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Thanks but No Thanks: A New Policy to Avoid Land Conflict

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Abstract

Land conflicts can be detrimental. An important goal of development policy is to help define and instill respect for borders. This is often implemented through mandatory and expensive interventions that rely on the expansion of government land administration institutions. We bring to the table a new policy that, in theory, promotes neighborly relations and equitable divisions at low cost. The salient features of this policy would be the existence of a regulatory institution and the option to bypass regulation in favor of a cooperative solution. Such a policy is particularly relevant when the government formally owns the land but tenure rights are about to be individualized. The key idea combines the logic of forward induction with the insight that social preferences transform social dilemmas into coordination problems. As a first and low-cost pass at empirical evaluation, we conduct a framed field experiment among farmers in the Ethiopian highlands, a region exhibiting features typical of many countries where borders are often disputed.

Key Words: conflict, land grabbing game, social preferences, forward induction, Ethiopia, experiment, land reform, development aid

JEL codes: C78, C93, D63, Q15

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Introduction

Property rights, trust, and peaceful relations with neighbors are important to individuals' willingness to invest in their land and to economic prosperity.[1] Lack of institutions that secure property rights for land has been deemed a fundamental reason why many sub-Saharan African countries remain comparatively poor (Knack & Keefer 1995; Goldsmith 1995; Acemoglu et al. 2001). An important goal for development assistance is therefore to develop cost-effective means to help define and ensure respect for property.[2] We bring to the table a new policy which, in theory, may solve the problem at no cost at all.

Poorly defined tenure rights can also contribute to land related conflicts. During the last decades, there has been an increase in land conflicts in sub-Saharan Africa (Peters 2004). Interestingly enough, the conflict implications of the structure of land property rights have often been neglected in the design and implementation of land reform policies. It is even argued that land policy and titling programs have exacerbated conflicts (Peters 2009). Land conflicts in rural areas can take many forms: between communities, between farmers and investors or the state,

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[1] The relevant literature in support of these claims is too extensive to attempt any serious survey; see, e.g,. Skaperdas (1992) on property rights, Besley (1995), Friedman et al., (1988), Hayes et al. (1997), Gebremedhin & Swinton (2003), Smith (2004), Deininger & Jin (2006), Goldstein & Udri (2008), Mekonnen (2009) on the role of tenure for investments and agricultural productivity, and Knack & Kiefer (1997) on trust. Witness the developments in Rwanda in 1994 for an example of how things can go terribly wrong when neighbor relations are not peaceful (André & Platteau 1998).

[2] The World Bank has recently stressed the need for research that evaluates the impacts of such reforms, including their cost-effectiveness. Deininger et al. (2011) is an example of such research.

and between farmers themselves. We focus on farmer-to-farmer land conflicts. At first glance, such situations resemble dilemma games, in which individual rationality conflicts with social efficiency. One way to avoid conflict is to use state enforcement power to provide all those services that can ensure peace: detailed surveying and registration and then police, courts, judges, legal counsel, etc. With some local variations, this is the strategy now embraced by many governments and donors as part of mandatory land titling programs. But that can be costly.[3] Our proposal, by contrast, would allow farmers to choose between external enforcement and cooperation. This relies on farmers to voluntary restrain themselves from laying claim to their neighbors' land, thus fostering an environment of trust and reduced conflict.

The key idea combines recent work in behavioral economics, on *social preferences*, and somewhat less recent work in game theory, on *forward induction*. We first argue that land-grabbing games may actually not be social dilemmas. If the involved parties care about other things than their own material gain (as recent work in behavioral and experimental economics suggests) then the situation is best thought of as a coordination game with multiple Pareto-ranked equilibria. We then introduce our proposal, which to use policy to tweak the land-grabbing game such that a forward induction argument generates coordination on a good outcome. Our suggestion is not to impose mandatory government regulation and control as a means to securing property rights and respect for borders, but rather to have this be a costly option which farmers can forgo. If government-mediated intervention is actively rejected, this signals the intention and expectation that subsequent play will conform with a cooperative pattern.

It would be incorrect to say that our proposal does not concern costly government intervention at all. It involves *counterfactual* costly government intervention. Intervention is feasible but shunned, and hence no actual intervention cost is incurred. In reality, the government will always need to ensure at least a minimum of legal institutions. This makes the government intervention credible. Still, by allowing for cooperation, the cost to these institutions could be reduced substantially. There is a well-documented allegory to such cooperation in Lin Ostrom's design principles for long-enduring Common Pool Resource institutions (1990) and in Ostrom et al. (1992). Ostrom shows that cooperation in management is possible, and that individuals can

[3] The cost of registration per plot varies greatly. At one end of the spectrum, we have Indonesia where a title costs about $80 (Grimm & Klasen, 2009). At the other end, we have Rwanda (Ali et al., 2011) and Ethiopia (Deininger & Jin, 2006; Deininger et al., 2008) where each certificate costs about $1.

make credible commitments and achieve higher joint outcomes without an external enforcer, given conducive institutional settings.

The formal articulation of our ideas is the first contribution of our paper. We view such arm-chair reasoning as valuable *per se*. However, empirical relevance should not be taken for granted. A second goal of our study is to take first steps toward testing the proposal in practice. To that end, we report the results from a framed field experiment.

The design mixes abstract and realistic features.[4] We rely on an experimental game directly reflecting the behavioral theory we test rather than on allotments of real land. This has the advantage of being affordable. While the game is more abstract than a true land conflict setting, the payoffs are designed to resemble those relevant in the field. In other dimensions, the setup is close to that of actual developing economies. We conducted the experiment in the Amhara Region located in the Ethiopian highlands, where borders are often not well defined and often disputed. The current government has ambitions to engage in land certification procedures whereby farmers obtain formal user-right status. Our subjects are farmers from this area, and the game they play is described by drawing realistic analogies to local conditions concerning land borders and conflicting neighbors' claims. We conducted our experiments in villages with relatively high and low levels of reported land conflicts.

This study thus proposes a specific and comparatively inexpensive form of policy that may help to define land property rights and to promote respect for borders. The salient features of this policy would be the availability of a *Divider* institution and the option to by-pass this *Divider* for a cooperative solution. Such a policy is particularly relevant when the government formally owns the land but tenure rights are about to be individualized.

The next section tells the game-theoretic story that serves as the formal foundation of our policy proposal. Then the experimental design and results are set forth. A discussion of policy implications concludes.

[4] See Harrison & List (2007) for a discussion of various features of field experiments.

Theory

This section presents and theoretically justifies our policy proposal. We structure the material by considering in turn the game form, selfish preferences, social preferences, our policy proposal, forward induction, overall conclusions, and testable hypotheses.

The Game Form

Imagine two neighboring farmers, each of whom owns a house with some adjacent land. The border between the houses is not well-defined, but each farmer can lay claim to some section of land extending from his house toward that of his neighbor. The benefit from land is that it can be used for agricultural production and hence yield income. If a farmer lays claim to land to which his neighbor does not lay claim, then the farmer gets that land at 'full value,' proportional to its size. If both farmers lay claim to some section of land, then there is loss of value due to 'conflict'. The farmers then split only half of the value that the land would have if uncontested, so each farmer gets a quarter of full value.

This situation can be formally described using a game form with features as follows:

- There are two farmers/players, called 1 and 2.
- Each farmer's strategy set equals {0, 1, …, T}, where T is the total amount of land located between the farmers' houses; a player's strategy indicates the amount of land adjacent to his house to which he lays claim.
- If a farmer chooses x while his neighbor chooses y, then the farmer gets land value $v\cdot(x-z) + v\cdot z/4$, where v is the value of uncontested land per unit and z is the number of units of contested land: $z = \max\{x+y-T, 0\}$.

Selfish Preferences

If a farmer cares only about land value, he has a dominant strategy to lay a claim of T. The outcome when both farmers choose accordingly is inefficient; each gets a payoff of $v\cdot T/4$ whereas, had each chosen $T/2$, then each would have gotten a payoff of $v\cdot T/2$.

In light of the inefficiency, there may be scope for government intervention to ensure property rights and border protection. For example, if enforcing an equal split of land costs C and this is charged equally to the farmers, then each gets a payoff of $(v\cdot T-C)/2$ which is worthwhile if $(v\cdot T-C)/2 > v\cdot \mathrm{T}/4$, or equivalently $C < v\cdot T/2$. For example, consider (in anticipation of the upcoming experiment) the case with T=4, v=8, and C=10. Before considering government intervention, we get the game in Figure 1:

Figure 1. Monetary Payoffs

	0	**1**	**2**	**3**	**4**
0	0, 0	0, 8	0, 16	0, 24	0, 32
1	8, 0	8, 8	8, 16	8, 24	2, 26
2	16, 0	16, 8	16, 16	10, 18	4, 20
3	24, 0	24, 8	18, 10	12, 12	6, 14
4	32, 0	26, 2	20, 4	14, 6	8, 8

Strategy 4 is dominant; when both players choose accordingly, they each get a payoff of 8. The outcome is inefficient, because each player would get more than 8 if each player chose 2 or 3. Moreover, both farmers would be better off if an equal split (strategy profile (2,2)) were enforced and the cost C=10 split equally between the farmers, as each would get a payoff of 16-10/2 = 11 > 8.

Social Preferences

The outcome with government intervention is inefficient in the sense that resources C=10 get wasted. Could there be hope for a better outcome? One reason why this may be feasible arises if the farmers do not just care for land value. This is compelling in light of the recently burgeoning literature on social preference, which argues (with reference to introspection as well as societal and experimental data) that humans often harbor objectives other than own material gain. In response, theorists have developed a variety of models of social preferences.[5] See Fehr & Gächter (2000), Sobel (2005), or Fehr & Schmidt (2006) for reviews and insightful commentary as to why economists should take social preferences seriously.

Different models modify the farmers' utilities in different ways. One may think that it matters greatly to economic analysis which model is considered. While this may be true as regards general games, it is not true as regards the following insights concerning our game form with the farmers: Most models admit as an equilibrium the cooperative outcome where each farmer lays a restrained claim of $T/2$. If the farmers could coordinate on such a 'nice'

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[5] Examples include models of inequity aversion (Fehr & Schmidt 1999, Bolton & Ockenfels 2000), concern for the least well-off individual (Charness & Rabin 2002), reciprocity (Rabin 1993, Dufwenberg & Kirchsteiger 2004, Falk & Fischbacher 2006), or guilt aversion (e.g. Battigalli & Dufwenberg 2009).

equilibrium, there would be no need for government intervention to improve the outcome. This rosy outcome is not guaranteed, however; most of the models also admit the high-conflict strategy profile where each farmer lays a claim of T as an equilibrium. Moreover, the equilibria are typically Pareto-ranked, so that equilibrium ($T/2$, $T/2$) is preferred by each farmer to equilibrium (T, T). The farmers thus face a coordination problem.

In order to make these observation concrete and precise (and then move on to our policy proposal) we now focus on a specific model, namely the Fehr & Schmidt (1999) (F&S) model of inequity aversion. As we explain toward the end of section 2, and show formally in Appendix A, insights similar to the ones we highlight obtain also under other models.[6]

Applied to a two-player game, the F&S model says that if player i gets a dollar payoff of $\$_i$ while co-player j gets $\$_j$ then i's utility equals

$$\$_i - \alpha_i \cdot \max\{\$_j - \$_i, 0\} - \beta_i \cdot \max\{\$_i - \$_j, 0\}$$

where $0 \le \beta_i \le \alpha_i$ and $\beta_i < 1$.

Consider again the case of the farmers' game form with T=4 and v=8. With $\alpha_1 = \alpha_2 = \beta_1 = \beta_2 = 0$ we get the game in Figure 1 as a special case. However, multiple Pareto-ranked equilibria arise if α_i and β_i are large enough. For example, if $\alpha_1 = \alpha_2 = \beta_1 = \beta_2 = 5/8$ we get the game in Figure 2 where the equilibria include strategy profiles (2, 2), (3,3), and (4, 4):

Figure 2. Social Preferences (inequity aversion a la F&S)

	0	**1**	**2**	**3**	**4**
0	0, 0	-5, 3	-10, 6	-15, 9	-20, 12
1	3, -5	8, 8	3, 11	-2, 14	-13, 11
2	6, -10	11, 3	16, 16	5, 13	-6, 10
3	9, -15	14, -2	13, 5	12, 12	1, 9
4	12, -20	11, -13	10, -6	9, 1	8, 8

[6] Even so, equity has indeed been a major policy concern when it comes to land redistribution in Ethiopia, which makes inequity aversion an unusually relevant example.

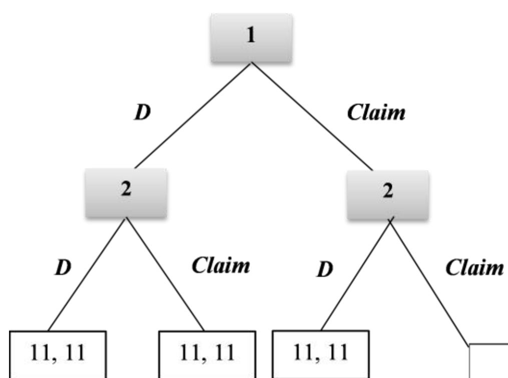
Things have improved, but only so much. Whereas the no-conflict outcome of strategy profile (2,2) is now sustainable in equilibrium, the high conflict outcome of strategy profile (4,4) cannot be ruled out because that is an equilibrium too.

The No-Intervention-Agreement Proposal

We are now ready to present our policy proposal aimed at ensuring the no-conflict outcome (according to the theory). Augment the above game form with a new option D: each farmer may call on a 'Divider' who at cost C (paid for equally by the farmers) enforces the (T/2, T/2) outcome. The Divider represents a government (which sends out a team of policemen, judges, and behavioral contract theorists). Then add the following twist: If neither farmer chooses D – the interpretation being that they have 'agreed' to forgo Divider intervention – then they play the same game form as described earlier.

Once preferences are specified, this change of rules generates a '*Divider* game'. With Fehr-Schmidt preferences as before, T=4, v=8, and C=10, we get the game in Figure 3:

Figure 3. Divider Game



	0	1	2	3	4
0	0, 0	-5, 3	-10, 6	-15, 9	-20, 12
1	3, -5	8, 8	3, 11	-2, 14	-13, 11
2	6, -10	11, 3	16, 16	5, 13	-6, 10
3	9, -15	14, -2	13, 5	12, 12	1, 9
4	12, -20	11, -13	10, -6	9, 1	8, 8

Forward Induction

What behavior should be expected in the game of Figure 3? Before proceeding formally, consider the following intuitive chain of arguments:

(i) No rational player rejects *D* with the intention of following up with 0 or 1; choices 0 or 1 give a player at most 8 in the subgame (following *Reject D*) so it would have been better to choose *D* to start with to get 11 > 8.

(ii) In the subgame, each player should figure out (i) and thus expect the co-player to not choose 0 or 1.

(iii) But each player also should figure out (ii), and thus not choose 4, which would be better than *D* only if the co-player chooses 0 (which (ii) ruled out).

(iv) But then it does not make sense to choose *D* because each player should figure out (iii) and so realize that, by rejecting *D* and then choosing 3, he could get at least 12, because by (ii) and (iii) the co-player will not choose 0, 1, or 4; note that 12 is more than the 11 he would get from *D*.

(v) The prediction, then, is that players will choose 2 or 3.

Game theorists call the chain (i)-(v) a forward induction argument; past choices tell stories about predicted future choices which in turn may affect initial choices. There is no universally accepted definition of forward induction and different scholars have proposed a variety of solution concepts to capture its spirit.[7] We do not need to enter here a discussion of which concept is best because they all deliver essentially the same prediction for the game in Figure 3. We opt for the simplest solution concept which can capture the chain (i)-(v). Arguably (and following Ben-Porath & Dekel 1992) this is iterated elimination of weakly dominated strategies (IEWDS) applied to the (reduced) normal form of the game in Figure 3, presented in Figure 4:

[7] See e.g. Kohlberg & Mertens (1986), van Damme (1989), Ben-Porath & Dekel (1992), Battigalli & Siniscalchi (2002), Asheim & Dufwenberg (2003).

Figure 4: Normal Form Divider Game

	D	**0**	**1**	**2**	**3**	**4**
D	11, 11	11, 11	11, 11	11, 11	11, 11	11, 11
0	11, 11	0, 0	-5, 3	-10, 6	-15, 9	-20, 12
1	11, 11	3, -5	8, 8	3, 11	-2, 14	-13, 11
2	11, 11	6, -10	11, 3	16, 16	5, 13	-6, 10
3	11, 11	9, -15	14, -2	13, 5	12, 12	1, 9
4	11, 11	12, -20	11, -13	10, -6	9, 1	8, 8

The reader may verify that IEWDS eliminates, in turn, first strategies 0 and 1, then strategy 4, then strategy *M,* so that finally strategies 2 and 3 survive. If we focus on equilibria involving strategies that survive IEWDS (as do Kohlberg & Mertens 1986; cf. van Damme 1992) one sees that there are two: (2, 2) and (3,3).[8]

Note also that, if we go back to the 'No-*Divider* Game' (Figure 2) and apply IEWDS, then strategy 4 cannot be ruled out. Strategies 2, 3, and 4 all survive IEWDS.

Overall Conclusions

Our example highlights several insights. First, the old inefficient outcome (4, 4) is no longer viable; we rule out the full-conflict outcome. Second, we also rule out the (*D, D*) outcome with costly mediated intervention. Thus the cost C=10 is never incurred. Third, each of the predicted equilibria (2, 2) and (3,3) involves an outcome which is better than the outcome with mediated intervention (since players get at least 12 each, rather than 11). Fourth, while the mediated intervention is not used, the fact that it *could have been used* shaped the analysis. If the *D* choice were not available, we would be back to the game in Figure 2, with its live possibility of a high-conflict (4,4) equilibrium.

How general are these insights? First of all, the arguments require that α_i and β_i are large enough. For example, if the players cared for land value only ($\alpha_1=\alpha_2=\beta_1=\beta_2=0$), the forward induction argument could never kick in. To see this, augment the game in Figure 1 with the *D* option; *mutatis mutandis* we get the game in Figure 5 in which *D* is the sole survivor of IEWDS:

[8] There is also an equilibrium in mixed strategies where each player chooses 2 with probability 10/13 and 3 with probability 3/13, in which each player has an expected payoff of 166/13.

Figure 5: Divider Game with Selfish Players

	D	**0**	**1**	**2**	**3**	**4**
D	11, 11	11, 11	11, 11	11, 11	11, 11	11, 11
0	11, 11	0, 0	0, 8	0, 16	0, 24	0, 32
1	11, 11	8, 0	8, 8	8, 16	8, 24	2, 26
2	11, 11	16, 0	16, 8	16, 16	10, 18	4, 20
3	11, 11	24, 0	24, 8	18, 10	12, 12	6, 14
4	11, 11	32, 0	26, 2	20, 4	14, 6	8, 8

On the other hand, the insights are robust in the sense that an analysis akin to that we conducted for the game in Figure 4 could have been done with many other combinations of the α_i and β_i parameters (including any combination with α_i>5/8 and 5/8<β_i<1).[9] Moreover, as shown in Appendix A, the results are not limited to the F&S model, as similar conclusions could be drawn using the models of Bolton & Ockenfels or Charness & Rabin.[10]

Experiment in the Ethiopian Highlands

What is the empirical relevance of the ideas developed in the previous section? To shed light on this issue, we ran a framed field experiment in a setting which befits our story, and where there would be large potential gains if the proposal worked well. We first describe the site and the design, and then the results.

Study Site, Design Details and Procedure

The experiment was conducted in eight *kebele*s (villages) in the East Gojam and South Wollo zones of the Amhara Region in Ethiopia. Four of the villages had a reported high

[9] We do not suggest that 5/8 is a lower bound. We do not suggest that 5/8 is a lower bound. Also, if β_i>21/32, strategy 4 gets eliminated under IEWDS alongside strategies 0 and 1. Finally, the results do not rely on C=10 specifically; with $\alpha_1 = \alpha_2 = \beta_1 = \beta_2$=5/8, any C such that 0<C<16 would do (and if 0<C<8 IEWDS would even imply the best outcome: strategy profile (2,2)).

[10] Forward induction arguments are conceivable also within psychological game-based models (e.g. reciprocity or guilt aversion); compare Battigalli & Dufwenberg (2009, Sections 2 & 5). However, since a proper analysis of psychological games raise many technical and other issues, we shall not explicitly go in that direction but rather be content with the robustness expressed in the text.

prevalence of land conflicts and the other four had relatively lower prevalence of land conflicts.[11] The region is located in the Ethiopian Highlands, where most people are engaged in small-scale subsistence farming. After the demise in 1974 of one of the longest existing feudal systems in the world, land in Ethiopia was nationalized. The region has since undergone frequent redistributions aimed at bringing more equitable allocation of lands of different quality. The process of redistribution was characterized by a lack of accurate measurement and demarcation. These factors created a situation where most people possess highly fragmented land, sharing poorly defined borders with numerous people, a fertile ground for land disputes (Wan & Cheng, 2001). A steady population growth, coupled with land laws prohibiting sale and exchange of land, thereby discouraging migration, exacerbate the problem.[12] The contested land in such an environment is typically not the whole land holding but rather marginal land along a vaguely defined border, similar to the theoretical model we developed in section 2. However, it is conceivable that the negative effects of the conflict could extend beyond the border line *per se*, for example by imposing transaction costs and eroding tenure security. Border conflicts among neighbors could also have adverse effects on social values like trust and reciprocity important for other domains of life. Thus, clear definition of borders has considerable efficiency benefits in such an environment.

Our experimental design builds on the theoretical model and the parameterization as described in the previous section. In the experiment, we used the area unit of *tilms*, which is a local land size unit in the region. One hectare corresponds approximately to 30-40 *tilms* depending on the land type and local tradition. The average land ownership in the region where we conducted our experiments is approximately 1.27 hectare per household (CSA, 2009). We set the contested land to be 4 *tilms*, which corresponds to approximately 5% of the total household farm size. These parameters are chosen to reflect local conditions.

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[11] Ethiopia consists of 11 regional states, which are divided into sub-regions called zones; the zones are divided into districts (woreda). The districts are divided into sub-districts (kebele), which are in turn constructed of local communities, called got. To simplify for the reader, we call the kebeles villages, which is the closest equivalent. Our sample villages are selected from an existing panel survey that covers 14 randomly selected villages in the region. After ranking the 14 villages based on farmer-to-farmer land conflict prevalence data from the survey, we selected the top four (which we call 'high-conflict' villages) and the bottom four (which we call 'low-conflict' villages) for our experiment. The classification is therefore relative.

[12] Farmers have holding rights, which means they can 'own' the land as long they are cultivating it and can bequeath it to their children, who will continue to hold the land if they cultivate it. Such laws limit market-based consolidation of land and decrease the probability of migration: farmers who choose to leave their villages get no value from their land as they lose their holding rights.

We relied on a between-sample design. Subjects were randomly and anonymously matched in pairs. We had two treatments: one without the *Divider* option as in Fig 2 (called *no-Divider treatment* hereafter), and another with the *Divider* option as in Fig 3 (called *Divider treatment* hereafter). In the no-*Divider* treatment, subjects could claim any integer number of *tilms* in the range from 0 to 4. In the *Divider* treatment, the subjects could choose to call for a *Divider*, resulting in a definite income, or claim any number of *tilms* in the range 0 to 4. The players decide simultaneously whether to choose the *Divider* or claim *tilms*. In line with the description in Section 2, the *Divider* rules even if it is only chosen by one of the farmers.

The experiment was conducted in Amharic, the local language spoken in the region. Because a large fraction of the subjects were illiterate, the experiment was orally described. To visualize our examples, we used posters (as in, e.g., Henrich et al., 2001). First the experiment was explained in general terms. Then, by using posters, the outcomes and payoffs of *all* possible scenarios were illustrated. On the main poster we had drawn four boxes in the middle of two houses describing the four *tilms* that were contested. We filled the boxes with colored slides to represent the claims by the households. We used different colors for the two households. When there was an overlapping claim over a box, i.e., a *tilm*, it was filled by both colors, resulting in a third color indicating that it is land under conflict. Besides the animated main poster, we had static posters of each outcome to show the monetary pay-off, with real bank notes stapled on to show how much money each farmer would earn in a specific combination of claims by both farmers. The instructions were read repeatedly and all combinations of outcomes were discussed. To make sure that everyone understood the game, subjects were also given the opportunity to ask questions in private. Then, everyone was provided with a decision sheet carefully designed in a manner similar to the posters, limiting the relevance of the ability to read and write for making decisions. Players were then instructed to place a sign that indicates their choice. In the no-*Divider* treatment, players could claim 0, 1, 2, 3 or 4 tilms. In the *Divider* treatment, players could either call for the *Divider* or claim 0, 1, 2, 3 or 4 tilms.

The power of our policy proposal relies on players harboring both social preferences and beliefs, and on those beliefs having certain properties. The importance of beliefs follows from the forward induction argument, as reflected in the comments in Section 2 regarding what players are expected to figure out. It is conceivable that the argument fails not because subjects lack social preferences, but because they do not hold the necessary beliefs. We therefore also collected some data on the subjects' beliefs. After the completion of the decision stage, each player was provided with another form intended to capture his/her belief about the co-player's decision. This form was similar to the decision sheet. Note that no player knew about this stage of the experiment beforehand and the procedure was explained after all decisions were completed. To incentivize belief elicitation, players were told they would earn an additional 5 Birr[13] if they guessed their co-player's decision correctly.

In each of the 8 villages, 60 households were selected randomly from a provided village list for the two treatments of the experiment. That is, we had 15 anonymous pairs for each of the two treatments in each village. We had 16 experiment sessions in total, two for each village, with a total of 240 subjects for each treatment, respectively. Two subjects (one from each treatment) decided to quit the experiment in the middle and one subject in the *Divider* treatment declined to make a decision. Thus, our data consists of 239 observations for the no-*Divider* treatment and 238 observations for the *Divider* treatment.[14]

In order to avoid contagious effects in our experiment by word-of-mouth communication between subjects of the two different sessions in a village, we had to make sure that they did not meet. On the other hand, we wanted to use the same experimenter in all sessions, which means that we could not run the two treatments simultaneously. We therefore had to hold two sequential sessions in a way that subjects who had participated in the first session did not meet subjects for the second session. Before the first session finished, we gathered all the subjects for the second session in an adjacent room and served refreshments until the subjects of the first session had left the compound.

Results

The data from the treatments are summarized in Tables 1 and 2. The second columns in each table present the distribution of choices in each treatment. The remaining columns of the tables show how own choice is related to belief about the choice made by the co-player. For example, in Table 1 where there is not a *Divider* option, among those 103 who choose 2 *tilms*, 67 thought that their partner would do so as well, while 18 thought that their partner chose 3 *tilms* and 18 thought that their partner chose 4 *tilms*.

[13] Birr is the local currency in Ethiopia. 1 USD was about 13 Birr during the time of the experiment.

[14] Note that the decisions of the anonymous co-players of those who dropped out or declined to decide are valid. Payoffs of for the pair-less subjects were calculated by taking their beliefs as their co-player's decision.

Table 1. Choices and Beliefs in the No-Divider treatment (n=239)

	Own choice	Belief of co-player's choice				
		0	**1**	**2**	**3**	**4**
0	0	*0*	*0*	*0*	*0*	*0*
1	2	*0*	*0*	*1*	*1*	*0*
2	103	*0*	*0*	*67*	*18*	*18*
3	54	*0*	*2*	*17*	*22*	*13*
4	80	*0*	*0*	*33*	*19*	*28*

Table 2. Choices and Beliefs in the Divider treatment (n=238)

	Own choice	Belief of co-player's choice					
		D	**0**	**1**	**2**	**3**	**4**
D	73	*27*	*0*	*0*	*20*	*14*	*12*
0	0	*0*	*0*	*0*	*0*	*0*	*0*
1	0	*0*	*0*	*0*	*0*	*0*	*0*
2	92	*7*	*0*	*0*	*69*	*11*	*5*
3	28	*3*	*0*	*1*	*18*	*6*	*1*
4	44	*4*	*0*	*0*	*21*	*12*	*7*

Our theory in section 2 suggests that social preferences combined with the logic of forward induction may lead to more cooperative outcomes in the *Divider* treatment than in the no-*Divider* treatment. That is, individuals could avoid conflicts if they are offered a costly outside option which they can voluntarily forgo. To test this prediction using our experimental data, we performed a series of comparisons in the proportion of choices and beliefs within and across the two treatments following the insights outlined in section 2. To start with, rational players should not claim 0 and 1 *tilm* in either treatment, as these choices are strictly dominated. Our results confirm this is indeed the case: in the no-*Divider* treatment, no subject chose 0 and only two subjects choose 1; in the *Divider* treatment, no subjects chose 0 or 1. Also, only three subjects believed their co-player would go for such payoff-dominated choices. This is a clear indication that our subjects have understood the experiment well.

The next prediction that comes out of our theory is that the incidence of conflict decreases in the presence of the *Divider* option. That is, fewer players are expected to choose 4 *tilm*s in the *Divider* treatment than in the no-*Divider* treatment. The basic idea is that, if the outside policy option triggers forward induction in the *Divider* treatment, players should move away from claiming 4 *tilm*s, as this is a best response only for a choice of 0 and 1 *tilm* by the other player, given the *Divider* option. This is also what we find: the proportion of players claiming 4 *tilm*s is 15 percentage points lower in the *Divider* compared to the no-*Divider* treatment. A two-sample proportion test shows that this difference is statistically significant (p-value<0.001 for both one-sided and two-sided tests). This result, however, is not enough to prove that the forward induction is working, as some of those who move away from claiming 4 *tilm*s may choose the *Divider* itself. Indeed, 30.7% the players in the *Divider* treatment choose the *Divider*. Contrary to the prediction of the forward induction argument, a null hypothesis that this is not significantly greater than zero is rejected at 1% level significance.

The above results show that close to one-third of the players 'get stuck' in the middle of the forward induction argument and fail to forgo the outside option, i.e. they choose the *Divider*. But it is important to notice that the majority of players do not choose the *Divider*. Hence, we can still test whether our policy proposal has an effect on behavior by comparing the choices among the players in the no-*Divider* treatment and the players who carried through with the forward induction and opted out of the *Divider* option in the *Divider* treatment.

Specifically, we compare the proportion of claims of 2 *tilm*s and 3 *tilm*s between the no-*Divider* treatment and the *Divider* treatment conditional on opting out of the *Divider*. The proportion of 3 *tilm* claims decreases as we go from the no-*Divider* to the *Divider* treatment even though the difference is not statistically significant (two-sided p-value=0.2221). As for 2 *tilms*, we find a difference between the treatments: a significantly higher proportion of players who reject an available *Divider* option choose the equal split than those who choose the equal split when no *Divider* option is available (a difference of 12.7 percentage points, two-sided p-value=0.010). This shows that our policy proposal indeed has an effect on choices in the direction suggested by our theory. One explanation for the non-significant difference in choices of 3 could be that those who skipped the *Divider* went for a 'better' equilibrium of (2,2) than (3,3). To some extent, this can be seen as a situation where forward-inducting players who opted out of the *Divider* option face a coordination problem and seem to then attempt to coordinate on the higher payoff equilibrium.

A closer look at the beliefs and preferences of players in contrast with their choices could shed further light on the choices made. For example, it follows from the theory that players who believe their co-player would claim 4 *tilm*s would also claim 4 *tilm*s if they are in the no-*Divider* treatment and would choose the *Divider* option in the *Divider* treatment.

We find evidence along these lines in our experiment. In the no-*Divider* treatment, almost half of the players (47.5%) who believe that that their co-player will claim 4 *tilm*s also claim 4 *tilm*s themselves. This proportion is much higher compared to the beliefs for those who claim 2 *tilms* (a difference of 16.9 percentage points, two-sided p-value=0.005 and one-sided p-value=0.0295) and 3 *tilm*s (a difference of 25.4 percentage points, both two-sided and one-sided p-values<0.01).

In the *Divider* treatment, most of the players who believe their co-player would claim 4 *tilms* choose the *Divider*, as expected; all other claims were significantly less likely. This result indicates that a portion of those who did not complete the forward induction process did not believe that the presence of the *Divider* was enough to entice their co-players toward cooperation. The rational choice was then for them to impose the *Divider* themselves. This does not necessarily imply a lack of friendly intentions in their own social preferences.

Another prediction arising from social preferences is that players who expect the other player to go for an equal split should also opt for an equal split in either treatment. We find support for this prediction in the data. In each treatment, more than half the players with belief that the other player would claim 2 *tilm*s also claimed 2 *tilms* and the percentage differences against each of the other options are statistically significant with (both one- and two-sided), with p-levels less than 0.0001.

The belief data also give some insight into how this policy innovation could reduce conflict. By comparing beliefs and choices across treatments, we can better understand what 'type' of player is more likely to be affected by the intervention. We can differentiate between two broad types of players who end up choosing conflict. First, we have those who go for conflict and also believe the co-player will go for conflict. If a player believes that the co-player will claim 4, then the rational response is to claim 4 – with or without social preferences (see figures 1 and 2) in the non-Divider treatment and despite the fact that the player himself might prefer cooperation. The second type of player goes for conflict even though he/she believes the co-player will go for an equal split. This is consistent with an absence of social preferences (see the differences in pay-offs between figures 1 and 2). It can be said that the latter have limited 'friendly tendencies' compared to the former. Our expectation is that the first type, which responds to the threat of conflict but does not seek conflict, will be given the opportunity to cooperate in the *Divider* treatment, while the conflict-prone might still attempt to claim 4.

Looking at the last columns of table 1 and table 2 sheds some light on this: the proportion of players who claim 4 and also believe the co-player will go for 4 is significantly lower in the

Divider treatment. When there is a *Divider*, the majority of those who claim 4 are those who believe the co-player will go for 2. That is, the presence of the *Divider* affects the behavior of players of the first type, those who respond to conflict but do not seek it. In other words, the decline in conflict arises because the presence of the *Divider* helps those with friendly attitudes to cooperate.

We also analyzed the data for the high and low conflict villages separately (see Appendix B). In the no-*Divide*r treatment, we find significantly that a higher proportion of subjects claim 4 *tilms* in high-conflict villages compared to low-conflict villages. Moreover, claims of 2 *tilms* are significantly lower in the high-conflict villages compared to the low-conflict villages when there is no *Divider*. These results can be seen as indicators of external validity for our experiment. When the Divider is introduced, we do not find a significant difference in behavior between high- and low-conflict villages. Thus, the positive impact of introducing a Divider was larger in villages with relatively higher prevalence of land conflicts. Our policy proposal seems to work better where it is needed the most.

Discussion

We consider a land-grabbing game where selfish players, who desire to get as much for themselves as possible, would be destined for costly conflict. A key initial observation is that social preferences may transform the situation into a coordination game. There is hope in this insight alone; if players coordinate on a 'good' equilibrium, they avoid the conflict. The second key idea is to boost the prospect of this outcome further, drawing on the logic of forward induction. We propose a policy which modifies the game so that players can elect to enforce a cooperative outcome at a cost. The game theoretic prediction is that they would *not* elect this option and instead coordinate on a good outcome more surely than had the *Divider*-option never been available.

The costs of land conflict in developing countries are huge, so the potential gains of this policy could be vast. Millions of hectares of agricultural land are currently under various kinds of reforms in Africa and elsewhere. The costs of these interventions, and the potential related conflicts, are high and difficult to carry for farmers, governments, and international aid agencies. Our theoretical results indicate a way to benefit from a design where interventions are made available on a voluntary basis, as opposed to the mandatory programs that are now the norm. If the forward induction argument works, our proposal is actually free! The proposal also illustrates how, in principle, policy intervention does not have to be actively managed. One may think of it as allowing for, or promoting, voluntary participation in an outcome with friendly relations.

Neighbors facing potentially costly conflict are aided not through hands-on intervention but through counterfactual intervention which could have occurred but did not. When farmers actively express that they do not want the intervention, this coordinates them to cooperate.

To test the empirical relevance of our proposal, we ran an experiment in the Amhara Region of Ethiopia – a natural setting where people have experienced land conflict. We find strong support for the first idea (social preferences generate a coordination game). Players who believe others cooperate often cooperate themselves. We find only guarded support for the second idea (forward induction). The subset of players who discard the costly-*Divider* option choose, and believe a co-player will choose, the most cooperative strategy to a larger degree than when the *Divider* option was not available in the first place. The prevalence of high-conflict outcomes is dramatically reduced, especially in areas with high levels of land conflicts, although we did not nearly obtain full coordination on the best possible outcome (in particular because more subjects than predicted by the theory chose to call for the *Divider*).

Policies that can reduce land-related conflicts are important in the context of highland Ethiopia, as shown by Holden et al. (2011). Based on a sample of 400 mediators who had mediated 18,620 conflicts, they found that more than half were land-related conflicts and almost 20% were border conflicts. Almost half of the 1530 conflicts that were referred to *woreda* courts were border conflicts. Border conflicts were also seen as the most difficult conflicts to deal with. Policies such as the one proposed here are therefore particularly relevant in such settings, where the first steps are being taken to formalize individual user rights to what has previously been either government owned or communally managed land.

We did not make it easy on our subjects. They played the game once, and were offered no opportunity to gain experience. They could not communicate pre-play; if people talk, then perhaps those who understand the forward induction argument will convince others. The design allowed *two* choices that were consistent with the forward induction argument (2 and 3), possibly making it less transparent. The game we used to model the conflict situation has two stages (Fig. 3), but subjects interact in a perhaps less transparent version corresponding to a reduced normal form game with simultaneous moves (Fig. 4). Finally, the task was rather abstract, involving labeled choices and payoffs on posters rather than real land. For all these reasons, our experiment represents but a start for serious empirical testing. We hope it inspires follow-up research that modifies features of our design and possibly relies on stronger field components.

In addition, it is natural to reflect on the following rather extreme aspect of our proposal: At face value, it assumes that, once the parties reject the Divider option, then no outside protection is offered whatsoever. Intuitively, that would seem to make rejecting the Divider a rather risky proposition. In practice, the policy can be expected to be coupled with alternative measures, say involving some limited police and court protection even if the Divider option is rejected by all.

We would be happy if a lasting impact of our study were to influence the thinking of development scholars and policy makers through the questions we have articulated: Is what at first glance seems to be a social dilemma really a coordination game? Could a policy involving voluntary participation promote a desired outcome at lower cost than that of heavy-handed government intervention? We have shown, for a specific context, that the answer is yes in theory and maybe in practice. We hope to inspire thinking about, and inquiry in regard to, the relevance of these questions more generally. Our specific context may serve as an inspiring metaphor in this connection.

Appendix A

In section 2, we said that the conclusion we drew using the Fehr-Schmidt model had counterparts in other models, notably those of Bolton & Ockenfels (2000) (B&O) or Charness & Rabin (2002) (C&R). We now show this formally.

Applied to a two-player game, a simple version of B&O's model says that, if player *i* gets $\$_i$, while co-player *j* gets $\$_j$, then *i*'s utility equals

$\$_i - \gamma_i \cdot |\$_i - (\$_i + \$_j)/2|$, where $0 \leq \gamma_i < 1$.

Now note that $\$_i - \gamma_i \cdot |\$_i - (\$_i + \$_j)/2| = \$_i - \gamma_i \cdot |(\$_i - \$_j)/2| = \$_i - \gamma_i' \cdot |(\$_i - \$_j)|$, where $\gamma_i' = \gamma_i/2$. Then note that $\$_i - \gamma_i' \cdot |(\$_i - \$_j)| = \$_i - \gamma_i' \cdot \max\{\$_j - \$_i, 0\} - \gamma_i' \cdot \max\{\$_i - \$_j, 0\}$. That is, with two players, the B&O model works just like the Fehr-Schmidt model with the constraint that $\alpha_i = \beta_i$. If we assume that $\gamma_i = 3/2$, then $\gamma_i' = 3/4$, and we get the same prediction as for the F&S model with $\alpha_i = \beta_i = 3/4$, which is the case covered in Section 2.

Next, consider the C&R model which, when applied to a two-player game, says that, if player *i* gets $\$_i$, while co-player *j* gets $\$_j$, then *i*'s utility equals

$\$_i + \varepsilon_i \cdot [\delta_i \cdot \min\{\$_i, \$_j\} + (1-\delta_i) \cdot (\$_i + \$_j)]$, where $\varepsilon_i, \delta_i \geq 0$ and $\varepsilon_i \cdot \delta_i < 1$.

In this case, it is harder to generate conclusions analogous to those in section 2, but not impossible. To appreciate this, consider for example the special ('semi-Rawlsian') case where $\delta_i = 1$ and $\varepsilon_i = \varepsilon_j = \varepsilon$, where $0 \leq \varepsilon < 1$. We get $\$_i + \varepsilon_i \cdot [\delta_i \cdot \min\{\$_i, \$_j\} + (1-\delta_i) \cdot (\$_i + \$_j)] = \$_i + \varepsilon \cdot \min\{\$_i, \$_j\}$, which applied to the *Divider* game form (Figure 5) yields

Figure 6: Divider game with semi-Rawlsian C&R preferences

	D	**0**	**1**	**2**	**3**	**4**
D	11+11ε, 11+11ε	11+11ε, 11+11ε	11+11ε, 11+11ε	11+11ε, 11+11ε	11+11ε, 11+11ε	11+11ε, 11+11ε
0	11+11ε, 11+11ε	0, 0	0, 8	0, 16	0, 24	0, 32
1	11+11ε, 11+11ε	8, 0	8+ 8ε	8+8ε, 16+8ε	8+8ε, 24+8ε	2+2ε, 26+2ε
2	11+11ε, 11+11ε	16, 0	16+8ε, 8+8ε	16+ 16ε	10+10ε, 18+10ε	4+4ε, 20+4ε
3	11+11ε, 11+11ε	24, 0	24+8ε, 8+8ε	18+10ε, 10+10ε	12+ 12ε	6+6ε, 14+6ε
4	11+11ε, 11+11ε	32, 0	26+2ε, 2+2ε	20+4ε, 4+4ε	14+6ε, 6+6ε	8+ 8ε

Now apply IEWDS. In round one, for any $0 \le \varepsilon < 1$, we can delete 0 and 1. In round two (unlike the case with F&S preferences) we cannot delete 4 on the grounds that this strategy is dominated by M (4 does better than D against 2 for any $0 \le \varepsilon < 1$). However, on some reflection, one sees that, if ε is high enough, then 4 is dominated by a *mixed* strategy which puts appropriate weights on a combination of D and 3.[15] Hence we can eliminate 4. And then, in round 3, because ε is high enough, we can eliminate D (which is dominated by 3). So, in this case, much as in our second section, strategies 2 and 3 are the game's sole survivors of IEWDS.

Note finally that, if we consider the No-*Divider* modification of the game in Figure 6 (i.e., the same game except that the D choices are removed) and apply IEWDS, then strategy 4 cannot be ruled out. Strategies 2, 3, and 4 all survive IEWDS.

[15] To see this, consider the limiting case where ε=1, which generates numbers easy to work with; after drawing the desired conclusion, we verify that it must hold also for slightly lower values of ε. Consider player 1 and his mixed strategy which assigns probability p to D and (1-p) to 3, where $0<p<1$. A sufficient condition for this mixture to weakly dominate 4 (in the reduced game where 0 and 1 are already eliminated) is that it yields strictly higher utility against each of 2's strategies 2, 3, and 4:

$p \cdot 22+(1-p) \cdot 28 > 24$ [mixture better than 4 if player 2 chooses 2]

$p \cdot 22+(1-p) \cdot 24 > 20$ [mixture better than 4 if player 2 chooses 3]

$p \cdot 22+(1-p) \cdot 12 > 16$ [mixture better than 4 if player 2 chooses 4]

All three inequalities hold if $2/5 < p < 2/3$. Hence any mixed strategy which assigns probability p to D and (1-p) to 3, where $2/5 < p < 2/3$, can be used to eliminate 4 in the game where ε=1. Given such a strategy, because the above inequalities are all strict and because payoffs change continuously with ε, it can be used also to eliminate 4 in the game where ε<1, if ε is close enough to 1.

Appendix B

High vs low conflict villages (% of choices)

	High conflict areas			Low conflict areas			Pooled		
Choice	*No Divider*	*Divider*	*Divider* excluding *D* choices	*No Divider*	*Divider*	*Divider* excluding *D* choices	*No Divider*	*Divider*	*Divider* excluding *D* choices
D	na	30	na	na	31.4	na	n.a.	30.7	n.a.
1	0	0	0	0.8	0.0	0.0	0.8	0.0	0.0
2	**33.3**	40.0	57.1	**52.9**	37.3	54.3	**43.1**	38.7	55.8
3	26.7	10.8	15.5	18.5	13.6	19.8	22.6	12.2	17.6
4	**39.2**	19.2	27.4	**27.7**	17.8	25.9	**33.5**	18.5	26.7

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