

# Causes and Consequences of Perceived Land Tenure Insecurity: Survey Evidence from Burkina Faso

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**ABSTRACT.** *This paper uses unique household survey data to identify the sources of land tenure insecurity in Burkina Faso and estimate their economic impacts. We find that risk of land conflicts related to migrants and conflict related to former residents of the village returning to claim land are particularly costly, with high levels of perceived concern over both types of conflict associated with reductions in agricultural productivity of over 40%. We further estimate that the overall productivity impact of land tenure insecurity in the study area is 8.9%. Insecurity is driven by a range of factors, including wealth and social exclusion. (JEL O12, Q15)*

## I. INTRODUCTION

Secure property rights to land are widely held to be a precondition for sustained economic growth and development (Coase 1960; North 1981). In the absence of secure property rights, incentives to accumulate and invest are muted. A vast microeconomic literature on this topic investigates the economic implications of the form that property rights take, most often whether formal title increases agricultural investment and productivity. In an important way, however, the security of property rights as it is relevant to economic decision-making is a function of the perceptions of the rights holder. The constraint on the expected returns to productivity-enhancing investment in agriculture is the belief on the part of the investor that she may lose her investment due to expropriation or conflict.

Using unique household survey data from rural Burkina Faso, we investigate the economic impacts of tenure insecurity as measured by the perceptions of the landholder. Our data allow us to consider a range of di-

mensions of tenure insecurity in terms of the perceived severity of the risk of six different types of conflict and two types of expropriation, and we estimate the effects of these different types of perceived risk on agricultural productivity. Four main findings emerge. The first is that while respondents report concern over a variety of types of conflict, some types of concern do not appear to affect economic behavior. For example, although our respondents report the greatest level of concern over conflicts related to livestock damage, we find that respondents who are concerned about this are no less productive than those who are not. Secondly, we find that certain types of perceived risk have a profound impact on productivity. For example, controlling for a range of other factors, cultivators who report that conflicts related to former residents returning to the village are a “serious concern” are 45.5% less productive than households that do not view migrants returning to the village as a concern. Thirdly, incidence of the economically costly dimensions of perceived tenure insecurity is heterogeneous. Wealthier households are more likely to perceive risk, as are those with less preferential access to the informal system. Finally, we use our data to estimate the overall productivity impact of perceived land conflict risk. We find that the impact is substantial, as conflict risk is responsible for an 8.9% reduction in overall agricultural productivity. Our results have important implications for assessing the true costs of tenure insecurity, and argue for the importance of considering not only the formal type of right held, but also the security of rights from the perspective of the holder of the right.

## II. PROPERTY RIGHTS, TENURE SECURITY, AND ECONOMIC OUTCOMES

### Implications of Insecure Property Rights and Formalization

In many developing country contexts, property rights over agricultural (and other) land are not fully defined or enforced. Where this is the case, agricultural outcomes may be affected in a number of ways. First, the risk of land conflict or expropriation weakens investment incentives by reducing the expected payoff to certain types of investment. Investments that are immobile or that pay off over time (e.g., wells, soil conservation measures, etc.) are less attractive if land rights are uncertain to be maintained during the time horizon over which the returns to the investment accrue (Besley 1995).

Secondly, insecure property rights may reduce access to credit. Where property rights are not fully protected and transferable, land cannot be used as collateral to obtain loans, which may be used to make productivity-enhancing investments. De Soto (2000, 6–7) argues that such “dead capital” has profound development consequences.

Thirdly, insecure property rights may have adverse impacts by inducing cultivators to allocate resources to defending property rights that could otherwise be put to productive use. Sjaastad and Bromley (1997), among others, have noted that certain types of visible investment such as tree planting are frequently made to strengthen recognition of property rights under the informal system. Where property rights are secure, investment strategies can be instead undertaken to maximize returns. Field (2007) finds that insecure property rights can result in reallocation of labor to watch over property and prevent competing claims.

Finally, weak property rights limit the transferability of land. Where land cannot be bought and sold, farm sizes will tend to be suboptimal, as households are unable to adjust their land endowments to match their endowments of other factors and access to capital. In addition, the value of investments in land cannot be recouped by selling the land, which

Brasselle, Gaspart, and Platteau (2002) term “the realizability effect.”

A large number of empirical studies have attempted to investigate these impacts, mainly by identifying empirical settings that allow for multiple property rights regimes to be compared with one another. In these studies, the property rights regime is frequently defined in terms of the type of documentation held by the landowner, and the most common focus on the impact of having a state-issued land titles or certificates versus those who do not. Results have been mixed; some studies have demonstrated strong impacts of formal land titles, particularly in Asia (e.g., Feder 1988) and Latin America (e.g., Alston, Libecap, and Scheider 1995; Lanjouw and Levy 2002). However, findings from Sub-Saharan Africa have been less optimistic, with many studies finding little or no economic benefit from land titling programs (e.g., Carter and Wiebe 1990; Migot-Adholla, Place, and Olouch-Kosura 1994; Bellemare 2012), or arguing that formalization efforts are not cost-effective (Jacoby and Minten 2007). There is some more recent evidence that innovative approaches to formalization can yield significant economic benefits in Sub-Saharan Africa (Holden, Deininger, and Gebhru 2009).

### Property Rights Regimes versus Tenure Insecurity

To the extent that formalization of property rights has led to disappointing outcomes, policy implications are not straightforward. Some have argued that the explanation is that customary systems of assigning and enforcing rights function effectively to protect investment incentives. The implication is that de facto property rights are, in fact, secure. In the particular context of Burkina Faso, this argument has been made Ouedraogo et al. (1996) and Brasselle, Gaspart, and Platteau (2002). Alternatively, de facto property rights may be insecure, but the low capacity of many African states may be to blame. Where governments are unable or unwilling to enforce property rights, issuing property documents would not be expected to change behavior, as Bromley (2008) argues is often the case in developing countries.

In assessing these competing explanations, it is useful to look beyond the impact of the form of the particular property rights regime to the issue of whether property rights are in fact secure. From the standpoint of investment incentives and other economic benefits, tenure security is fundamentally a matter of perception. Where landholders perceive their rights to be at low risk of conflict or extinction, they will make their economic decisions accordingly. Where the converse is true, investment and resource allocation decisions will be conditioned by this perceived risk.

The distinction holds important policy implications. Property rights formalization and other reforms will bring only limited economic benefits if landholders perceive their tenure to be ultimately secure. Conversely, where tenure is insecure, property rights reforms can have an important impact in shifting investment incentives.

A number of previous studies have incorporated subjective measures of tenure security into agricultural productivity or investment regressions, as we do here. However, these efforts have had to rely on simple measures that may fail to adequately capture the extent to which respondents perceive their rights to be insecure. For example, an Ethiopian dataset includes a measure used by Shiferaw and Holden (1998) and Anley, Bogale, and Haile-Gabriel (2006) that consists of a yes-no response to the question of whether the cultivators believe they are likely to be able to keep their land over their entire lifetime. Similarly Anim (1999) and Amsalu and de Graaf (2007) rely on yes-no survey questions that ask respondents whether they feel secure in their land. Jacoby and Minten (2007) use whether the respondents say that they have heard of cases in which farmers have lost land due to being unable to prove ownership. Few of these studies cited show a statistically significant impact of tenure insecurity on their outcome of interest.<sup>1</sup>

The shortcomings of these kinds of measures are demonstrated explicitly by Fenske's

(2011) meta-analysis of studies of the tenure-investment relationship in West Africa. He considers the impact of different approaches to measurement on the likelihood that studies find an impact between tenure security and investment. He finds that studies that use subjective measures of tenure security show less of an impact than studies that measure tenure security in other ways, and notes the possibility that "researchers are unable to accurately elicit subjective measures of cultivators' worries" (p. 146).

The implication is that existing data collection efforts have not been able to adequately capture the extent to which landholders perceive their rights to be insecure in way that allows for quantitative analysis of the economic impacts. In the next section, we describe our data collection effort that attempts to fill this lacuna.

### III. CONTEXT AND DATA

#### Land Conflict and Tenure Insecurity in Burkina Faso

Burkina Faso has a heavily agrarian economy, with 85% of the population engaged in agriculture, livestock rearing, or forestry (World Bank 2009). While the law permits private ownership, in practice agricultural land is largely governed by customary tenure systems. Rights to land are vested in traditional authorities called *chefs de terre*. Land is typically acquired either through inheritance or allocated by the *chef de terre*. In addition, there is an active system of both short- and long-term loans of land between households (Mathieu et al. 2003). Sales and rental markets are rare in rural areas.

Anecdotal evidence suggests that conflicts related to land are a serious problem of increasing severity (USAID 2010). Mathieu et al. (2003) describe a scenario of population pressures leading to increasing land scarcity in the face of competing interests, as younger heads of household call into question the authority of traditional systems dominated by elders, while the children of migrants seek to assert permanent rights. Ouedraogo (2006) highlights a rapid influx of investment in farmland by agribusinesses, civil servants,

<sup>1</sup> Ayelew Ali, Dercon, and Gautam (2007) provide an exception, finding that farmers who believe that their land may be expropriated are less prone to plant higher-value crops.

and others as a source of concern. Gray (2002) points to increasing tensions between groups with historical claims to an area and migrants, which often take the form of conflicts between pastoralists and sedentary farmers.

### Data: Overview and General Characteristics

The household survey data used in this paper were collected in 2010 as part of the Millennium Challenge Corporation's independent evaluation of the Burkina Faso Compact's Rural Land Governance Project implemented by Millennium Challenge Account–Burkina Faso from 2009 to 2014.<sup>2</sup> The survey instruments included four separate questionnaires designed to collect data at the household, parcel, individual, and village levels, respectively. Household- and parcel-level information was obtained from the household head, while information about perceived conflict risks was collected from each adult in the household. Village-level data were obtained by administering a questionnaire to a knowledgeable informant in each village. The survey instruments were designed to capture detailed information pertaining to the experience of land conflicts, as well as perceptions of tenure insecurity and conflict risk. In addition, the survey collected a range of information on characteristics and activities at the household, parcel, individual, and village levels. The sample consists of 1,923 households over 377 villages. These households have some form of land tenure over a total of 4,352 parcels, and the survey identifies 6,712 adults of whom 3,072 are the primary decision-makers over at least one plot.

While the survey is not designed to be nationally representative, it is designed to be a representative sample spanning 34 preselected communes, an administrative unit in Burkina Faso. These communes were selected to encompass a broad range of agro-ecological and demographic conditions found in Burkina, and reflect a geographic area equal to approximately 25% of the country's total area.

TABLE 1  
Summary Statistics

Characteristic	Value
<i>Household Level</i>	
Annual household income (dollars)	415 (1,145)
Nonagricultural income	81.4%
Household size	8.48 (5.15)
Number of parcels	2.31 (0.85)
Own cattle	29.7%
Female-headed households	6.8%
Migrant households	16.5%
Ever experienced land conflict	19.2%
Household head's parents from same village	75.5%
<i>Plot/Cultivator Level</i>	
Parcel size, hectares	1.62 (2.26)
Length of tenure, years	15.24 (13.68)
Quality: sloped terrain	6.5%
Quality: lowland terrain	20.4%
Acquired through inheritance	46.1%
Acquired through allocation by household head	23.2%
Acquired through gift/allocation by traditional authority	20.5%
Acquired by purchase/rental	0.2%
Value of output per hectare (dollars)	12.68 (189.48)
Literacy of cultivator	13.0%
% of cultivators who are household heads	65.9%
% female cultivators	34.6%
Age of cultivator	44.36 (15.58)

Note: Standard deviations in parentheses.

Table 1 presents summary statistics of some of the general characteristics of the sample and the variables we use in our regressions. Households tend to be poor and agricultural, with an average cash income of \$415, and 89.2% engaged in some form of agricultural production. Adult literacy is 13.0%. Each household owns an average of 2.31 parcels, with a mean parcel size of 1.62 hectares. Acquisition of land is mainly through inheritance, with land markets virtually nonexistent; less than 1% of parcels were acquired by sale or rental.

Land tenure arrangements within households in the study area are such that the household head allocates land among the members of household, with the particular household member having day-to-day decision-making authority over the parcels that they have been allocated for cultivation. In our parcel-level analysis, we thus associate the characteristics

<sup>2</sup> See the Millennium Challenge Corporation's website for documentation of the dataset: <https://data.mcc.gov/evaluations/index.php/catalog/104>; data may be requested at <https://www.mcc.gov/contact-us>.

of the cultivator with each parcel, rather than the household head. In our sample, 65.9% of the parcels are cultivated by the household head, while 34.6% are cultivated by women, primarily the wives of household heads.

A wide range of crops is produced in the study area for both consumption and sale. The most common crops are cereal grains, particularly millet, corn, and sorghum. Fruit and vegetable production is substantial, while the principal cash crop is cotton.

An important variable in the dataset for the subsequent analyses in this paper is agricultural productivity. We measure agricultural productivity in terms of the total value of agricultural output per hectare of land over the previous agricultural season. To calculate this value, we use prices from the FAOSTAT database,<sup>3</sup> where available; for the crops for which prices are not available we use the median imputed price reported by farmers in the survey, normalized to account for differences between imputed prices and FAOSTAT prices for other crops. Using FAOSTAT prices helps to mitigate the potential for regional price variations that may be correlated with tenure insecurity to bias our results.

### Perceptions of Tenure Security

Our analysis draws on 30 questions included in the survey instrument on perceived security of tenure. Respondents were asked to evaluate the risk of six different types of types of conflict, as well as conflicts in general, as either “not a problem,” “somewhat of a problem,” or “a serious problem.”

The six different types of conflict risk were identified during preliminary qualitative fieldwork:

1. *Conflicts with migrants over rights to agricultural land.* The arrival of migrants seeking agricultural land was frequently cited as a significant concern. Migration was said to have become increasingly common, with land availability an important driver of migration decisions. In the absence of land markets, migrants must try to obtain land through informal arrangements, which often lead to conflict.
2. *Conflicts with nonresidents seeking land for nonagricultural purposes.* A second source of concern that respondents identified was the so-called new actors,” who are wealthy outsiders primarily from urban areas seeking to obtain land for speculative or commercial purposes. For the purposes of the survey, these were categorized as nonresidents seeking land for non-agricultural purposes.
3. *Conflicts with former residents of the village returning to claim land.* Land transfers in the study area take place at the discretion of traditional authorities and are rarely accompanied by formal documentation. As a result, a common source of conflict is the return of a former resident of the village seeking to reestablish prior claims to land that is being cultivated by others. In addition, in the absence of land markets, long-term loans of land are common and may also result in disputes, particularly when land that has been loaned out is inherited.
4. *Inheritance conflicts.* Conflicts between family members over inheritance rights are another source of concern. These may occur between siblings, or between widows and their children or the offspring of other wives in the case of polygamous households.
5. *Conflict related to damage caused by livestock.* Livestock rearing is a common income-generating activity in the study area, on the part of both sedentary farmers and transhumance pastoralists who pass through. As a result, damage to crops and other property caused by livestock is a common source of disputes.
6. *Conflict related to access to water or pasture for livestock.* An additional source of livestock-related conflict relates to transhumance pastoralism. Migratory cattle movements take place along corridors of land that have been set aside and designated for this purpose. Due to growing land scarcity, agriculturalists are reported to be increasingly infringing on these corridors and cultivating them, restricting access to pastureland or water sources.

For each of these types of conflict, respondents were asked to evaluate the risk over four frames of reference: for their own households, for their villages in general, for their villages in the near future, and for their villages in the

<sup>3</sup> See FAOSTAT, available at <http://faostat3.fao.org/home/E> (accessed December 3, 2015).

TABLE 2  
Perceived Conflict Measures, in Percent

	In Your Opinion, What Level of Risk Does Each of the Following Types of Conflict Present?											
	For Your Household			In the Village Today			In the Village in the Near Future			In the Village in the Far Future		
	None	Somewhat	Serious	None	Somewhat	Serious	None	Somewhat	Serious	None	Somewhat	Serious
Arrival of new migrants	69.6	16.4	4.8	61.2	23.9	6.5	50.0	24.4	9.6	42.0	24.9	13.5
Outsiders seeking land for nonagricultural use	73.3	14.9	4.4	66.1	19.4	5.5	54.9	21.4	7.7	48.3	21.8	10.5
Former residents returning	71.1	14.9	7.6	61.8	21.8	8.7	52.6	22.8	11.4	46.6	23.0	14.3
Inheritance	71.3	16.5	5.2	59.1	25.6	6.6	50.5	26.2	9.4	44.6	25.3	12.6
Livestock damage	28.4	42.6	23.2	16.6	49.2	27.9	12.6	43.6	32.6	11.7	36.9	37.0
Access to water for livestock	62.5	24.2	6.8	53.9	30.5	8.2	46.0	30.8	11.1	41.5	29.9	14.1
Conflicts in general	41.6	33.9	19.2	33.4	39.3	22.0	27.9	38.5	28.1	24.4	34.8	35.4

TABLE 3  
Perceived Expropriation Risk Measures, in Percent

	Are You Concerned That You Could One Day Lose Your Land as a Result of the Following?		
	Not at All	Somewhat	Yes
Expropriation by the state	34.3	19.2	46.5
Expropriation by villager	75.9	12.3	11.9

further future. The instrument was designed this way for two reasons: First, economic decision-making may be determined not only by the immediate risk of conflict that households face individually, but also by the potential for more broad conflicts to occur over longer periods of time. Second, land conflict is a sensitive issue in Burkina Faso. Respondents who are vulnerable to conflict may be reluctant to disclose this view to interviewers but may be more forthcoming when asked to assess conflict problems more generally, such as in the village as a whole. This is a similar approach to the one taken in the World Bank's *Business Environment and Enterprise Performance Surveys* (World Bank 2015) to assess corruption: rather than ask respondents directly about the illicit payments they were making, that survey instead was able to obtain useful data by asking respondents how much a typical firm in their industry pays in bribes.

Tenure insecurity may also include concerns over expropriation of land by either the state or traditional authorities that do not explicitly relate to conflict. To capture these aspects of tenure insecurity, the survey also included two questions on perceived expropriation risk. These questions ask the landholders whether they are concerned that they could lose their parcel to either the government or someone in the village. Response options are "not at all," "somewhat," or "yes."

The responses to the tenure security questions over each of the four reference frames are summarized in Tables 2 and 3. Concern over land conflicts in general is widespread, as 53.1% perceive at least some risk of conflict for their household. Respondents rate concern over livestock damage-related con-

TABLE 4  
Average Correlations between Conflict Risk Reference Frames

	Your Household	In the Village in General	In the Village in the Near Future
In the village in general	0.812		
In the village in the near future	0.706	0.848	
In the village in the further future	0.571	0.685	0.794

*Note:* Correlations are averaged over each conflict type.

flicts significantly higher than the other types of conflict, with only 28.4% indicating that these conflicts were not a risk for their household, and 23.2% citing such conflicts as a serious risk. For each of the remaining five types of conflict, the majority of respondents indicated no perceived risk, but in all cases at least one-quarter of respondents did report some degree of concern over each type of conflict.

In terms of our reference frames, for all six types of conflict as well as the questions on conflicts in general, the ordinal ranking is the same: respondents report the greatest concern over the potential for conflict in the village in the far future, followed by conflict in the village in the near future. Conflict at present in the village is less of a concern, with respondents reporting the least concern over conflict risk to their own households. Respondents are thus more willing to attribute conflict risk to scenarios that are removed from them, both in terms of time and space.

Respondents also report significant concerns about land expropriation: 24.2% reported at least some concern that other villagers could take their land from them; expropriation by the government was a major concern, as 46.5% indicated at least some concern that they could one day lose their land to the state.

The motivation for designing a survey instrument that differentiates between types of conflict and reference frames is to try to capture a full range of the different sources of tenure insecurity. To provide a sense of the extent to which this differentiation is useful, we present the correlations between reference frames in Table 4 and between types of conflict risk in Table 5. The reference frames of household, village in general, and village in

the near future are highly correlated, ranging between 0.706 and 0.848. Correlations with the final reference frame—village in the further future—are somewhat weaker, with a correlation between this reference frame and own household of 0.571. The implication for future research efforts is that it appears that fewer reference frames are needed. However, it may be useful to differentiate between perceived risk facing the household, and a more general sense of risk.

Conversely, survey questions that differentiate between types of conflict and expropriation risk yield a substantial gain in information. Table 5 shows that the different types of conflict risk measures tend to be only moderately correlated with one another, with the majority of the coefficients falling between 0.2 and 0.4. The two expropriation risk measures are weakly correlated with both conflict risk measures and one another, with all coefficients falling below 0.2. The implication here is that tenure insecurity is not a generalized phenomenon; different households perceive themselves to be vulnerable to different types of conflict and expropriation.

#### IV. EMPIRICAL ANALYSIS

##### Approach and Overview

Our empirical analysis proceeds along three lines. First, we investigate which of our measures of tenure insecurity have consequences for agricultural productivity. Second, we look at the determinants of tenure insecurity by examining the relationship between the economically meaningful measures of tenure insecurity and a variety of individual-, parcel-, household-, and village-level charac-

TABLE 5  
Average Correlations between Tenure Insecurity Measures

	Arrival of New Migrants	Outsiders Seeking Nonagricultural Land	Former Residents Returning	Inheritance	Livestock Damage	Access to water for Livestock	Conflicts in General	Expropriation by State
Arrival of new migrants								
Outsiders seeking land for nonagricultural purposes	0.538							
Former residents returning	0.431	0.360						
Inheritance	0.296	0.286	0.361					
Livestock damage	0.225	0.181	0.260	0.297				
Access to water for livestock	0.177	0.192	0.244	0.223	0.354			
Conflicts in general	0.294	0.248	0.305	0.400	0.374	0.242		
Expropriation by state	0.0737	0.0854	0.1135	0.1234	0.0737	0.0802	0.151	
Expropriation by villager	0.1226	0.0856	0.1325	0.0957	0.1243	0.1496	0.147	0.196

Note: Correlations calculated for own household reference frame.

teristics. Third, we estimate the overall cost of tenure insecurity in agricultural productivity terms in the study area, and include some robustness checks to confirm this estimate.

**Individual Tenure Insecurity Measures and Agricultural Productivity**

As discussed in the previous section, our survey captures a range of dimensions of tenure insecurity, which may reduce agricultural productivity in a variety of ways. In this section, we consider the extent to which each of these dimensions has implications for agricultural productivity. To do so, we undertake a range of estimations of the following general empirical model:

$$Y_{ijk} = \beta_0 + \beta_1 X_j + \beta_2 V_i + \beta_3 W_j + \beta_4 Z_k + \beta_5 \delta_k + e_{ijk}, \quad [1]$$

where  $Y_{ijk}$  is the log of agricultural productivity per hectare on parcel  $i$  cultivated by person  $j$  of household  $k$ ,  $X_j$  is the tenure security measure or measures,  $V_i$ ,  $W_j$ , and  $Z_k$  are parcel, cultivator, and household characteristics, respectively, and the  $\delta_k$  are a set of 34 location dummies to capture unobserved differences in agro-ecological conditions.

We estimate the model separately for each of our 30 measures of tenure insecurity. Since each of the perceived tenure insecurity measures consists of three possible responses evaluating the level of concern as “none,” “somewhat,” or “serious,” we incorporate the tenure security measures by using two dummy variables in each estimation corresponding to the responses of “somewhat” and “serious,” respectively.

Our control variables are as follows: At the household level, we control for the size of the household, total nonagricultural income, and the number of cattle to distinguish households that may hold land for pasturing purposes. At the level of the cultivator, we control for gender, age, and literacy. We also include a dummy variable equal to one if the cultivator is a male who is not the head of the household. The reason for this is that both household head status and gender may affect productivity, but these are highly collinear: most women in the sample are not household heads, and most cul-

tivators who are not household heads are wives of the household head.

Our parcel-level controls are size, the length of time for which the cultivator has had the parcel, and whether the household resides on the parcel, as dwellings take up space that could be used for cultivation and may also indicate the parcel is not used primarily for agriculture. We also include a number of dummies representing the quality of the land for agricultural purposes. These include whether the land is irrigated, whether the land is sloped, and whether the terrain is in a lowland area. Note that in the study area, irrigation takes place on a large scale, so that this variable does not represent individual decisions by cultivators to invest in irrigation infrastructure.

We purposefully exclude measures of investment in land from our control variables. Previous research indicates that cultivators with more secure tenure will be more apt to undertake productivity-enhancing investments in land, such as soil conservation measures, digging wells or boreholes, application of fertilizers, and so forth. As our intention here is to assess the productivity impact of tenure insecurity, we opt for a more reduced form approach, and leave to future research an examination of the linkages between tenure security, investment, and productivity.

The results are shown in Table 6.<sup>4</sup> For brevity, we omit the control variables and report only the coefficients of the tenure insecurity measures in each of the 30 estimations. The concerns that are most closely associated with agricultural productivity are conflicts over the arrival of new migrants, conflicts over former residents returning, and conflicts over access to water for livestock. Conversely, concerns over outsiders seeking land for nonagricultural purposes, inheritance, livestock damage, and conflicts in general, as well as both of the expropriation measures, do not exhibit statistically significant relationships with productivity (with one likely spurious exception, the

“somewhat” coefficient of livestock damage in the village today).

In terms of the three measures with strong associations with productivity, in each case the statistical significance of the results is robust across each of the four reference frames, but there is some variation across reference frames in the size of the coefficients. For both the “arrival of new migrants” and “former residents returning” coefficients, the magnitude is largest for the “for your household” reference frame, diminishing as we move to more distant reference frames in the last two columns of the table. One interpretation is that concern over migrants and former residents returning reflects individual households that are disadvantaged in the traditional village order. Migrants or returnees will be more likely to challenge the claims of those who cannot call upon traditional systems of enforcement to back them; hence, these concerns tend to be household specific.

The “access to water for livestock” coefficient, by contrast, is smallest in magnitude for the “for your household” reference frame, and larger when the frame of reference is the village in the future. This measure may thus be capturing a more generalized sense of concern; respondents who perceive that competition over resources between farmers and pastoralists is increasing in their area adjust their future decisions accordingly.

Comparing these results to Tables 2 and 3, we see that there is little correspondence between the extent to which respondents assessed the various types of conflict as problems, and actual changes in behavior indicated by our regression results. For example, while conflicts related to livestock damage were identified as the most prevalent concern, the coefficients in the regressions on agricultural productivity were statistically insignificant.

One interpretation is that the frequency of livestock damage-related conflicts may be relatively high, leading to respondents identifying it as a major concern, but the actual consequences of each incident may be relatively small. Unlike conflicts related to migration or former residents returning to claim land, livestock damage does not constitute a fundamental threat to the holder’s rights.

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<sup>4</sup> Throughout, we take a somewhat conservative approach to statistical significance by reporting the significance level at which we can reject the hypothesis that at least one of the two coefficients in each regression is different from zero.

TABLE 6  
Regressions of Agricultural Productivity on Single Tenure Insecurity Measures

	For Your Household		In the Village Today		In the Village in the Near Future		In the Village in the Far Future	
	Somewhat	Serious	Somewhat	Serious	Somewhat	Serious	Somewhat	Serious
Arrival of new migrants	-0.002 (0.084)	-0.455** (0.181)	0.068 (0.075)	-0.443*** (0.148)	0.191*** (0.067)	-0.379*** (0.126)	0.194** (0.069)	-0.231** (0.102)
Outsiders seeking land for nonagricultural purposes	-0.155 (0.084)	-0.036 (0.162)	0.018 (0.077)	-0.073 (0.144)	0.093 (0.071)	-0.147 (0.123)	0.119 (0.065)	-0.087 (0.108)
Former residents returning	-0.025 (0.075)	-0.422*** (0.137)	0.078 (0.069)	-0.355** (0.132)	0.101 (0.069)	-0.356*** (0.115)	0.148** (0.066)	-0.314*** (0.094)
Inheritance	0.013 (0.079)	-0.044 (0.134)	0.094 (0.065)	-0.098 (0.119)	0.108 (0.072)	-0.071 (0.117)	0.115 (0.067)	-0.119 (0.098)
Livestock damage	-0.117 (0.068)	-0.077 (0.091)	-0.181** (0.075)	-0.165 (0.094)	-0.067 (0.077)	-0.092 (0.090)	-0.035 (0.074)	-0.058 (0.084)
Access to water for livestock	-0.032 (0.078)	-0.229* (0.117)	-0.021 (0.073)	-0.265** (0.115)	0.005 (0.071)	-0.328*** (0.098)	0.025 (0.070)	-0.313*** (0.102)
Conflicts in general	0.004 (0.066)	-0.015 (0.090)	0.071 (0.062)	-0.001 (0.091)	0.097 (0.070)	-0.078 (0.090)	0.017 (0.072)	-0.061 (0.083)
Expropriation by state	0.063 (0.081)	0.002 (0.085)						
Expropriation by villager	0.099 (0.072)	-0.083 (0.097)						

Note: Coefficients, with robust clustered standard errors in parentheses. Each estimation includes the set of control variables described in Section IV; these results are omitted for brevity.  
\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

Thus, such conflicts may be a major concern, but may not induce changes in investment behavior.

Finally, we note that the size of many of the coefficients is quite large: cultivators who express “serious” concern over the arrival of new migrants are 45.5% less productive than those who express no concern, while serious concerns over former residents returning represents a 42.2% reduction. These results highlight the importance of tenure insecurity; in a later section we turn to estimating its overall impact.

### Determinants of Tenure Insecurity

A second line of empirical analysis is to explore how concerns over tenure security relate to household, parcel, and village characteristics. To investigate the factors that drive tenure insecurity, we estimate a series of ordered probit models of the following form:

$$TS_{ijk}^* = \beta_1 X_i + \beta_2 Y_j + \beta_3 Z_k + e_{ijk},$$

$$TS_{ijk} = \begin{cases} 1 & \text{if } TS_{ijk}^* < c_1 \\ 2 & \text{if } c_1 < TS_{ijk}^* < c_2, \\ 3 & \text{if } TS_{ijk}^* > c_2 \end{cases}$$

where  $TS_{ijk}$  is tenure insecurity for individual  $i$  in household  $j$  residing in village  $k$ , and  $X_i$ ,  $Y_j$ , and  $Z_k$  are individual, household, and village characteristics, respectively. We estimate the model for each of the three  $TS$  variables that showed the strongest association with agricultural productivity: migrants seeking new land over the “for your household” reference frame, former residents returning to claim land over the “for your household” reference frame, and access to water for livestock in the village in the near future.

We explain our choice of explanatory variables by drawing a conceptual distinction between four expected sources of variation in reported tenure insecurity. First, we would expect differences in tenure security to be driven by local socioeconomic conditions that tend to impact tenure security across households. To account for these types of impacts, our model includes several village-level characteristics. From the household survey, we cal-

culate average income in the village. The remaining village-level characteristics are drawn from the accompanying village-level survey and include remoteness measured by distance from a main road, and the presence of a health clinic as a proxy for the overall level of development. Finally, to consider the potential for livestock-related conflicts we include dummy variables reflecting the presence of transhumance cattle routes, and whether the village-level informant indicated that livestock rearing is prevalent in the village.

Second, tenure security should be impacted by household-specific factors related to the capability of the household to defend its land rights. Goldstein and Udry (2005) demonstrate that position within the local political hierarchy is an important determinant of tenure security in Ghana, and we would expect similar effects in our case related to the ability to defend claims to land within the informal system. We include a number of measures to proxy for this, including household income and a dummy variable for female-headed households. We also include whether the household head is an ethnic minority in the village, and also whether the household has migrated from another area. The decision to migrate may be driven in part by the ability to obtain secure access to land, which may confound this latter measure as a proxy for social status. Thus, we also include whether the household head’s parents were migrants as well. Since these last three variables are highly correlated, we estimate our models with each individually in separate specifications.

Third, we would expect that more-desirable land would be at greater risk for some types conflict. The incentive to initiate a conflict and challenge the land claim of another is greater if the benefit of a successful challenge is more-productive land. We thus include measures of characteristics associated with productive potential. These are total size of the land holding, as well as dummy variables indicating irrigation, lowland topography, and sloped land for any of the individual’s parcels. We expect all but slope to be positively associated with productive potential. As an indirect measure, we also include whether the household owns cattle, as pas-

TABLE 7  
Determinants of Perceived Tenure Insecurity

	Arrival of New Migrants	Former Residents Returning	Access to Water for Livestock
Village: remote	-0.0219 (0.0708)	0.127* (0.0701)	0.204*** (0.0711)
Village: per capita income	0.0778** (0.0391)	0.0656* (0.0383)	0.0403 (0.0420)
Village: transhumance cattle route	0.102 (0.0887)	-0.00868 (0.0888)	-0.0352 (0.0874)
Village: livestock prevalence	0.0474 (0.0907)	0.0449 (0.0918)	-0.199** (0.0880)
Village: health clinic	0.0158 (0.0841)	0.0287 (0.0815)	0.129 (0.0800)
Male household head	0.166*** (0.0456)	0.0200 (0.0469)	0.129*** (0.0408)
Female household head	-0.0150 (0.169)	-0.162 (0.157)	-0.0512 (0.136)
Literacy	0.235*** (0.0684)	0.245*** (0.0646)	0.142** (0.0562)
Household head's parents migrated	0.0941 (0.0675)	0.299*** (0.0775)	0.271*** (0.0681)
Log of household's income	0.0382** (0.0166)	0.0432** (0.0171)	0.0356** (0.0162)
Log of number of cattle	0.0484 (0.0310)	0.0461 (0.0289)	0.0724*** (0.0244)
Household size	0.0108 (0.00685)	0.000686 (0.00484)	0.00464 (0.00503)
Irrigation	-0.120 (0.148)	0.154 (0.155)	0.316* (0.164)
Lowland	0.145 (0.104)	0.0983 (0.0936)	-0.0951 (0.102)
Sloped	0.260* (0.137)	0.477*** (0.128)	-0.118 (0.133)
Size of household landholding	-0.0366*** (0.00907)	-0.0169** (0.00836)	0.00875 (0.00642)
Constant 1	2.136*** (0.358)	2.081*** (0.365)	1.093*** (0.381)
Constant 2	3.061*** (0.353)	2.807*** (0.365)	2.181*** (0.386)
Number of observations	6,134	6,283	5,930

Note: Clustered standard errors in parentheses. Commune-level dummy coefficients omitted.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

tureland tends to be significantly less valuable than agricultural land.

It is important to note these second and third sources of tenure insecurity are liable to be interrelated in two important ways that may complicate interpretation of the coefficients of the variables that we use to measure them. First, we would expect that households that are politically connected would be able to use this fact to gain access to higher-quality land than other households. Thus, to the extent that there are unobserved sources of political connectedness, measures of land quality may be capturing these, and vice versa. Second, households may identify land conflicts as a serious problem because they have more to lose, which our survey instrument would capture as reflecting greater insecurity. To the extent that wealthier households are better connected politically, this would tend to associate measures of political connectedness with greater concern over conflict. These issues would seem to be of particular concern with respect to the income measures.

Finally, individual-level characteristics might drive variation in reported tenure security. Household heads may be more or less aware of potential sources of conflict than

other adults in the households. Similarly, a substantial literature shows that risk is not shared equally within the household, with gender biases present in male-headed households (e.g., Strauss and Beegle 1995). To the extent that land conflicts affect household heads more or less than other adults in the household, this would lead to differences in perceived severity of conflict risk within the household. At the same time, as discussed above, we would expect female-headed households to be particularly vulnerable. To simultaneously account for gender differences and potential differences between the head of the household and other household members, we include dummy variables for male head of household respondents and female head of household respondents, respectively. Thus, our base case is a respondent who is not the head of the household.

The main results are presented in Table 7. To facilitate comparison, the table includes the results for each of the three tenure security variables for the specifications, using the parental migration variable as the proxy for social status, rather than the household migration or ethnic minority variables, which we discuss below. In no case does the choice of

TABLE 8  
Determinants of Tenure Insecurity, Proxies for Social Capital Results

	Arrival of New Migrants	Former Residents Returning	Access to Water for Livestock
Ethnic minority	-0.0409 (0.0816)	0.0291 (0.0743)	0.119 (0.0793)
Migrant household	0.0422 (0.0767)	0.168* (0.0890)	0.0860 (0.0744)
Household head's parents migrated	0.0941 (0.0675)	0.299*** (0.0775)	0.271*** (0.0681)

Note: Clustered standard errors in parentheses. Commune-level dummy coefficients omitted. Regressions include covariates from Table 7.  
\*  $p < 0.1$ ; \*\*\*  $p < 0.01$ .

social status variables materially affect the coefficients of the other variables.

In terms of our village-level characteristics, individuals living in more remote villages tend to express greater concern over conflicts related to former village residents returning to the land, as well as conflicts related to access to water for livestock. Higher-income villages experience greater concern over the first two types of conflict, suggesting that initiating conflicts is more attractive when land has a higher value.

Male household heads report significantly more concern over migration and access to water for livestock than other household members, while female household heads show less concern about all types of conflict, though none of the coefficients are statistically significant. This may indicate that male household heads are better informed about conflict risk than other household members, or potentially that they have more to lose from conflict than other household members and thus view conflict as a greater concern. Alternatively, this result may indicate less reticence to acknowledge conflict risk by male household heads in an interview setting. Literate respondents are also significantly more likely to report concern over all three types of conflict.

Another notable finding is that higher-income households show greater concern over conflict in all three cases. This may be because conflicts are more costly to higher-income households and thus engender greater concern. Alternatively, higher-income households may face greater risk of conflict, as they tend to hold higher-value land, which is more attractive for others to initiate a conflict over. In either case, higher-income households appear to be unable to translate their wealth into

a correspondingly greater capacity to defend against conflicts.

In terms of land characteristics, the results do not paint a clear picture. More-productive irrigated parcels are linked to greater concern over access to water for livestock, while less-productive sloped land is strongly associated with concern over migration and former residents returning. The size of the landholding is inversely related to concern over the first two types of conflict, and unrelated to concern over livestock access to water. Similarly, there is a statistically significant inverse relationship between the size of the landholding and concern over conflict related to migration, former residents returning, and conflicts in general. The implication is that characteristics of landholdings affect concern over conflict, but that the relationship is not straightforward.

Our results for the coefficients of the three variables proxying for social status variables are presented in Table 8. In all three cases, whether the parents of the household head migrated shows a greater impact on tenure insecurity than whether the household itself has migrated. An interpretation of this result is that while migration is associated with tenure insecurity, households selectively migrate to areas where they have personal connections that reduce tenure insecurity. However, these personal connections do not translate across generations, and their children face greater insecurity. This finding may also reflect that some level of wealth and capability may be required to migrate, so that households that have migrated themselves have the capability to do so, while some households whose parents migrated may be unable to do so themselves. Finally, we note that status as an ethnic

minority is not significant in any of the specifications.

### The Cost of Tenure Insecurity

In this section, we evaluate the overall costs of tenure insecurity in the study area in terms of agricultural productivity. To do so, we estimate a specification of our general linear model [1], presented in Section IV, in which the vector of tenure insecurity measures  $\mathbf{X}_j$  consists of each of the six types of conflict risk, as well as both of our expropriation risk measures. Since the reference frames across individual risk types are highly correlated with one another, and the overall results are fairly consistent across reference frames, we restrict our consideration to the “for your household” reference frame for all conflict risk variables.

The results of this estimation are presented in Table 9. Consistent with Section IV, the coefficients of the serious risk of “arrival of new migrants” and “former residents returning” are statistically significant at less than 5%, and similar in magnitude to the specifications in the previous section in which each variable was included separately. None of the other tenure insecurity coefficients are significant.

In terms of the control variables, literate cultivators are significantly more productive, as are lowland parcels. The number of cattle owned by the household is negatively associated with productivity, as is plot size. This latter finding may indicate decreasing returns to scale; alternatively it may be proxying for land use, indicating that large land holdings tend to be primarily less-productive pastureland. The  $R$ -squared is 0.30, which is in line with similar studies that estimate agricultural productivity using cross-sectional data.

We use the results from this regression to estimate the overall impact of tenure insecurity on agricultural productivity in the study area. Recall that all of our tenure insecurity measures are dummy variables corresponding to responses of “somewhat” and “serious” to the various types of conflict and expropriation risk. To estimate the overall impact on productivity we multiply the coefficient of each of our tenure insecurity variables by the proportion of the cultivators in the sample who

gave the response associated with that variable and sum the results. Doing so results in an estimated productivity loss of 8.9% due to tenure insecurity. We discuss the implications of this finding in the conclusion below.

### Robustness Checks

In this section, we investigate the validity of the above finding that tenure insecurity reduces agricultural productivity by 8.9% in two ways. First, we use instrumental variables (IVs) estimations to assess the possibility that endogeneity may be driving our results and leading us to overestimate the costs of tenure insecurity. Provided the IVs are both correlated with endogenous explanatory variables, and uncorrelated with the error term in the ordinary least squares (OLS) model, the IV approach eliminates the risk of omitted variable bias. Second, we use an alternative approach to aggregating the individual tenure insecurity variables based on principal components analysis, and estimate the productivity impact of tenure insecurity using this approach.

A potential concern with our main results is endogeneity, particularly due to omitted variable bias. While we have controlled for a range of plausible factors, it is still conceivable that our findings are driven by some unobserved variable that drives both perceived tenure insecurity and agricultural productivity. To further allay these concerns, in this section we undertake IVs estimation of our general model. As we will show, the only plausible instruments in the data are weak, which leads to biased estimates. For this reason, the main findings presented in the previous section are based on the OLS results rather than the IV estimation. Nonetheless, the weak IV results can provide a useful means of testing whether endogeneity has led the OLS model to overestimate the impact of tenure insecurity on agricultural productivity.

Our data contain two variables that serve as plausible instruments for tenure insecurity. First, the data include information on each household’s previous experiences with land conflicts. Ongoing conflicts may affect agricultural productivity directly, but we would expect past conflicts to impact current pro-

TABLE 9  
Regression of Agriculture Productivity on Multiple Tenure Insecurity Measures

Tenure Insecurity Measures	Coef.	Controls	Coef.
Migration: somewhat	0.0703 (0.0893)	Female	-0.117 (0.0979)
Migration: serious	-0.449** (0.194)	Male non-household head	0.105 (0.137)
Outsiders seeking nonagricultural land: somewhat	-0.160 (0.0910)	Age	0.00111 (0.00210)
Outsiders seeking nonagricultural land: serious	0.276 (0.180)	Literate	0.145* (0.0759)
Former residents returning: somewhat	-0.0134 (0.0759)	Plot size	-0.209*** (0.0257)
Former residents returning: serious	-0.334** (0.128)	Length of tenure	0.00229 (0.00277)
Inheritance: somewhat	0.0655 (0.0810)	Irrigation	0.208 (0.142)
Inheritance: serious	0.118 (0.138)	Household resides on the parcel	-0.0513 (0.0368)
Livestock damage: somewhat	-0.0956 (0.0695)	Lowland terrain	0.598*** (0.0969)
Livestock damage: serious	0.0122 (0.0942)	Sloped terrain	-0.0212 (0.113)
Water access: somewhat	0.0101 (0.0823)	Household size	0.0104 (0.00741)
Water access: serious	-0.176 (0.115)	Log of nonagricultural household income	-0.00686 (0.00706)
State expropriation: somewhat	-0.0774 (0.0846)	Log of number of cattle	-0.0708** (0.0305)
State expropriation: serious	0.0126 (0.0867)		
Expropriation by villager: somewhat	0.123 (0.0768)		
Expropriation by villager: serious	-0.0434 (0.0957)		
Constant	6.504*** (0.177)		
Number of observations	4,157		
R-squared	0.301		

Note: Clustered standard errors in parentheses. Commune-level dummy coefficients omitted.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

ductivity by influencing the perceived risk of future conflicts. We thus use past incidence of conflicts that have subsequently been resolved as one instrument. Our second instrument is a dummy variable equal to one if the parents of the household head were born in the village where the household resides. This instrument is suggested by the possibility that disadvantaged access to traditional systems of defining and enforcing property rights may be an important reason for tenure insecurity. We would expect that longer-established lineages would tend to enjoy a privileged position in informal systems of property rights and enforcement that rely on traditional norms.

Since we have 16 perceived tenure insecurity variables but only two available instruments, we must construct an aggregate index of tenure insecurity for which to instrument. To construct the index, we use the coefficients from the regression in the previous section as weights and calculate a weighted sum of our 16 perceived tenure insecurity measures. This provides a single index of tenure insecurity, which we can then instrument for using the two variables described above.

We omit presentation of the first-stage results, but note that the Cragg-Donald  $F$ -statistic is 6.70, indicating the presence of weak instruments; that is, our incidence of resolved

TABLE 10  
Aggregated Tenure Insecurity Measure Ordinary Least Squares (OLS) and  
Instrumental Variable (IV) Results

	OLS	IV
Perceived tenure insecurity	-0.517*** (0.198)	-8.755** (4.385)
Female	-0.116 (0.0977)	-0.265* (0.159)
Male non-household head	0.0875 (0.133)	0.191 (0.189)
Age	0.000988 (0.00208)	-0.000556 (0.00315)
Literate	0.136* (0.0743)	0.139 (0.125)
Plot size	-0.209*** (0.0256)	-0.207*** (0.0264)
Length of tenure	0.00214 (0.00279)	0.00110 (0.00351)
Irrigation	0.220 (0.141)	0.313* (0.188)
Household resides on the parcel	-0.0494 (0.0369)	-0.0552 (0.0518)
Lowland terrain	0.602*** (0.0970)	0.581*** (0.119)
Sloped terrain	-0.0275 (0.112)	0.0359 (0.186)
Household size	0.0110 (0.00758)	0.0177* (0.00985)
Log of nonagricultural household income	-0.00794 (0.00691)	-0.000832 (0.0113)
Log of number of cattle	-0.0809*** (0.0300)	-0.0536 (0.0506)
Constant	6.383*** (0.160)	5.978*** (0.326)
Number of observations	4,157	4,127
R-squared	0.295	0.369

Note: Clustered standard errors in parentheses. Commune-level dummy coefficients omitted. d

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

conflicts and parents' migrancy status instruments are only weakly correlated with the tenure insecurity index. IV results using weak instruments are known to be biased, and interpretation of the coefficients is problematic (Stock, Wright, and Yogo 2002). While the weak instruments problem means that our IV model is not able to provide accurate estimates of the impact of tenure insecurity, as we discuss below, the results can still be used to argue for the validity of the results in the previous section derived from the OLS model.

Table 10 shows the results of the OLS and IV regressions of agricultural productivity on tenure insecurity. Our IV model uses limited information maximum likelihood (LIML) estimators rather than the more standard two-stage least squares approach, as LIML has been shown to reduce the bias associated with weak instruments (Staiger and Stock 1997). The coefficient of the instrumented tenure insecurity variable is of the expected sign, remains statistically significant at 0.05, and is substantially larger in magnitude than the OLS coefficient. Despite the weakness of the instruments, a test of overidentification using the Anderson-Rubin statistic that is robust to weak instruments suggests their validity. The Anderson-Rubin statistic is 0.258, with a chi-

squared test  $p$ -value of 0.61, thus failing to reject the null hypothesis that the model is overidentified.

We can further compare the IV and OLS results by constructing a confidence set for the IV estimate, using the approach of Moreira (2003). In this case, the confidence set for the IV coefficient is  $[-21.290, -3.595]$ . The upper bound is thus well below the OLS coefficient of  $-0.517$ . The implication of the IV results is that the negative impact of our perceived tenure insecurity measures on productivity are robust to the concern that endogeneity may bias our estimates upward, and that in fact endogeneity may be attenuating our results. A potential explanation for why this might be the case is that more-productive land tends to be more insecure by virtue of the fact that it is more attractive to those who might initiate a conflict. We thus suggest the interpretation that our main result of an 8.9% reduction in agricultural productivity due to tenure security represents a lower bound on the true impact.

In the previous section, our approach to aggregating our multiple measures of tenure insecurity was to use the regression coefficients of each of the 16 variables, reflecting the different dimensions of tenure insecurity. A po-

tential alternative approach to aggregation would be to use principal components analysis (PCA), a widely used method to reduce the dimensionality of data in cases of multicollinear explanatory variables using eigenvectors of the covariance matrix. Application of PCA in our case is somewhat complicated by the fact that as the analysis in Section IV shows, some of the survey questions that investigated different aspects of conflict and expropriation risk do not appear to reflect the dimensions of tenure insecurity that are economically costly. Thus, the eigenvector may not correspond to the particular dimensions of the tenure security that are economically costly. As a result, PCA may lead to a less precise measure of tenure insecurity than our approach to aggregation in the previous section, particularly when a broader range of conflict and expropriation risk variables is included. For this reason, the method of aggregating the variables using the regression coefficients in the previous section is our preferred model, rather than using PCA.

In order to investigate the possibility that our estimate of the cost of tenure insecurity is an artifact of our approach to aggregation, we implement three alternative versions based on PCA as robustness checks. The first of these, denoted PCA1, incorporates 16 tenure insecurity variables, consisting of dummies indicating “somewhat” or “serious” for each of the six types of conflict risk in the “for your household” reference frame, as well as dummies for the “somewhat” and “yes” responses to the two perceived expropriation risk questions.

The second estimation, PCA2, includes only dummy variables for the “serious” response to the six conflict and two expropriation risk questions. The reason for this approach is that Table 6 indicates that the “somewhat” responses do not tend to be associated with reduced productivity, so restricting the model to these variables may more accurately capture the economically costly aspects of tenure insecurity. Finally, PCA3 takes a more conservative approach to ensuring that the aggregated variable reflects only those dimensions of tenure insecurity that affect productivity by using only the three variables in the “for your household” reference frame that

were statistically significant in Table 6. These were the responses of “serious” to the conflict risks associated with new migrants, former residents returning to the village, and access to water for livestock, respectively.

For each of the three PCA models, we estimate model [1] using the first principal component<sup>5</sup> as the measure of tenure insecurity. We can then use these coefficients to calculate the implied cost of tenure insecurity to agricultural productivity using these alternative approaches to aggregation.

The regression results using the PCA-derived measures of tenure insecurity are shown in Table 11, along with the means of the PCA variables and implied cost of tenure insecurity to agricultural productivity. The coefficient of the tenure insecurity measure in PCA1 is of the expected sign, but not statistically significant. Meanwhile, the tenure insecurity coefficients in the PCA2 and PCA3 models are negative and statistically significant at 10% and 1%, respectively, and both imply the same 5.0% productivity loss due to tenure insecurity. The PCA2 and PCA3 estimates of productivity loss are broadly similar in magnitude to our main result of an 8.9% reduction, though somewhat smaller. The results are consistent with the expectations described above: measures using PCA to aggregate the tenure insecurity confirm the association with reduced productivity but are less precise, particularly when more variables are included. On the whole, the PCA results suggest that the relationship between tenure insecurity and agricultural productivity found in the analysis in the previous section is robust to alternative approaches to aggregation.

## V. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Using unique survey data from Burkina Faso, we find that tenure insecurity as measured by the perceived risk of land conflict or expropriation reduces agricultural productivity by a minimum of 8.9%. This finding is comparable to Deininger and Castagnini's

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<sup>5</sup> For brevity, we omit presentation of calculations of the first principal components in each case.

TABLE 11  
Regression of Agricultural Productivity on Principal Components Tenure Insecurity Measures

	PCA1	PCA2	PCA3
Perceived tenure insecurity	-0.0790 (0.0750)	-0.160* (0.0883)	-0.395*** (0.123)
Female	-0.0579 (0.102)	-0.0590 (0.102)	-0.0633 (0.101)
Male non-household head	0.0806 (0.137)	0.0798 (0.136)	0.0981 (0.137)
Age	0.000541 (0.00215)	0.000491 (0.00215)	0.000660 (0.00214)
Literate	0.123 (0.0780)	0.126 (0.0782)	0.128 (0.0781)
Plot size	-0.209*** (0.0256)	-0.210*** (0.0255)	-0.210*** (0.0255)
Length of tenure	0.00271 (0.00274)	0.00268 (0.00272)	0.00254 (0.00271)
Irrigation	0.211 (0.140)	0.213 (0.140)	0.210 (0.139)
Household resides on the parcel	-0.0685* (0.0376)	-0.0681* (0.0374)	-0.0694* (0.0372)
Lowland terrain	0.607*** (0.0951)	0.608*** (0.0952)	0.607*** (0.0952)
Sloped terrain	-0.0281 (0.111)	-0.0250 (0.111)	-0.0252 (0.112)
Household size	0.0102 (0.00765)	0.0103 (0.00764)	0.0102 (0.00757)
Log of nonagricultural household income	-0.00881 (0.00683)	-0.00831 (0.00685)	-0.00757 (0.00692)
Log of number of cattle	-0.0822*** (0.0305)	-0.0807*** (0.0305)	-0.0749*** (0.0303)
Constant	6.498*** (0.161)	6.539*** (0.163)	6.535*** (0.163)
Number of observations	4,158	4,158	4,158
R-squared	0.279	0.279	0.282
Mean of perceived tenure insecurity variable	0.195	0.313	0.126
Implied agricultural productivity loss	—	5.0%	5.0%

Note: Clustered standard errors in parentheses. Commune-level dummy coefficients omitted.

\*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ .

(2006) estimate that the productivity loss due to land conflicts in Uganda is between 5% and 11%. In contrast to Brasselle, Gaspart, and Platteau (2002), who argue that customary tenure systems provide adequate security in Burkina Faso, our results imply that there would be substantial economic benefit to securing the property rights of agricultural producers.

Moreover, our figure of 8.9% may underestimate the true cost of tenure insecurity. Though our survey instrument has been carefully designed, perceived tenure insecurity remains a latent variable, and our results maybe attenuated by measurement error. Our IV results also support the interpretation of 8.9% as a lower bound.

Our results also have implications for policies and programs designed to improve economic outcomes by addressing tenure insecurity. As the analysis in Section IV showed, some dimensions of tenure insecurity are strongly associated with agricultural productivity, while others are not. Moreover, the economically costly dimensions of tenure insecurity may not be those that are raised most frequently; for example, respondents were most likely to express concern over conflicts related to livestock damage, but these con-

cerns are not associated with reduced agricultural productivity. Thus, tenure-related policies and programs geared toward economic outcomes would benefit from a nuanced understanding of how tenure insecurity relates to economic behavior in the particular context.

This implication is consistent with a broader literature that has shown that remedying insecure tenure is not straightforward. A common policy response is for governments to formalize property rights and issue land titles. However, as Bromley (2008) argues, formalization of property rights in developing countries has been largely misguided and ineffective, with the empirical literature on the impacts of previous land titling efforts in rural Sub-Saharan Africa showing mostly disappointing results. Bromley explains this by arguing that property rights arrangements must be seen within a broader context of institutions that determine the incentives and constraints facing rural agricultural producers. Formalizing tenure in the absence of addressing other aspects of the institutional environment will not be sufficient to overcome other constraints and generate meaningful economic impacts for producers.

Our results suggest a number of areas for further research. Our findings show that carefully constructed efforts to measure perceived tenure insecurity can yield useful and interesting results and could be fruitfully undertaken in other contexts. In addition, while the present study has considered the impact of tenure insecurity directly on productivity, further research could investigate the more structural channels by which tenure security affects productivity. Finally, an investigation of the determinants of tenure insecurity could yield insights into why some households are more secure than others, and provide important implications for the design and targeting of property rights policies and interventions.

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