\tilde{\theta}) \left[\left(\frac{1}{2} P + \frac{1}{2}(1-P) \right) \left[2E(\theta/\theta < \tilde{\theta})(1-c) + \delta V^V \right] \right] \\
&\quad + (1 - F(\tilde{\theta})) \left[E(\theta/\theta > \tilde{\theta}) + \delta V^P \right]
\end{aligned}
$$

Transitory Shocks

- This expression reduces to

$$V^P = \frac{\bar{\theta}}{1-\delta} - \frac{cF(\tilde{\theta})E(\theta/\theta < \tilde{\theta})}{1-\delta\left(1-F(\tilde{\theta})\right)}$$

  hence, naturally, the difference between victory and peace is the future cost of fighting.

- By plugging this into (4) we obtain a fixed point condition for $\tilde{\theta}$.

$$\tilde{\theta} = \frac{\delta}{1-2P(1-c)}\left[(2P-1)\frac{\bar{\theta}}{1-\delta} + \frac{cF(\tilde{\theta})E(\theta/\theta < \tilde{\theta})}{1-\delta\left(1-F(\tilde{\theta})\right)}\right] \tag{5}$$

Transitory Shocks

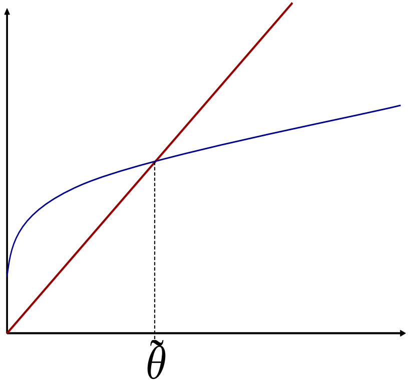

Figure: Crossing Once

Transitory Shocks

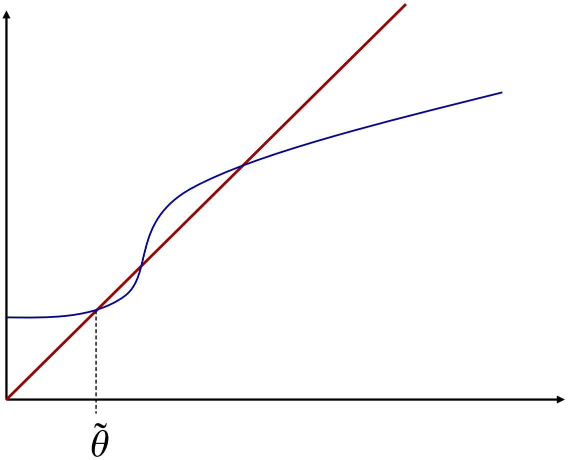

Figure: ...but can cross more than once

Transitory Shocks

- These two curves cross at least once.
- The best equilibrium is defined by the first time they cross.

Proposition

For every $P > \frac{1}{2}$, $c \in \left(1 - \frac{1}{2P}, 1\right)$, $\delta \in (0, 1)$, *there exists a* $\tilde{\theta} \in (0, \infty)$ *such that fighting is inevitable when* $\theta_t < \tilde{\theta}$

- Hence groups necessarily fight when the economic situation is bad enough.
- This simple intuition can explain the fixed effects results (type 2 findings).

Transitory Shocks

We obtain the following comparative statics:

1. The propensity to fight is increasing in δ
2. The propensity to fight is increasing in P
3. The propensity to fight is decreasing in c

Coordination and Fear

Consider the following timing:

1. θ_t is revealed and observed by both players
2. Players simultaneously decide whether to attack
3. If only one player attacks, she wins with probability $P \geq \frac{1}{2}$
4. If both players attack, they win with probability $\frac{1}{2}$

If there is fighting, the loser is eliminated from the game.

Coordination and Fear

- If the two groups have identical land-holdings, the best Subgame Perfect Equilibrium of this game is the same as the previous game.
- Namely, in the most peaceful SPE players use a threshold $\tilde{\theta}$ strategy.
- This is because bargaining does not do much with identical players as transfers never occur in equilibrium.

Coordination and Fear

- But now, suppose that observability of θ_t is not perfect.
- Instead, groups observe a signal $x_{it} = \theta_t + \sigma\epsilon_{it}$ where ϵ_{it} comes from a symmetric distribution i.i.d. across time and players, centered at 0 and σ is a positive constant.
- The rest of the game stays the same.

Coordination and Fear

Note that this is a variation on the usual global games information structure:

1. The game is dynamic
2. There is no area of dominance for playing peace

We can use the results in Chassang (2007) and Chassang and Padró i Miquel (2008) to determine the most peaceful subgame perfect equilibrium.

Coordination and Fear

- As $\sigma \longrightarrow 0$, the most peaceful subgame perfect equilibrium of the game converges to the risk dominant equilibrium for a V^V defined with a new threshold.
- Under symmetry, the risk dominant equilibrium is defined by equal deviation losses:

$$\theta_t + \delta V^P - P2\theta_t (1-c) - P\delta V^V >$$
$$\tfrac{1}{2}2\theta_t (1-c) + \tfrac{1}{2}\delta V^V - (1-P)\, 2\theta_t (1-c) - (1-P)\, \delta V^V$$

or

$$\theta_t \left(2\left(1-2P\left(1-c\right)\right)-c\right) > \delta \left[V^V \left(2P - \frac{1}{2}\right) - V^P\right]$$

which is different from the condition before.

Coordination and Fear

- The fixed-point equation that defines the new threshold is now:

$$\hat{\theta} = \frac{\delta}{1-(1-c)(4P-1)}\left[\frac{2\bar{\theta}}{1-\delta}(2P-1) + \frac{cF(\hat{\theta})E(\theta/\theta<\hat{\theta})}{1-\delta\left(1-F(\hat{\theta})\right)}\right]$$

- It is easy to show that $\hat{\theta} > \tilde{\theta}$.

Coordination and Fear

- Intuition:
    1. When there is no common knowledge of θ_t, groups worry about the signal that the opponent might have obtained.
    2. If they play peace, they leave themselves open to a surprise attack.
    3. Therefore, when the opportunity cost of fighting seems small, they prefer to attack as an insurance.
- This "preemption motive" always makes peace more difficult to sustain.
- In the interval $\left[\tilde{\theta}, \hat{\theta}\right]$ peace is not sustainable due to mutual fears as opposed to opportunism.

Conclusion

- In the simple model presented here the opportunity cost argument has some bite
- It can explain why there is fighting when transitory economic circumstances are bad
- However, more systemic explanations are needed for the cross-country results:
    1. Weakness of the state
    2. Structure (appropriability) of economic rents