Economic Shocks and Civil War*

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Abstract

This article revisits the relationship between income per capita and civil conflict. We establish that the empirical literature identifies two different patterns. First, poor countries have a higher propensity to suffer from civil war. Second, civil war occurs when countries suffer negative income shocks. In a formal model we examine an explanation often suggested in the informal literature: civil wars occur in poor countries because the opportunity cost of fighting is small. We show that while this explanation fails to make sense of the first empirical pattern, it provides a coherent theoretical basis for the second. We then enrich the model to allow for private imperfect information about the state of the economy and show that mutual fears exacerbate the problem caused by negative income shocks.

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The prevalence of civil war and the evidence of its disastrous effects has recently motivated a burgeoning empirical literature. It arises clearly from this series of papers that the most robust predictor of a country's probability of civil war onset is its level of per capita income. Indeed, low GDP per capita empirically dominates all other correlates, including the level of democracy, the degree of ethnic diversity or the dependence on natural resource exports.[1]

A potential explanation for this relationship is based on the opportunity cost of fighting. This argument considers an agent deciding whether to devote effort to a productive endeavor or to violent predatory activities. The basis of the argument is that in a low GDP economy, wages are small and therefore the returns to the productive activity are small. In this situation of low opportunity costs, citizens are more likely to turn to predatory activities.[2]

As intuitive as this argument sounds, Fearon (2007) argues that it is, at best, an incomplete explanation for the relationship between fighting and income per capita. The intuition behind this critique is powerful: in a poor economy, the opportunity cost of conflict is small. However the resources that can be appropriated by exerting violence are also small. Conversely, in a rich economy wages might be higher, but there is also a lot more wealth that can be expropriated by violent means. Therefore net incentives to exert violence might go either way. Hence, there is no natural strong theoretical relationship between the size of the economy and the propensity to fight. Fearon (2007) demonstrates this logic in a formal model based on contest functions.[3]

In this article we clarify the role of opportunity costs in explaining the relationship between income and civil war. We develop our contribution in several steps. First, we briefly revisit the empirical literature and document that there is not one but two distinct empirical patterns.

[1] Collier and Hoeffler (1998, 2004) and Fearon and Laitin (2003) explicitly make this point.

[2] For instance, 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."

[3] Formal analysis of conflict follows two different traditions. Political scientists have focused on bargaining models in which the decision to fight is an outside option used in the case of bargaining breakdown. See, for instance, Fearon (1995), Powell (1996, 1999 and 2004) and Slantchev (2003). Powell (2002) provides a survey of this literature. Conversely, economists have developed models based on contest functions and the trade-off between production and coercion. Hirshleifer (1995, 2001), Grossman (1991), and Skaperdas (1992) are some early examples. In their canonical formulations, none of these models can account for the relationship between income (the size of the pie) and violence. In fact, most of these models predict more conflict as the size of the pie increases. See, for instance, Neary (1997).

On the one hand, cross country regressions show that there is a strong relationship between low income per capita and civil war prevalence. On the other hand, fixed effects regressions show that civil wars occur in the aftermath of economic shocks that reduce income per capita. As we discuss in detail, it is important to understand the distinction between these two different patterns because entirely different mechanisms might be generating them. This distinction contributes to the literature because these different empirical analyses have always been treated as if they were uncovering a single relationship between income and violence.

Second, we analyze a bargaining model of conflict in which violence might occur due to the presence of offensive advantages that induce a commitment problem. While this is a different model from Fearon (2007), it shares a common feature: the opportunity costs of conflict and the returns to conflict are both increasing with the size of the economy. As a consequence, neither a static version of the model, nor a repeated version, are able to generate a relationship between income levels and violence. We therefore show that the formal argument in Fearon (2007) can be extended to bargaining models of conflict. Therefore, it is difficult to explain the first empirical relationship –the prevalence of war in poor countries– using the opportunity cost argument.

In contrast, we show that this argument can explain the second empirical pattern –war occurs when economic circumstances are bad. In a dynamic version of the model in which the size of the pie can change every period, conflict occurs when a negative income shock reduces the size of the pie below a threshold. The intuition behind this result is interesting. When the state of the economy is bad, wages are temporarily low and hence the opportunity cost of conflict is small. However, the prize of victory does not diminish at the same rate: current lootable resources will also be small as they are hit by the bad economic shock, but upon victory, groups gain control over assets that will have a much higher value in the future, once the negative economic situation is over. For instance, if groups are fighting for control of land, it might seem puzzling that violence over land ensues precisely when returns to land are small. The intuition that we obtain from the model is that groups do not fight for current returns. They fight for the future returns that control over land will allow them to enjoy. The negative shock (for instance, a drought) simply reduces the opportunity cost of such fighting.[4] This finding reinforces the distinction we draw between the two separate patterns in the data: this theoretical mechanism can explain the second empirical pattern, but not the first, thus showing their logical disconnect.

In the last section we show that imperfect information exarcerbates the problem and makes conflict more likely. Specifically, we enrich the model with imperfect private assessments of the state of the economy.[5] This changes the strategic environment. Actors now need to consider the possibility that their neighbours have a pessimistic assessment of the state of the economy and might therefore decide to attack. In this new environment, we show that wars might occur due to spiralling mutual fears.[6] Interestingly, however, this does not change the predictions of the model: conflict still occurs in the aftermath of negative income shocks. Anarchy and mutual fears serve as an amplification force of the opportunity cost argument, expanding the range of states of the economy in which fighting is inevitable.

1 Two Empirical Regularities

There is an extensive empirical literature on the causes of civil war.[7] The bulk of this research uses country level data in the form of a panel, with repeated observations for every country. Many of the variables of interest, such as the ethnic composition of the country or the ruggedness of its terrain, do not display time variation. As a consequence, the results highlighted in most of this literature use either ordinary least squares, or some limited dependent variable model without fixed effects at the country level. It follows that these results are mostly identified out

[4] While the model we analyze is specific, it is easy to see that this basic intuition carries over to other conflict frameworks in the literature. Skaperdas and Syropoulos (1996) and Garfinkel and Skaperdas (2000) show in a contest function model that growth in future resources exacerbates conflict. While the result in these models is confounded by other effects, part of the reason they obtain it is the mechanism we highlight here.

[5] To the best of our knowledge, this is the first formal framework of conflict that combines a commitment problem with imperfect information.

[6] The possibility that mutual fears generate civil war originates in Posen (1993) and Jervis and Snyder (1999), who adapt the spiral argument for intrastate wars. As Jervis and Snyder (1999) discuss, a shortcoming of this explanation is that it fails to make sense of when such spirals occur, since anarchy is ever present but wars a few and far between. We therefore sharpen the predictions of this argument by showing that mutual fears generate conflict in bad economic circumstances.

[7] See Sambanis (2002) and Miguel and Blattman (2009) for overviews of this literature.

of variation across countries. These specifications are therefore useful to find out what country characteristics generate a high proclivity to suffer civil wars. As Hegre and Sambanis (2006) show in their extensive sensitivity check of this literature, the level of income per capita is a country characteristic that predicts civil war onset in an extremely robust way.

Remark 1 *The first empirical regularity is that poor countries have a higher propensity to suffer from civil war.*

While this empirical association is very robust, it cannot be claimed as causal. Countries differ in many dimensions besides income per capita and hence omitted variable bias and reverse causality might be generating part of this correlation.[8] Some recent studies have tried alternative specifications to address this issue. For instance, Fearon and Laitin (2003) report that the logarithm of income is significant in a regression with country fixed effects. Also, recent studies that are particularly concerned with causal identification find that an exogenous drop in income (due to rainfall variation) causes civil war in regressions with country fixed effects.[9] Indeed, Hegre and Sambanis (2006), show that there is a different association between income and war that is also robust. Namely, low income growth increases the risk of civil war. Note that income growth is in fact just a transformation of changes in income. By using changes in income and fixing long term characteristics of countries, these specifications do not compare across countries but rather within country, along time. Their findings indicate that civil war occurs when negative economic shocks hit countries.

Remark 2 *The second empirical regularity is that negative income shocks cause civil war*

To see that these two findings are logically independent, note that the first regularity refers to *where* civil wars occur, while the second refers to *when* civil wars take place. Because income

[8] While the literature has addressed this problem with extensive lists of controls, it is well-known that this is only a partial solution, as many of the controls can themselves be endogenous.

[9] The seminal paper using this strategy is Miguel et al (2004). Ciccone (2008) revisits it and shows that indeed explanatory power is given by drops in income.

variation across countries is much larger than within country along time, the first pattern is mostly about average income levels, while the second pattern is about variations around this average level. Therefore, a theory that tries to explain the first finding compares across long-term country characteristics, while a theory that addresses the second finding has to fix such characteristics and analyze the effects of income shocks. The opportunity cost argument, and the Fearon (2007) critique, were developed in the context of the first empirical regularity. We now develop a model that agrees with the critique regarding long-term income levels, but shows that the opportunity cost can account for the second empirical pattern.

2 Economic Size and Civil War

2.1 Static Model

Consider two groups $i \in \{1, 2\}$, sharing a territory of size 2. Assume without loss of generality that group 1 is weakly richer and controls $1 + \lambda$ units of land. Group 2 therefore controls $1 - \lambda$ units, for $\lambda \in [0, 1]$. Land is used to produce crops. Crops are generated according to the following production function:

$$C(\theta, L, l) = \theta L l$$

where L is the amount of land that the group controls, l is the amount of labor used for production and θ captures land fertility. Each group controls 1 unit of labor. Hence, if all labor is used for production, the total production in this economy is simply 2θ. We therefore use θ as a measure of the size of the economy. Groups seek to maximize the amount of crops they can consume at the end of the game.

Besides producing, a group can try to seize land and crops from its neighbor by violent means. If a group decides to attack, it obtains an offensive advantage and wins the fight with probability $P > \frac{1}{2}$. In case of conflict, both groups divert $c \in (0, 1]$ units of labor from production to fighting. The opportunity cost of fighting is therefore the foregone production of that labor, $2c\theta$. Hence, as θ increases, both the size of the economy and the opportunity cost of fighting increase.

Violence can be averted by negotiation and bargaining. Specifically, if there is a transfer of land that one group can willingly make to the other such that it prevents war, we allow groups to reach such agreement and avoid fighting. In keeping with Fearon (1995), such transfer of land must generate a situation in which each group is better off with its post-transfer land holdings than unilateraly deviating and launching an attack that captures the offensive advantage.[10] As there is perfect information, groups know whether such a transfer exists. If it does not exist, then bargaining cannot avert war and a symmetric conflict ensues in which each group can win with probability $\frac{1}{2}$.[11]

Note that the lack of a transfer that can sustain peace does not imply the absence of settlements that both groups would prefer rather than fighting. As it is well known in the literature, it is the inability to commit to such agreements, in this case due to the presence of offensive advantages, which causes bargaining to break down.[12]

We focus on characterizing the set of parameters that make peace impossible in equilibrium. We then examine how this set relates to the size of the economy and the opportunity cost of fighting, both proportional to θ.

Denote by T the land transfer that the rich group might give to the poor group to avert conflict. As stated above, this transfer must be such that after relinquishing land, the rich group is better off keeping the peace than unilaterally attacking. In case of attacking, the group wins with probability P and obtains the crops on both units of land –taking into account that some labor has been devoted to fighting rather than to producing. Hence the total amount of production to be enyojed by the winner is $2\theta(1-c)$. If the group loses the war it obtains 0. Hence, the

[10] In Fearon (1995) pg 403, the following argument is put forward "since states can always choose to attack if they wish, a peaceful resolution of the issues is feasible only if neither side has an incentive to defect unilateraly by attacking."

[11] In solving the model, as in Fearon (1995), we focus directly on the existence of such a transfer arrangement and hence we abstract from particular bargaining protocols. Powell (2006) provides a natural extensive form bargaining game wich has both alternating offers and the presence of offensive advantages. He shows that the solution of this game reduces to a condition equivalent to the one examined here.

[12] For an extensive discussion see Fearon (1995) and Powell (2006).

condition for the rich group to prefer giving a land transfer T rather than fighting is simply

$$(1+\lambda)\,\theta - T\theta > P2\theta\,(1-c)\,.$$

The left hand side of the condition is the payoff of transfering land and not attacking and the right hand side contains the expected payoff of launching an attack. For peace to be attainable, this transfer T also needs to satisfy the poor group. Its post-transfer utility must be higher than its expected returns from attacking. Formally,

$$(1-\lambda)\,\theta + T\theta > P2\theta\,(1-c)\,.$$

Simple algebra shows that a T that simultaneously satisfies these two conditions only exists if and only if

$$\theta > P2\theta\,(1-c)\,. \tag{1}$$

Hence peace is attainable if and only if condition (1) holds. Note that λ does not appear in this condition. Hence landholding inequality does not affect whether conflict will occur or not. Note also that when condition (1) holds, a group that controls 1 unit of land does not want to unilaterally launch a war. Therefore we have an equivalence: the set of parameters for which an equal division of land does not generate war equals the set of parameters for which there is a settlement T that avoids war, for any original distribution of land. We state this result in the following Lemma.

Lemma 1 *In the presence of bargaining, the original land distribution does not affect whether peace is attainable or not. Given any land distribution, peace is attainable if and only if unilateral deviations from peace are not profitable when both groups have equal landholdings.*

To gain intuition, note that the role of bargaining is to allow groups that are *satisfied* with the status quo –i.e. groups that prefer the current distribution of payoffs rather than their expected payoff from war–to avoid war by transfering some land to groups that are *dissatisfied*. Hence bargaining only works in situations in which one group is dissatisfied while the other one is satisfied. In this case of perfect information, bargaining can thus mollify any incentive from war that arises from unequal land holdings.[13]

However, when condition (1) does not hold, both groups are simultaneously dissatisfied even if landholdings are equal, and hence no transfer is possible. In sum, efficient bargaining eliminates wars that arise from inequality but it cannot avoid violence caused by the commitment problem induced by offensive advantages. Therefore, to find out whether peace is sustainable or not, it suffices to set bargaining aside and check directly whether an allocation with equal land holdings is stable.[14]

By simple manipulation of condition (1) we obtain that war occurs whenever

$$P > P^S \equiv \frac{1}{2(1-c)} \tag{2}$$

Hence, in keeping with the results in Fearon (1995) and Powell (2006), the offensive advantage needs to be sizable in order to destabilize peace. Indeed, for $P \in \left(\frac{1}{2}, P^S\right)$ there certainly exists an offensive advantage but no violence results because fighting entails an opportunity cost. The larger is this opportunity cost c, the larger is P^S and hence larger the offensive advantage needs to be in order to make peace unattainable.

More important to our focus, note that whether peace is sustainable or not does not relate to θ, the size of the economy. This can already be seen in (1) where both the value of peace and the returns to war are proportional to θ. With this finding we replicate the conclusion in Fearon (2007), in a very different model based on bargaining. The opportunity cost of conflict alone does not generate a natural relationship between the size of the pie and the propensity to

[13]This echoes a finding first established in Powell (1996). War is most likely to occur when the status quo distribution differs from the distribution of power. Since in this model the distribution of power is symmetric –both players have the same expected payoff if they attack– the most peaceful distribution of land is given by equal landholdings. If in this equal situation players still prefer to attack, bargaining cannot help.

[14]It should be emphasized that this is not to say that bargaining and inequality are inconsequential. Indeed, if we did not allow for efficient bargaining, inequality would definitely matter making peace more difficult to attain.

fight. The fundamental reason is that the aggregate spoils, 2θ, and the aggregate opportunity costs of fighting $2c\theta$ both increase with the size of the economy. When an economy is poor and labor productivity is low, the opportunity cost of devoting labor to seize land is small. But at the same time, the value of this land is also low. If both effects are linear, we obtain no relationship whatsoever.[15]

2.2 Dynamic Model

We have shown that the opportunity cost of conflict cannot explain the prevalence of fighting in poor countries in our static model. We now turn to demonstrating that the same holds in a dynamic setting. To see that this is the case, consider a dynamic extension of the model above in which groups interact every period $t = 1, 2, 3...$

In every period, groups start with the landholdings they controlled at the end of the previous period. They can then bargain and transfer land as in the static model. If a bargain exists that avoids conflict, it is implemented. As before, this settlement must be such that both groups are better off accepting it than deviating with a unilateral attack that leads to victory with probability $P > \frac{1}{2}$. If there is no settlement that can avoid conflict, then there is a symmetric war which each group can win with probability $\frac{1}{2}$.

There is only one round of fighting, so war is effectively a game-ending move as in most of the literature. The winning group captures the land and production of the losing group and enjoys the fruits of both pieces of land into the future. The defeated group loses the current crop and obtains a payoff of 0 for the rest of the game.

Groups mazimize the present discounted value of crop consumption. Formally, they care about

$$U = \sum_{t=1}^{\infty} \delta^t c_t,$$

[15] Of course, if these effects were not linear, we would obtain a link. As discussed in Fearon(2007), this seems a rather weak theoretical basis of such a strong empirical pattern as the sign of the relationship would depend on ad hoc functional form assumptions.

where c_t is consumption in period t and $\delta \in (0,1)$ is the time discount factor.

Note that the structure of this game is such that Lemma 1 applies: disputes that arise from unequal land holdings can readily be solved by bargaining and transfers. Hence, to characterize the set of parameters such that war is inevitable, we can set bargaining aside and proceed directly to examine the case with equal land holdings in which each group holds 1 unit of land.

Consider the decision whether to launch an attack. If a group refrains to do so, it obtains

$$\theta + \delta V^P$$

where θ are the returns to peaceful farming on the 1 unit of land it controls, and V^P is the present discounted value of future equilibrium play. If instead the group decides to attack, the expected payoffs are

$$P\left(2\theta\left(1-c\right)+\delta V^V\right)$$

where $2\theta\left(1-c\right)$ is the total production in the period where there is war (which the attacking group will capture with probability P) and V^V is the present discounted value of victory. Since we have assumed that fighting is decisive in that the loser disapperars from the game, we obtain

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

that is, the victorious group enjoys the peaceful return to 2 units of land at perpetuity.[16]

To compare the payoff from peace to the payoff from war we need to determine V^P. This is a completely stationary game, where there is no change between one period and the next. Hence, if peace is sustainable at $t=1$, it must be sustainable at any point t in the future. Therefore, if peace is sustainable, the future equilibrium play must yield simply

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

[16]The results that follow in this and next section would be qualitatively identical if the losing group could return $\Phi > 1$ periods after its defeat

This is the present discounted value of peaceful cohabitation with the neighboring group, with 1 unit of land each.

Therefore, the condition that determines whether groups with equal land holdings can live in peace is

$$\theta + \delta\frac{\theta}{1-\delta} > P\left(2\theta\left(1-c\right) + \delta\frac{2\theta}{1-\delta}\right).$$

Hence, we have that war is inevitable if and only if

$$P > P^D \equiv \frac{1}{2\left(1-c\left(1-\delta\right)\right)}. \tag{3}$$

Hence as in the static model, a sufficiently large offensive advantage is necessary for war to be inevitable. Note, however, that P^D is decreasing in δ. It follows that in this model, patience makes groups eager to fight. The reason is quite intuitive: fighting is over in one period, and hence costs are only paid for one period. However, the proceeds from victory are enjoyed for the foreseeable future. The more patient groups are, the larger the prize seems with respect to the costs, and hence the bigger the temptation to attack.[17]

If (3) is satisfied, the only subgame perfect equilibrium of this game has war at $t = 1$, no matter what the value of θ is. Hence again we fail to find a relationship between θ and conflict. The intuition is simply that making the model repeated does not provide an escape from the logic detailed in the previous subsection. In environments where the opportunity costs of fighting $2c\theta$ are small because productivity is small, the total size of the pie to fight over $\frac{2\theta}{1-\delta}$ is also small. Therefore, costs and benefits from fighting move proportionately to the size of the economy, yielding no natural link.

This robust theoretical finding casts doubt on the capacity of the opportunity cost argument to explain the first empirical regularity –namely, the negative cross-country correlation between

[17] That patient players are more prone to fight occurs in a variety of conflict settings. See Powell (1993) and Garfinkel and Skaperdas (2000) for two very different models that provide the same comparative statics. If the destruction caused by war was long-lasting (for instance, a proportion c of land becomes non-productive) the condition would lose its dependence on δ and look exactly like the static condition.

income levels and civil war prevalence. This has originated the search for alternative explanations. For instance, Fearon and Laitin (2003) and Fearon (2007) hypothesize that the level of income per capita is not in fact a direct cause of conflict, but rather a proxy for the strength of the state or for the structure of income generation, which directly affect the conditions for insurgency survival. Note that these are structural explanations that hinge on a non-causal interpretation of the first empirical pattern. More specifically, income per capita is taken to be a correlate of the institutional or economic structure of the country, which is the real cause of civil war.

3 Economic Shocks and Civil War

The models above, however, cannot address whether the opportunity cost of fighting can explain the second stylized fact, namely the fact that civil wars occur in the presence of negative income shocks. The reason is that in the previous section land productivity is a long-term constant that characterizes the economy. To address economic shocks, in contrast, we need to allow for changes in productivity.

Consider the dynamic model in the previous subsection, with the following modification. In each period t, land productivity varies, as we would expect from variations in rainfall or in world prices for cash crops. More specifically, denote by t land productivity in period t. We assume that in each period, t is independently drawn according to a well-defined cumulative distribution fuction $F(\theta)$, with continuous support on $(0, +\infty)$. Therefore total potential production, $2\theta_t$, while always positive, can vary in size. We assume that the expected value of θ is well defined, $E(\theta) = \bar{\theta}$.

For clarity, we state here the timing of every stage game.

1. θ_t is revealed and observed by both groups
2. Bargaining takes place

3. If a settlement is possible, it is reached. Consumption takes place and the game moves to $t+1$

4. If no settlement is possible, there is a decisive war. The winner captures all production and controls all land for the rest of the game

As in the previous section, bargaining is successful if there is a settlement that both groups prefer rather than launching a surprise war which they win with probability $P > \frac{1}{2}$. If no such settlement exists, there is a symmetric war in which each group can win with probability $\frac{1}{2}$. War entails an opportunity cost as each group needs to pull c units of labor from production into fighting. As before, efficient bargaining is able to deal with any conflict originated by unequal land-holdings. Hence, we can set bargaining aside and examine in detail the case of equal land holdings.

We solve for the most efficient Subgame Perfect Equilibrium of this game. Since resources are only wasted in case of war, the most efficient equilibrium is also the equilibrium that minimizes the probability of fighting.

Consider a group that, upon observing θ_t, is deciding whether to attack or not. If it decides not to attack, it expects the following payoff

$$\theta_t + \delta V^P$$

where V^P is the expected continuation value of a subgame perfect equilibrium of the game. Alternatively, if it decides to deviate by attacking, its expected returns are

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

With probability P the attacker wins and obtains $2\theta_t\left(1-c\right)$in the current period (the production on both pieces of land taking into account that $2c$ units of labor have been diverted into fighting).

In addition, the winner gains control of both units of land into the future. Hence, we have

$$V^V = E\left[\sum_{t=1}^{\infty} \delta^t \theta_t\right] = \frac{2\bar{\theta}}{1-\delta}. \tag{4}$$

So the condition for peace to be possible is simply

$$\theta_t + \delta V^P > P\left(2\theta_t\left(1-c\right) + \delta V^V\right).$$

This condition can be rearranged to find out in which circumstances peace is possible.

$$\theta_t\left(1 - 2P\left(1-c\right)\right) > \delta\left[PV^V - V^P\right] \tag{5}$$

This is the fundamental equation of this model. It implies that war occurs if current economic circumstances are bad enough, independently of expected future play. To see this, consider first the right hand side of this condition. The highest value that V^P can possibly take is $\frac{\bar{\theta}}{1-\delta}$. This is the expected value of farming 1 unit of land for the foreseeable future and would be the value of playing an equilibrium with no positive probability of fighting (and therefore the highest value that peace can produce with symmetric players). This implies that

$$PV^V - V^P \geq P\frac{2\bar{\theta}}{1-\delta} - \frac{\bar{\theta}}{1-\delta} = \left[2P - 1\right]\frac{\bar{\theta}}{1-\delta} > 0$$

and therefore the right hand side of this equation is strictly positive for any V^P. Consider now the left hand side in (5). Since θ_t is always positive, a necessary condition for peace is

$$1 - 2P\left(1-c\right) > 0 \tag{6}$$

Interestingly, when (6) holds, the static game in the previous section obtains peace for any θ. This can be readily confirmed by realizing that this condition is equivalent to $P < P^S$ in

(2). This puts these two models in sharp contrast. While $1 - 2P(1-c) > 0$ is a necessary and sufficient condition for peace in the static model, it is not sufficient to guarantee peace in the dynamic model with economic shocks.

To see this, recall that the right hand side of (5) is strictly positive for any continuation value V^P. This implies that even if (6) holds, there exists a θ_t close enough to 0 such that the condition is not satisfied and war is inevitable. Hence, no matter the equilibrium strategies that players expect to be implemented in the future, war must occur for sufficiently bad economic shocks.

We are interested in characterizing the most efficient subgame perfect equilibrium. It follows from the previous discussion that this equilibrium must have war only for realizations of θ_t below a threshold $\tilde{\theta}$. There are two reasons for this. First, as established above, it is clear from (5) that in addition to any other incidence of conflict in equilibrium, conflict must occur in poor realizations of θ_t. Therefore it makes sense to search for an equilibrium in which conflict *only* occurs for such poor realizations. Second, by having conflict only for poor realizations, the loss caused by war ($2c\theta_t$) is minimized as it occurs only when θ_t is small. Therefore, the most efficient subgame perfect equilibrium must be characterized by simple threshold strategies that are not history dependent: groups play peace if $\theta_t > \tilde{\theta}$, and play war otherwise. We now need to find the lowest possible threshold $\tilde{\theta}$.

In an equilibrium in threshold $\tilde{\theta}$ strategies, the continuation value of peace is easy to characterize. It is the highest solution to the following equation:

$$\tilde{V}^P = F(\tilde{\theta})\frac{1}{2}\left[2E(\theta \mid \theta < \tilde{\theta})(1-c) + \delta V^V\right] + \left(1 - F(\tilde{\theta})\right)\left[E(\theta \mid \theta > \tilde{\theta}) + \delta \tilde{V}^P\right].$$

With probability $F(\tilde{\theta})$, the realization of θ_t falls below $\tilde{\theta}$ and hence war ensues. A group wins this war with probability $\frac{1}{2}$, and within the first square brackets is the expected value of winning such war and enjoying the fruits of victory into the future. With probability $1 - F(\tilde{\theta})$, the economic shock is good enough to support peace. Inside the second square parentheses is the expected value of peace and the continuation value of the equilibrium. Solving this equation for

$\tilde{V}^P$ yields

$$\tilde{V}^P = \frac{\bar{\theta}}{1-\delta} - \frac{cF(\tilde{\theta})E(\theta \mid \theta < \tilde{\theta})}{1-\delta\left(1-F(\tilde{\theta})\right)}. \tag{7}$$

This expression is intuitive. The future value of playing peace in this equilibrium equals the value of playing peace forever, $\frac{\bar{\theta}}{1-\delta}$, minus the expected value of the cost of war that will occur as soon as $\theta_t < \tilde{\theta}$. This expression is decreasing in $\tilde{\theta}$ because the larger the threshold $\tilde{\theta}$, the higher the probability that con‡ict will occur. This increases the losses for two reasons. First, war will occur sooner in expectation and hence costs are less discounted. Second, with a larger threshold the expected amount of resources lost in the war is bigger.

The optimal threshold $\tilde{\theta}$ is simply the lowest value of θ_t that satisfies (5) with equality. Substituting in (4) and (7) and rearranging we find an equation that implicitly characterizes it.

$$\tilde{\theta} = \frac{\delta}{1-2P(1-c)}\left[(2P-1)\frac{\bar{\theta}}{1-\delta} + \frac{cF(\tilde{\theta})E(\theta \mid \theta < \tilde{\theta})}{1-\delta\left(1-F(\tilde{\theta})\right)}\right] \tag{8}$$

Existence of $\tilde{\theta}$ is guaranteed because the right hand side is always strictly positive, bounded and continuous.[18] In contrast, the left hand side can take any value in $(0, +\infty)$. Therefore there are values of $\tilde{\theta}$ low enough such that the left hand side is below the right hand side, and values of $\tilde{\theta}$ high enough such that the opposite is true.[19] We have therefore established the following proposition.

Proposition 1 *For $P < P^S$, the most efficient subgame perfect equilibrium of the dynamic game with economic shocks is given by a stationary threshold strategy, where the threshold is the smallest positive solution to (8).*

For $P > P^S$, there is no equilibrium that avoids war at $t = 1$, for any realization θ_1.

Hence the best equilibrium of this game shares some characteristics with the equilibrium in

[18] The right hand side is simply $\frac{\delta\left[PV^V - V^P\right]}{1-2P(1-c)}$. A (loose) upper bound to this expression is $\frac{\delta P}{1-2P(1-c)}\frac{2\bar{\theta}}{1-\delta}$.

[19] Both sides are increasing in $\tilde{\theta}$ and hence multiple thresholds are possible. However, as we are interested in characterizing the most efficient equilibrium, only the smallest threshold matters. Note also that the smallest threshold must necessary define a stable equilibrium.

the previous section. In particular, if the offensive advantage is large enough, $P > P^S$, war is inevitable, independently of the size of the pie. However, in the presence of economic shocks, a small offensive advantage is enough to generate con‡ict *for bad enough states of the economy.* Note that this is true for any $P > \frac{1}{2}$, in sharp contrast with the previous section.

The intuition behind this dependence on income shocks is exactly the opportunity cost argument. When t is small, the opportunity costs of fighting are small because returns to labor are meager. However, the future value of a victory remains constant because it depends on the expected future returns to land. If returns to labor (the opportunity cost) are low enough, groups want to unilateraly defect from peace, which makes war inevitable. Thus, in the presence of a drought, groups do not fight for the meager returns to land today. Rather, they fight today to capture land that will be valuable tomorrow, when the drought ends. They fight precisely because current returns to land (and therefore labor) are small enough that they make capturing additional land for the future very tempting.[20]

Note that this argument hinges on current opportunity cost being lower than expected future income. It is not crucial whether these changes in income result from a negative income shock. For instance, a poor country that expects a future windfall (maybe because of the discovery of new mineral resources that will be exploited after a period of time) would also be at risk of conflict.

This equilibrium displays intuitive comparative statics.

Proposition 2 *The threshold $\tilde{\theta}$ defined by (8) is increasing in P and δ, and decreasing in c.*

Hence the probability of fighting is higher when offensive advantages are stronger, when groups are more patient, and when the opportunity costs of fighting are smaller. Patience destabilizes for the same reason it does in the previous section. As the prize of war is control of land into the

[20] Again, thanks to efficient bargaining, this equilibrium is independent of the original distribution of land. An economy that starts with an unequal distribution would have peace (occasionally supported by land transfers from the land-rich group to the land-poor group) as long as $\theta_t > \tilde{\theta}$. The first time that $\theta_t < \tilde{\theta}$, conflict ensues independently of the distribution of land at time t or in any previous period. In the absence of bargaining this is not true, and land distribution matters as the binding threshold would be the one for the land-poor group.

future, less discounting effectively increases returns to attacking.

Therefore, while the opportunity cost argument was shown in the previous section to have difficulties explaining the first empirical pattern of civil wars, it turns out to provide a simple and compelling theoretical underpinning of the second stylized fact: civil wars occur in periods of economic distress. The fact that the same theoretical argument fails to explain one fact but works for the other is further evidence that these two empirical findings are logically independent.[21]

4 Mutual Fears and Civil War

In the model above, groups observe perfectly the state of the economy. When they fight, it is because it is common knowledge that the opportunity cost of fighting is too low to sustain peace. However, obtaining perfectly accurate information about the returns to land might be difficult. More likely, groups predict how good the harvest will be using available data. Since they might have different observations, or different ways of predicting, it is quite possible that they have slightly different beliefs on the current level θ_t. This opens an intriguing possibility: groups might now attack not because they think that θ_t is too low but rather because they think their opponent beliefs might be too low to sustain peace. In other words, groups might attack due to the mutual fears that imperfect observation generate. We now demonstrate that such fears exacerbate the problem of income shocks.

We make a simple modification of the model in the last section. Assume that we have two groups with 1 unit of land each that interact as above for $t = 1, 2, 3...$ Instead of observing θ_t, however, each group observes a signal about θ_t. More specifically, assume that group $i = 1, 2$ observes $x_{it} = \theta_t + \sigma\varepsilon_{it}$ where ε_{it} is a random draw from a symmetric and continuous distribution independently and identically distributed across time and players and centered at 0. σ is a positive

[21]This is not to say that structural explanations of war have no say in the second stylized fact. Our argument shows that the opportunity cost argument can account for this relationship but does not exclude other explanations that would be, in any case, complementing. For instance, Dalbó and Powell (2009) provide an informational theory of conflict that also predicts violence in such times.

constant that measures how imperfect these private signals are.[22]

After observing the signal, groups simultaneously decide whether to attack or to play peace. For simplicity, assume that a war diverts all labor from production to fighting, that is $c = 1$. If a group attacks while the other plays peace, the attacking group wins with probability $P > \frac{1}{2}$. If both groups attack, then there is a symmetric war that will be decided with probability $\frac{1}{2}$ in favor of each group. War is decisive, as before, and the winner obtains the use of all land into the future. The following proposition characterizes the most peaceful equilibrium of this modified game.

Proposition 3 *As $\sigma \to 0$, the most peaceful equilibrium strategies converge to threshold strategies. Players therefore attack only if $x_{it} < \hat{\theta}$. This common threshold $\hat{\theta}$ is the smallest solution to*

$$\hat{\theta} = \delta \left[(2P-1) \frac{2\bar{\theta}}{1-\delta} + \frac{F(\hat{\theta}) E(\theta \mid \theta < \hat{\theta})}{1 - \delta \left(1 - F(\hat{\theta})\right)} \right]. \tag{9}$$

To see how the introduction of imperfect information changes the capacity to have peace, compare this expression with the threshold in the previous section. Note that, for $c = 1$, expression (8) simplifies to

$$\tilde{\theta} = \delta \left[(2P-1) \frac{\bar{\theta}}{1-\delta} + \frac{F(\tilde{\theta}) E(\theta \mid \theta < \tilde{\theta})}{1 - \delta \left(1 - F(\tilde{\theta})\right)} \right]. \tag{10}$$

This makes the comparison simple. The only difference between these two fixed point equations is the fact that the first element in the square brackets is larger in (9). This implies that the right hand side in (9) is always above the right hand side in (10). As a consequence, the first must cross the 45 degree line later. It follows that $\hat{\theta} > \tilde{\theta}$. Therefore, introducing very precise but imperfect assessments of the state of the world generates mutual fears that expand the set of economic circumstances that end up in war.

To see why groups cannot use $\tilde{\theta}$ as a threshold in the absence of common knowledge, imagine that they try to use such strategy. Hence, they are supposed to play peace if their private signal

[22] This information structure was first introduced by Carlsson and van Damme (1993).

x_{it} is above and attack only if it is below. Note, however, that they do not know the signal their opponent is receiving. In their view, their opponent might receive a signal slightly above, or slightly below their own. The noise structure ensures that whatever its current signal is, group i believes the opponent has a worse (lower) signal with a 50% chance. Now consider the problem of a group that receives a signal exactly equal to $\tilde{\theta}$. Given the strategies groups are supposed to follow, it knows that it will be attacked with probability 50% as this is the probability that the opponent will get a signal below $\tilde{\theta}$. It is easy to check that at $\theta_t = \tilde{\theta}$, with a 50% chance of being attacked, the best response is actually to attack: the opportunity costs of labor are too low to risk entering a war without the offensive advantage.[23] Therefore a threshold strategy at $\tilde{\theta}$ cannot be an equilibrium of this game. The equilibrium threshold needs to compensate for the 50% chance of being attacked and hence it must be higher than $\tilde{\theta}$.

In sum, enriching the commitment problem in the previous section with a vanishing amount of imperfect information generates an equilibrium with two mutually reinforcing incentives to fight. As discussed in the previous section, for particularly bad realizations of productivity, $\theta_t < \tilde{\theta}$, groups fight because the returns from predating their neighbors outweight the opportunity costs of violence. If productivity is observed with noise, for realizations $\theta_t \in \left[\tilde{\theta}, \hat{\theta}\right]$ violence also occurs, but it is not due to predatory incentives anymore. Rather, violence occurs due to mutual fears: if a group could commit not to attack, the neighbour would be happy playing peace. In the absence of such commitment, groups prefer to launch attacks because they fear getting involved in a conflict in which the opponent seizes the offensive advantage. Hence, mutual fear acts as an amplification force of negative income shocks, expanding the set of shocks that result in violence.[24]

[23] To see this, note that $\tilde{\theta}$ marks the size of the economy at which a group that expects the opponent to be completely peaceful is indifferent between attacking or not. Therefore, if there is positive probability of facing a violent opponent, the group must strictly prefer to attack.

[24] The idea that mutual fears can generate conflict goes back to Hobbes (1651). In modern International Relations, Herz (1950), Schelling (1960) and Jervis (1978) refined and modified it alternatively naming it "security dilemma"or "spiral model." Posen (1993), and Jervis and Snyder (1999) applied these ideas to civil war. Kydd (1997) and Baliga and Sjöstrom (2004) provide formal theories of this phenomenon. See also de Figueiredo and Weingast (1999).

5 Conclusion

This article examines the capacity of the opportunity cost argument to explain the empirical relationship between GDP per capita and civil war prevalence. We have documented that there is not one but two robust empirical patterns. On the one hand, civil war prevalence is negatively correlated with income per capita at the country level. On the other hand, negative income shocks causally predict civil war onset.

We develop a simple bargaining model that agrees with the conclusion in Fearon (2007): the opportunity cost of conflict is a weak explanation for the fact that poor countries exhibit a high proclivity to suffer from civil war. However, when we enrich the model with income variation, we show that the opportunity cost can explain by itself the fact that civil wars occur in the aftermath of negative economic shocks.

Therefore it seems that the next step that the theoretical literature should take is to explore in depth several alternative explanations for the first empirical pattern. If differences in income per capita hide structural differences between countries, it is important to understand precisely what structural elements cause instability. Fearon and Laitin (2003) and Fearon (2007) suggest that the weakness of the state might be the real cause of insurgent viability. Other structural differences might be more economic in nature: for instance, in rich economies a much higher fraction of income is generated by human capital, which is obviously very difficult to appropriate by violent means. A similar argument can be made with respect to reliance on the primary sector. More empirical work is also needed to better identify these structural channels.

While our analysis shows that the opportunity cost of fighting can explain the second empirical pattern, it definitely does not exclude other contributing mechanisms. In particular, it is quite clear that some structural explanations would also interact with negative income shocks. A close analysis of these mechanisms is important because it could inform conflict prevention policies and post-conflict reconstruction efforts. Note also that to the extent that poor countries suffer from proportionally larger income shocks, the explanation we have uncovered for the second fact might have some bearing on the cross-country correlation.

Finally, we show that misperceptions and mutual fears exacerbate the effect of income shocks. As Jervis and Snyder (1999) discuss, a problem with theories of conflict that are based on mutual fears is their difficulty predicting when conflict erupts. Indeed, fear is constantly present, but wars seldom happen. In our framework we show that mutual fears serve as an amplifier of negative economic shocks, thereby characterizing the circumstances that will trigger these pernicious spirals.[25]

[25] See Chassang and Padró i Miquel (2008a) for a detailed discussion.

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6 Appendix

Proof of Proposition 3. This game satisfies all the conditions of Lemma A.2 in Chassang and Padró i Miquel (2008b) with $\theta_t = \tilde{\pi}$, $F_i = PV^V$, $S_i = (1 - P)\, V^V$ and $W_i = \frac{1}{2}V^V$. This lemma establishes the structure of the most peaceful equilibrium. ■