Insecurity and Welfare: Evidence from County Data*

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Abstract

Using original survey data collected at the county (commune) level, we examine the relationship between insecurity and welfare. Correcting for unobserved heterogeneity at the commune level, we find that insecurity is associated with lower incomes and health status in all our analysis, and it associated with lower school enrollment and higher infant mortality in regressions. Results are robust to the inclusion of shocks potentially affecting both welfare and insecurity. We further find a significant association between insecurity and the provision of certain public services, notably schooling and health care. A similar relationship is found with the placement of development projects. Taken together, the evidence suggest that insecurity is an important determinant of welfare in the country studied.

Keywords: crime, school enrollment, health, project placement

JEL: O15, I38, K42

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1 Introduction

It is increasingly recognized that human welfare is affected by the insecurity brought up by war, civil strife, and crime (e.g. Clinard and Abbott 1973, Bourguignon 2000). Direct effects arise from victimization and the fear it instills in neighbors, relatives, and members of the community at large. Indirect effects come from reduced investment and incomes and from diminished provision of – and access to – public services.

This paper examines the indirect effect of crime-driven insecurity on incomes and public services. We test whether insecurity is associated with a reduction in various welfare indicators. Attempt to investigate this relationship are typically hindered by the need to control for unobserved heterogeneity. We overcome this difficulty by using what amounts to location-specific fixed effects. Other empirical investigations of insecurity and welfare have relied primarily on cross-country comparisons (e.g. Soares 2004, Fajnzylber, Lederman and Loayza 2002b, Fajnzylber, Lederman and Loayza 2002a, Gaviria and Pages 2001), with all the difficulties inherent to this kind of research – e.g., different data sources, time period, cultures, etc. Here we use data coming from a single country that were collected at the same time using the same questionnaire. The data covers the whole country.

Results show that an increase in insecurity is associated with a significant reduction in incomes and in access to health centers and schools. The effect is robust to the inclusion of various controls, and the use of alternative methods such as propensity score matching or instrumental variable regression. We also investigate possible channels through which insecurity may affect welfare. We find that a rise in insecurity in a given location is associated with a reduction in the likelihood that a new school or health center is built there. We also provide evidence that insecurity is associated with a reduction in the likelihood of attracting a development project. Results further indicate that certain types of economic activity such as large-scale manufacturing are more sensitive to changes in insecurity than others, like small-scale mining.

These findings are by themselves not surprising. What is surprising is that they are so strong in a country that is not known for drug trade or guerilla activity. In spite of attracting many tourists and sizeable foreign investment, the studied country suffers from what could be called pervasive low-level insecurity. Much of it is related to property crime and the ineffectiveness of the police and prison system (e.g. Ministere de la Justice 1999, Fafchamps and Moser 2003). This study shows that crime and the

feelings of insecurity it generates seem to have large welfare effects through economic activity and the provision of public services.

Since Becker (1968)'s initial foray, an economic literature on crime has emerged and is now well established in developed countries. Much of this work has focused on the issues of deterrence (e.g. Ehrlich and Brower 1987, Ehrlich 1996, Levitt 1997, Levitt 1998, Levitt 1996, Farmer and Terrell 2001) and the determinants of criminal behavior (e.g. Ehrlich 1975, Blau and Blau 1982, Sah 1991, Ludwig, Duncan and Hirschfield 2001, Morgan 2000, Freeman 1996, Raphael and Winter-Ember 2001, DiIulio 1996). Some work has also been done on the cost of crime prevention to individuals and on the effect that crime has on investment and the choice of residence (e.g. Cullen and Levitt 1999, Freeman, Grogger and Sonstelie 1996, Helsley and Strange 1999).

More recently, the literature has turned to the study of crime in poor and middle-income countries. In a series of articles relying on cross-country comparisons, Fajnzylber, Lederman and Loayza show that crime-related insecurity hurts growth (e.g. Fajnzylber et al. 2002b, Fajnzylber et al. 2002a, Fajnzylber, Lederman and Loayza 2000, Fajnzylber, Lederman and Loayza 1998, Lederman, Loayza and Menendez 2000). There is also a growing body of work based on micro data. Pradhan and Ravallion (1999), for instance, show that insecurity ranks high on the welfare priorities of Tanzanian dwellers. Demombynes and Ozler (2002) examine crime in South Africa and show that high crime rates in poor districts spill over to richer neighborhoods. Using data from Madagascar, Fafchamps and Moser (2003) show that the incidence of certain categories of crime is higher in isolated areas than in urban centers, thereby reversing the general perception that crime is primarily an urban phenomenon. The authors also show that police deterrence is ineffective in Madagascar. Fafchamps and Minten (2004) further show that an exogenous increase in poverty is associated with a rise in crop theft.

This literature has recently been joined by economic work on conflicts. Collier and Hoeffler (1998) and Collier and Hoeffler (2002) have shown that many violent political conflicts follow an economic rationale, particularly the capture of a valuable income source such as a diamond mine. Using cross-country evidence, Collier, Hoeffler and Soderbom (2004) show that once initiated, violent political conflict tends to persist. The relationship between crime and conflicts is examined by Collier and Hoeffler (2004)

who provide evidence that conflicts fuel crime but not the reverse. Using panel household data from Uganda which has been plagued by civil war for a decade or more, Deininger (2003) shows that civil strife reduces welfare, but crime does not. In contrast to the existing literature, this paper empirically tests the association between welfare and insecurity and investigates the channels through which these effects are likely to take place.

The paper is organized as follows. In Section 2, we briefly present the conceptual framework and testing strategy. Section 3 discusses the data and presents summary statistics. In Section 4 we test whether insecurity reduces welfare. Section 5 examines a number of channels through which insecurity affects welfare. Conclusions and suggestions for further research are presented at the end.

2 Conceptual framework

Following Becker (1968), it is now customary to recognize that crime responds to economic incentives. Crime is also widely believed to affect economic incentives, although the magnitude of this effect is unclear. Other sources of insecurity, such as riots, civil wars and political conflict, are similarly thought to influence economic outcomes.

To investigate the relationship between insecurity and welfare, we estimate regressions of the form:

$$W_{it} = \alpha S_{it} + \beta C_{it} + u_i + \varepsilon_{it} \tag{1}$$

where W_{it} is a welfare indicator for location i at time t, S_{it} is a measure of insecurity, C_{it} is a vector of controls, u_i is a fixed effect, and ε_{it} is an error term. The fixed effect capture any location-specific time-invariant factor that may affect welfare. Controlling for such effects is essential because many location-specific features such as isolation or population density may influence welfare as well as insecurity. Failing to control for these factors may generate a spurious correlation between welfare and insecurity.

Differencing (1) to eliminate the fixed effect, we obtain a regression model of the form:

$$\Delta W_{it} = \alpha \Delta S_{it} + \beta \Delta C_{it} + \Delta \varepsilon_{it} \tag{2}$$

where the notation $\Delta x_{it} \equiv x_{it} - x_{it-1}$. Equation (2) regresses changes in welfare on changes in insecurity, controlling for various other effects so as to minimize omitted variable bias. Estimating (2) for various welfare indicators is the first purpose of our econometric analysis.

We also wish to investigate the channels through which insecurity may affect welfare. To do so, we examine whether insecurity is associated with a number of potential channels N_{it} which are generally regarded as strongly related with specific dimensions of welfare. For instance, health is affected by the presence or absence of health facilities. We can therefore test whether an increase in insecurity is associated with a lower likelihood of creation of a health facility in a given location, i.e., whether:

$$\Delta N_{it} = \gamma \Delta S_{it} + \nu_{it} \tag{3}$$

Here as before, differentiating eliminates time-invariant fixed effects that may be correlated with insecurity as well as with the presence of a health facility.

3 The data

The purpose of the rest of this paper is to estimate equations (2) and (3) using comprehensive survey data on Madagascar. Madagascar constitutes a perfect test case for an investigation of insecurity and welfare. The country is quite poor, with a GDP per head of US$260 in 2002 (The World Bank 2003). The Malagasy government estimates that 69% of the population are below the poverty line (e.g. GOM 2003, Mistiaen, Ozler, Razafimanantena and Razafindravonona 2002). The country is also known to have a high crime rate (Fafchamps and Moser 2003).

A map of Madagascar with provincial and communal boundaries is shown in Figure 1. Population density is depicted in shades of grey. With a population of 16 million and a size equivalent to that of France, Belgium, and Holland combined, Madagascar has a low population density – the median population density in each commune is 26 inhabitants per square Km. We see that population is densest in the Central highlands around the main cities of Antananarivo (the capital city) and Antsirabe. The Eastern highlands and coast between Toamasina and Fianarantsoa are also heavily populated. This

largely reflects climate patterns that make these areas more productive for agriculture. Other major cities such as Toamasina, Mahajanga, Toliara, and Antsiranana are coastal port cities with a small rural hinterland surrounding them. The Western and Southwestern parts of the country are more arid and much less populated.

Although Madagascar has not experienced any major armed conflict since independence,[1] insecurity is known to be a major problem. Fafchamps and Moser (2003) provide evidence that the homicide rates is comparable to that of the US in the early 1990s, when it was at its highest. Cattle rustling is a major problem in low population density area, with extremely high rates of cattle theft and the involvement of organized crime (e.g. Rasamoelina 2000, Razafitsiamidy 1997). Crop theft is also a commonly cited problem, and Fafchamps and Minten (2004) show an exogenous increase in poverty to be associated with a rise in crop theft.

Insecurity appears to be related to insufficient law enforcement. Ministere de la Justice (1999) and Root (1993) provide ample evidence that the legal system is not running effectively. Fafchamps and Moser (2003) show that law enforcement has no deterrent effect on crime. Survey responses suggest that, in some parts of the country, criminals who are caught do not spend any time in jail because of inefficient courts and lax prison rules. In these circumstances, we would expect insecurity to have a measurable impact on welfare.

The data on which we base our empirical analysis comes from a survey conducted by the authors in 2001. Our unit of analysis is the commune, a geographically defined administrative unit roughly equivalent to a municipality or county. Madagascar has six provinces (or faritany), which are divided into fivondronanas. The fivondronana are made up of communes – the smallest administrative units with direct representation from the central or provincial government. Rural communes are further divided into fokontanys, which essentially represent individual villages. As of late 2001, there were approximately 1390 communes in Madagascar.[2]

[1] After a disputed presidential election, the country was temporarily divided into two in early 2002, each faction occupying part of the island. After a blockade of the Central Highlands that lasted several months, the stand-off was eventually resolved when the incumbend president fled the country in June 2002. In spite of the severity of the political crisis, the level of political violence was kept surprisingly low, with estimates of crisis-related casulaties numbering less than 100 victims.

[2] The exact number remains unclear due to the existence of conflicting "official" lists. This confusion is the result of changes in the boundaries and composition of some communes in the mid-1990s.

The crime statistics and other data used in this paper were all collected as part of the commune survey. The survey was conducted over a three-month period in 2001 in a collaboration between Cornell University, Oxford University, and the Malagasy agricultural research institute (FOFIFA). A total of 1385 communes were surveyed, all but 9 currently functioning communes.[3] The remoteness of some communes and the general lack of national data on certain subjects meant that little was known about the spatial distribution of public goods and services, economic activity, or insecurity prior to the survey.

The survey was conducted at the commune's administrative center. Enumerators were instructed to gather a number of statistics from the relevant government offices in the commune. More subjective questions, such as those concerning community perceptions of existing conditions, were answered by a focus group composed of a small group of prominent residents of the commune – typically municipality officials and key informants. Crime statistics were collected only for 1999, 2000 and 2001 so as to minimize recall bias. To the best of our knowledge, there does not exist systematic time series crime data on all the municipalities of the country.

Descriptive statistics on insecurity and welfare are presented in Table 1. Focus group respondents were asked whether insecurity improved or worsened in their commune over the five years period preceding the survey. Their subjective assessment is reported in the first column of Table 1. We see that 30% of respondents estimate that the level of insecurity in their commune improved between 1996 and 2001 while 51% estimate that it worsened. Only 19% responded that it remained unchanged.

Focus group respondents were also asked whether average income in the commune increased or fell over the same period. Responses are summarized in column 2 of Table 1. In half of the communes, respondents stated that the average income in their commune rose while 35% stated that it fell. Similar questions were asked regarding the health status of inhabitants, school enrollment, and infant mortality in the commune. The reader should keep in mind that, for the first three variables an increase is good, but for infant mortality it is bad. A majority of respondents felt that health status and school enrollment have increased, while infant mortality has decreased.

Many of the nefarious effects of insecurity depend on perceived risk and thus on perceptions of in-

[3] Nine communes were missed in the survey, either because they are too isolated or too insecure or both. The number of missing communes is very small so selection bias is unlikely to be an issue in the estimation.

security. Responses to the insecurity question therefore provide a measure of insecurity that is more economically relevant than actual crime statistics. The reader may nevertheless wonder whether subjective perceptions by focus group respondents bear any relationship with actual risk. To investigate this, we compare subjective perception of insecurity to crime incidence figures.

Respondents were asked to rank the security situation in their commune. Responses, presented in Table 2, show that 28% of respondents find the security situation either bad or very bad while 25% find it good or very good. The others find it average. Recognized high crime areas have been flagged as a 'red zone' by the government; 30% of the country's commune are counted as part of the 'red zone'. Table 2 also presents stated development priorities of commune respondents. Insecurity comes third in this ranking, being the top development priority for 15% of the communes, and second priority for another 13% of communes. Insecurity is especially a concern in remote communes, a result in line with the work of Fafchamps and Moser (2003). Since remote communes also tend to be larger, when we weigh responses by area we find that insecurity is the first or second development priority in communes representing 43% of the country's area.

It is of interest to examine whether subjective assessments of insecurity are related to actual insecurity. Given the absence of civil unrest during the period under investigation, crime must the primary source of insecurity. In the second panel of Table 2 we report crime statistics collected in the commune survey. These statistics were collected separately for 1999, 2000 and 2001. Here they are averaged over the three year period 1999-2001 and reported per 100,000 inhabitants.

Of the five types of criminal activity recorded in the commune survey, cattle rustling is the most common. An average of 80 or so head of cattle are stolen on average each year in each commune – an average of 1500 or so head of cattle per 100,000 inhabitants. This figure is influenced by a number of a small number of very large outliers where cattle rustling takes place at an 'industrial' level. But the median is still 62 head of cattle reported stolen each year per 100,000 inhabitants.[4] Burglaries are the

[4]The high incidence of cattle rustling may be related to traditional practices of certain ethnic groups. The Bara, one of the dominant ethnic groups in Southwestern Madagascar, are known cattle thieves because young men are supposed to prove their manhood by stealing cattle. When they have done so, they are ready to get married (Ramiarantsoa 1995). The Sakalava have similar customs. Cattle rustling is more common in the western part of the island. This largely reflects the fact that this drier part of the island is most suitable for extensive livestock production, which naturally facilitates livestock theft (Smith, Barrett and Box 2001).

next most common type of crime, with some 43 burglaries on average per year per 100,000 inhabitants. The average number of reported homicides is higher than the high US national average from the early 1990's: 8.5 homicides per 100,000 inhabitants (Fox and Zawitz 2000). This number is a bit higher than the 1994 national average of 6.4 intentional homicides reported in Fajnzylber et al. (1998). The median number of homicides is much lower, suggesting that crime is concentrated in certain communes. As shown by Fafchamps and Moser (2003), the highest homicide rates are found in isolated, less densely populated areas. The incidence of rape appears low, with less than three reported cases on average per 100,000 inhabitants. This is likely due to under-reporting bias. Vehicle theft is extremely rare, reflecting the low number of personal vehicles on the island and the fact that few people know how to drive.

To ascertain the validity of the subjective assessment of the security situation by survey respondents, we would like to regress this ranking on crime statistics. Before we do so, however, we worry that the responses given in the commune survey may be influenced in a systematic manner by the composition of the focus group. It is conceivable, for instance, that members of specific professions may be more sensitive to crime and tend to over-report it. To the extent that the composition of the focus group is correlated with location and crime, this may result in a spurious relationship. At the bottom of Table 2 we present the information we have regarding the composition of focus groups. The average number of participants is close to 9 people. Communal employees and social service workers represent over 60% of the respondents. This is unsurprising since they are likely to be the best of source of quantitative information about communal affairs. There is also a non-negligible proportion of farmers and this proportion varies from focus group to focus group.

Table 3 reports an ordered probit regression of the subjective insecurity ranking on the five crime rate variables and the red zone dummy. Focus group variables are included to control, to the extent possible, for response bias. Results demonstrate that insecurity as perceived by focus group respondents largely reflects actual crime: the red zone dummy and three of the five crime variables are significant – often at the 1% level.[5] Car theft is not significant, most probably because it is very rare. From these observations

[5]It is conceivable that the feeling of insecurity responds more strongly to recent events. To investigate this possibility, we reestimate the model using only crime reported in the year preceding the survey (2001) and only crime reported in 1999. We obtain slightly stronger results (higher t-values) using 2001 crime data or the 1999-2001 average than using the 1999 numbers. But the results are otherwise quite similar.

we conclude that the subjective assessment of insecurity reported by respondents is closely related with objective risk measures; it is not just driven by irrational fear and prejudice.

These results are consistent with earlier studies which have shown that, in Madagascar, perceived insecurity is significantly related to the prevalence of crime which, in the studied country, increases with isolation (Fafchamps and Moser 2003) and poverty (Fafchamps and Minten 2004). While in developed economies most crime occurs in urban areas, (Fafchamps and Moser 2003) have shown that in Madagascar crime rates are higher in isolated rural areas and that much crime is associated with cattle rustling. This is confirmed in Table 3: cattle theft has a strong effect on feelings of insecurity, either directly (the coefficient of cattle theft has a t-value close to 8) or indirectly through the 'zone rouge' (high crime) dummy, which is exclusively rural and concentrated in high cattle theft areas. Anthropological studies of cattle theft in Madagascar document the role of organized roaming gangs that steal cattle from one commune and walk it over long distances to sell it elsewhere. Similar observations have been made for Northern Kenya by McPeak and Barrett (2001).

4 Insecurity and welfare

We now examine the relationship between perceived insecurity and the four welfare measures collected in the survey – income, access to health care, access to schooling, and infant mortality. Since all five measures compare the situation prevailing at the time of the survey with that prevailing five years earlier, they are already in differenced form, i.e., as they appear in equation (2).

Ordered probit regression results are presented in Table 4. Focus group composition variables are included as controls for possible response bias. Results show a strong negative association between an increase in insecurity over the period 1996-2001 and an improvement in income, health status, and school enrollment. Put differently, communes that experienced an increase in insecurity experienced a significantly lower increase in income, health status, or school enrollment. Infant mortality increases with insecurity but the effect is not statistically significant. These results suggest that insecurity is significantly and negatively associated with several dimensions of welfare.

The question that immediately follows is through what channel(s) this relationship occurs. Before we

turn to this question, however, we must verify that the results shown in Table 4 are robust. The first possibility we investigate is the idea that both insecurity and welfare were affected by some other factor, resulting in a spurious relationship. For instance, it is conceivable that communes affected by a cyclone or a drought experienced a fall in income and a rise in insecurity, as shown for instance for Tanzania by Miguel (2003). To reduce the chance of such omitted variable bias, we include as additional regressors a number of variables capturing a wide variety of shocks. This approach does not entirely eliminate the risk of omitted variable bias, but it is the best we can do with the data at hand.

Shock variables are described in Table 5. Each variable measures the number of years, over the three years preceding the survey, during which a given shock or disease affected the commune. Each variable takes values from 0 (no year) to 3 (in all three years). As evidenced by Table 5, the list of shock variables is quite long as it includes climatic events (cyclone, drought, flood), plant pests and diseases (locusts, rice fleas), human diseases, and livestock diseases. Bad climatic events are a frequent occurrence, the late start of the rains being the most often cited shock. Cyclones hit the East coast of the country every year, devastating crops, causing floods, and cutting roads. Some human diseases, malaria for instance, are endemic in most of the country so there is very little variation from year to year. Others such as plague vary over time.

An additional source of concern is the possibility that disgruntled or pessimistic focus groups may respond to all questions in a negative manner. This would generate a response bias that would be common to the insecurity variable and the variables measuring changes in welfare over time. The analysis presented in Table 2 suggests that subjective perceptions about the *level* of insecurity correlate well with objective measures of crime, but here we are concerned about subjective perceptions about *changes* in insecurity. Unfortunately commune-level crime statistics going back to 1996 and before do not exist for Madagascar. Consequently we cannot conduct the same analysis as we did in Table 2 by regressing perceptions about changes in insecurity on changes in reported crime between 1996 and 2001.

We seek to address this concern by constructing two proxies for 'gripe'. Including these proxies as additional controls should reduce the omitted variable bias. We also construct our first proxy for gripe using the residual from the regression presented in Table 3. For memory, in that regression we regress the

level of insecurity – as reported by the focus group at the time of the survey – on recent crime statistics. The error term from this regression can be taken as a proxy for the focus group's tendency to over-report insecurity.

The second proxy we construct uses answers to focus group questions that are not directly related to welfare or insecurity but are likely to be correlated with 'gripe'. More specifically, we use answers to questions on late rains and total rainfall over the three years preceding the survey, as reported by the focus group. We combine answers to construct an index of how much the respondents complained about bad rains. We then regress this index on the value of the same index averaged over neighboring communes. The idea is that rainfall in communes nearby should be correlated with own rainfall but not with the pessimistic temperament of the respondents. Results are shown in Appendix, Table A1. The regression is highly significant, with an R^2 of 0.24. The residual from this regression measures how much more than neighboring communes the respondents complained about rainfall. This residual is a proxy for gripe if we are willing to assume that rainfall is spatially correlated – so that rainfall in neighboring communes is a good predictor – and that gripe is distributed more or less independently across communes. While there is little doubt about the first assumption, we unfortunately have no way of verifying the second. The validity of the procedure therefore rests on this maintained assumption.

Table 6 presents ordered probit regressions of changes in welfare indicators on changes in insecurity, the composition of the focus group, the two proxies for 'gripe', and the various shock and disease variables listed in Table 5.[6] We see that the insecurity coefficients retain the same sign and magnitude in all four regressions. They remains significantly negative in the first two regressions, but they are not significant in the other two. Except for one coefficient which is significant at the 10% level, the gripe variables are not significant.

Although shock and disease variables are used here only as controls, it is instructive to check whether they have the anticipated effect. We find that many climatic shocks are associated with a fall in welfare. For instance, floods, droughts, and late rains all tend to reduce income. Typhoid is associated with a fall

[6] We omit malaria and two animal diseases – distomatosis and Newcastle disease – because they are endemic in the entire country and have too little variation for their coefficient to be identified. Including them does not change the conclusions regarding insecurity, however.

in health status and school enrollment. Other results are more puzzling, such as the positive association between other livestock diseases and improvement in two of our welfare indicators. In this case, it is possible that higher prosperity leads households to buy, sell, and keep more livestock, thereby creating conditions favorable to epidemics. The positive association between plant diseases and income and health status may be due to the fact that plant diseases are more common in humid years when incomes are high.

It is conceivable that recent shocks loom larger in respondents' assessment of improvements in welfare. To investigate this possibility, we reestimate Table 6 using only shocks reported to 2001. Results, not shown here to save space, are basically identical to those reported in Table 6. We also worry that, given the high frequency of many reported shocks, they approximate average incidence rather than shock. To correct for this possibility, we regress shock measures on a large number of commune physical characteristics, such as latitude, longitude, elevation, average rainfall, and the like. The residuals from these regressions represent variation in shock variables that cannot be attributed to time-invariant characteristics. We then obtain the residuals from these regressions and use them as proxies for unanticipated shocks in Table 6. Results, not shown here to save space, yield a stronger estimated effect of the insecurity variable, which is significant not only in the income and health status regressions but also in the infant mortality regression.

As emphasized in the literature on treatment effects (e.g. Lee 2005, Wooldridge 2002), the results in Table 6 may be misleading if treated and untreated observations have very different values of the control variables. The linear functional form imposed by the regression framework can yield misleading results if the true slope of the treatment effect varies across communes with different characteristics (Dehejia and Wahba 1999). To correct for this possibility, we need to compare treated and untreated communes that are comparable. Various non-parametric matching techniques have been proposed that seek to compare treated observations only to untreated observations with similar observable characteristics. One of these methods is propensity score matching, but there are more general matching methods as well.

To fit our analysis into this framework, let us define as treated those communes that suffered an increase in insecurity; those that did not are controls. Roughly half of the communes fall in each category.

We report in Table 7 the results obtained using two different matching techniques.

The first one is the nearest neighbor matching method proposed by Abadie, Drukker, Herr and Imbens (2004). To understand how this method works, say the vector of covariates is x. We want a measure of distance between the x's. One easy metric is the vector norm $(x'Vx)^{1/2}$ where V is a positive definite weight matrix. The distance $||x_1 - x_2||_V$ between two vectors x_1 and x_2 is then

$$||x_1 - x_2||_V = ((x_1 - x_2)'V(x_1 - x_2))^{1/2}$$

Abadie et al. (2004) recommend letting $V = S^{-1}$ where S is the covariance matrix of covariates x. This metric is referred to as the Mahalanobis metric. We implement this method using all the controls appearing in Table 6 as part of the covariate vector x.

The second set of results reported in Table 7 are based on propensity score matching. In this method, we begin by regressing treatment on the controls, the results of which are shown in Table A2 in appendix.[7] The predicted probability of treatment generated by this regression is called the propensity score. Rosenbaum and Rubin (1983) have shown that, as long as there is no selection on unobservables, the effect of the treatment can be consistently measured by comparing treated and untreated communes with similar propensity scores.

Estimates of the average treatment effect for our four welfare variables of interest are presented in Table 7, using common support. For propensity score matching, we use the radius method with a caliper of 0.1 as this yields the most stable results. For comparison purpose we also report results for the unmatched. Results are very similar to those reported in Table 6: both matching estimators yield a significant difference between treated and control for average income and health status, but no significant effect infant mortality and school enrollment. This confirms that the results reported in Table 6 are not an artifact of the regression framework.

There remains the possibility that the gripe variables do not fully control for response bias. The resulting measurement error in the insecurity variable may lead to endogeneity bias. In an attempt

[7] The regression by and large satisfy the balancing property. Balancedness is violated at the 5% level in two cases (out of a total of 24 variables times 7 blocks) involving two different variables in two different blocks, without any evidence of a pattern.

to correct for this source of bias, we seek to instrument the insecurity variable. To do this, we need to find an instrument for the change in insecurity over the years preceding the survey. We use the population census of 1993 to construct two variables that are likely to affect subsequent changes in crime but could not have been caused by it. In Madagascar, the presence of young men in the village is likely to improve the security situation. This is because rural insecurity is often due to gangs that attack villages to steal cattle, a point that has been emphasized repeatedly in the anthropological literature (e.g. Rasamoelina 2000, Razafitsiamidy 1997) and in regression analysis of crime in Madagascar Fafchamps and Moser (2003). Young males makes communities less vulnerable to such attacks and may serve as a deterrent.[8]

To capture this idea, we construct a variable that measures the growth in the proportion of teenage males in the commune population. The 1993 population census report age in 5-year categories. Males aged 10 to 14 in 1993 will be between 13 and 17 in 1996 and between 18 and 22 in 2001. These are the teenage males in the recall period covered by the commune survey. Let their proportion in the population be written S_{10-14}. In contrast, males aged 15 to 19 in 1993 were teenagers at the time of the census but have basically become adults by the time of our recall period. Let their proportion in the population be written S_{15-19}. The regressor is $\Delta S = S_{10-14} - S_{15-19}$; if it is positive, there are more teenage males during the survey recall period relative to the preceding 5 year period – and vice versa if it negative. If the presence of teenage males deters thieves, the variable should have a negative effect on insecurity: more teenage males relative to the preceding period reduces insecurity. To allow for spillover effects across communes, we use ΔS in neighboring communes as additional regressor in the propensity score regression. While this identification strategy is not ideal – i.e., it does not rely on a controlled or quasi experimental source of variation in insecurity – it should satisfy the exclusion restriction and it is the best we can do with the available data.

The instrumenting regression, shown in Table A3 in appendix, is basically the same as Table A2 except that it includes two more variables and is estimated using least squares. As expected, a higher

[8] It is also conceivable that the presence of young males coming of age during the period covered by our analysis had an worsening effect on crime and insecurity because crime (especially violent crime) is often correlated with testosterone levels (Wilson, Daly and Pound 2002). We would expect this pattern in societies where crime is perpetrated by nearby residents, but it is unlikely to apply to rural Madagascar where cattle rustling by itinerant gangs is the major security concern.

proportion of young males is associated with a smaller increase in insecurity. The population variables are jointly significant but the value of the joint F-test is below 10, suggesting that we a weak instrument problem.

Regression results with instrumented insecurity are shown in Table 8. Overidentification tests of the validity of the instruments fail to reject the null hypothesis that instruments are uncorrelated with the errors in the main regression. Since we have weak instruments we apply the Anderson-Rubin test as implemented by Moreira (2001). This procedures corrects the threshold value for the significance of the insecurity variable that allows for weak instruments. The results from this test are reported at the bottom of Table 8.

Results show a massive increase in the magnitude of the insecurity coefficient (6.5 to 25 times larger). This is consistent with the presence of measurement error, uninstrumented results suffering from attenuation bias. This is hardly surprising given that subjective rankings are known to vary with mood, time of the day, and other psychological and physiological factors (e.g. Frey and Stutzer 2002, Diener, Suh, Lucas and Smith 1999, Layard 2002). After instrumentation, the insecurity variable is significant with the anticipated sign in the income, health status, and infant mortality regressions. These results accord serve as an additional confirmation that the association between changes in welfare and insecurity is not simply a consequence of response bias.

5 Possible channels

Having documented a robust relationship between insecurity and certain dimensions of welfare, we briefly examine possible channels through which this relationship may take place. We begin by reporting the opinion of the respondents. Each focus group was asked to provide the main cause for the change in each of the four welfare indicators. Their responses, broken into categories, are summarized in Table 9.

The most often cited cause for variation in income is a change in agricultural prices.[9] Insecurity is listed as the main reason for change in income by 8% of the communes. This is a fairly remarkable result

[9] Unfortunately, we do not have longitudinal information on agricultural prices at the commune level and cannot therefore test whether communes that became more insecure experienced a fall in agricultural prices.

since an change in insecurity must be quite severe before being given as the main reason for changes in income in the commune as a whole. The provision of a new health center and of a new school are given as the most important reasons for changes in health status and school enrollment, respectively. Health facilities also loom large in responses regarding infant mortality. Contrary to income, insecurity is not often listed for health status, school attendance, and infant mortality. This may be misleading, however, because insecurity may hinder or delay the construction of new schools and health centers in affected communities.

To investigate this issue more in detail, we test whether an increased in insecurity is associated with a lower probability of attracting public services into the commune. We have information on when various infrastructures and services were first established in the studied communes. This information is summarized in Table 10 which shows the proportion of communes with the infrastructure or service in 1996 and 2001. We see that the study period witnessed a fairly large increase in the provision of secondary schools, basic health centers, and drinking water. The increase in agricultural input and output markets was less pronounced.

Based on the information presented in the first panel of Table 10, we create dummy variable that takes the value 1 if a new infrastructure or service was instituted in the commune during the 1996-2001 period. We then regress this dummy on the change in insecurity during the same period, as shown in equation (3). Of course, this regression is conditional on the commune not already having the infrastructure or service in 1996. We therefore estimate the model as a selection-corrected probit. Because the selection equation seeks to explain the level of infrastructure in 1996 – not the change in the subsequent period – we use time-invariant commune characteristics as regressors for the selection equation. To minimize selection bias in the change equation, we use a generous list of regressors including various geographical features thought to affect either the demand for public services or the cost and political desirability of providing them. The list includes longitude and latitude (major determinants of climate and thus of agricultural potential), elevation (Madagascar is a mountainous country), rainfall, temperature, soil type dummies, population density (based on the 1993 census), distance from the nearest road, and ethnic and provincial dummies. All these regressors are clearly pre-determined and most are beyond human influence. Since

these regressors are not our focus of interest, we need not discuss them any further. As before, we include gripe proxies in the welfare regressions and we control for the composition of focus groups.

Regression results shown in Table 11 indicate that an increase in insecurity is associated with a lower likelihood that a secondary school or health center is built. Other public infrastructures such as drinking water and agricultural markets appear unaffected. The tentative conclusion we can draw from this and the earlier evidence is that insecurity affects welfare at least partly through lower provision of certain public services. It is worth noting that the two public services affected by insecurity, secondary schools and health centers, both require that an educated workforce (teachers, doctors and nurses) live in the commune or nearby. Agricultural input and output markets, in contrast, are operated by small local traders who move across markets and need not reside in the affected areas (e.g. Fafchamps and Minten 1999, Fafchamps, Gabre-Madhin and Minten 2004). This contrast suggests that one factor that hinders the delivery of public services to insecure areas is the difficulty to convince teachers and health workers to work and reside there.

We also have information on the number of new development projects taking place in the commune over the 1996-2001 period. As shown in Table 10, during this period the average number of new development projects per commune was 2.23 with a median of 2. Only 19% of communes did not have a new development project during the period. We regress the (log of the) number of new development projects (+1) on the change in insecurity. Results, presented in Table 12, again show a negative relationship: communes that experienced a deterioration of the security situation received fewer new development projects. The magnitude of the effect is non negligible: if the security situation worsened a bit instead of staying the same, this results in a 6% fall in the number of projects undertaken in the commune. Going from 'worsened a lot' to 'improved a lot' results in a 25% increase in the number of development projects. Given that development projects typically aim at increasing incomes and improving welfare, this evidence suggests that insecurity also lowers welfare by discouraging the placement of development projects in affected areas.

We conduct a similar analysis on manufacturing and mining employment. Results – not shown here to save space – show a significant negative effect of an increase in insecurity on employment growth in

large manufacturing firms (more than 50 employees), but no effect on mining employment and on smaller manufacturers. To the extent that large firms depend more on sophisticated equipment and educated manpower, this again suggests that insecurity is less harmful to traditional, informal income generating activities than it is to economic activity of a more modern nature.

The survey also provides some evidence that insecurity has a negative effect on agriculture. Respondents were asked what factors hinder the expansion of cultivated acreage in lowland (irrigated) and upland (non-irrigated) areas. Insecurity was cited by 10% of respondents for lowland expansion and by 23% of respondents for upland expansion.[10] Insecurity is cited more often in land-abundant communes that are more remote and where insecurity is higher. Based on the work of Fafchamps and Minten (2004) and (e.g. Rasamoelina 2000, Razafitsiamidy 1997), the fear of crop theft and of encounters with cattle thieves may be the dominant concerns of villagers. This provides yet another channel by which insecurity affects welfare: the fear of venturing too far from the village appears to discourage many farmers from expanding cultivated acreage and hence output.

6 Conclusion

Using original data collected by the authors, this paper has examined the relationship between insecurity and welfare. Identification of this relationship is not based on a controlled or natural experiment, so causal inference is potentially problematic and results should be interpreted in this light. We do, however, control for commune fixed effects – arguably the main cause for concern in analyses of this type. We also do our best to check the robustness of our results with respect to potential sources of bias, in particular omitted variable bias and response bias.

The results show that an increase in insecurity, as perceived by respondents, is associated with lower incomes, school enrollment, and health status, and with a higher infant mortality. This association is consistently significant for incomes and health status. For school enrollment and infant mortality, it is only significant for some estimators. Results are robust to the inclusion of shocks potentially affecting

[10] For lowland cultivation, 3% of communes cited insecurity as the first reason for not expanding acreage; another 7% cited it as second reason. For upland cultivation, insecurity was cited as first and second reason by 8% and 15% of communes, respectively.

both welfare and insecurity. These findings are in contrast to those of Deininger (2003) who found no effect of crime on rural incomes in Uganda.

We then turned to the channels through which insecurity may affect welfare. We find a significant relationship between an increase in insecurity and improvements in the provision of certain public services, notably schooling and health care. We find a similar relationship with the placement of development projects. We also find some evidence that insecurity is associated with an employment reduction in large manufacturing firms – but not in mining – and that it discourages farmers from expanding cultivated acreage.[11]

Taken together, the evidence suggest that insecurity is probably an important determinant of welfare in the country studied. Insecurity seems to affect welfare in many ways: through incomes via its effect on economic activity and development projects; and through access to public services by hindering the placement of social infrastructures in insecure areas. Certain types of public services – schools and health centers – and certain types of economic activity – e.g., large-scale manufacturing – appear more sensitive to insecurity than others such as mining and agricultural trade.

These findings raise the issue of why insecurity is so pervasive in Madagascar. The lax attitude of police, courts, and jail institutions appears largely responsible for this state of affairs (e.g. Root 1993, The World Bank 1995). Fafchamps and Moser (2003), for instance, show that police presence has no deterrent effect on crime in Madagascar. Based on a survey of legal institutions in the country, Ministere de la Justice (1999) documents many shortcomings in the implementation of existing laws. In particular, it is common for convicted criminals to be allowed out of jail in exchange for money. As a result, only petty criminals who cannot afford to pay remain in prison.

To further investigate this possibility, a question on jail effectiveness was asked to focus group respondents in a follow-up survey.[12] Respondents were asked whether, if a major cattle thief were found in the commune, he would be sent to prison and would stay there. Responses, summarized in Table

[11] It is not contended that service provision helps welfare. It is thus not really necessary for us to demonstrate that a link exists in our data as well. The reader may nevertheless like to know that when change in public provision is added to Table 8, results conform with expectations – adding a school raises school enrollment, adding agricultural input and output markets raises incomes, and adding a health center tends to raise health status and reduce infant mortality. The latter effect, however, is only significant at the 15 to 20% level.

[12] This survey covered a sample of 150 communes and was undertaken in November 2002.

13, show a sharp contrast between provinces. While the majority of respondents living in the Central highlands (Antananarivo and Fianarantsoa) believe that the thief would be sent to jail, respondents in other parts of the country – most notably Antsiranana – overwhelmingly believe the thief would either not be convicted or, if convicted, would not serve his sentence.

These findings suggest that a major effort is long overdue to restructure and discipline the police and especially the prison institutions in Madagascar. The main focus should be organized crime, particularly cattle rustling. The evidence presented here indeed suggests that the insecurity generated by crime, especially in remote rural areas, discourages economic activity and makes it difficult to provide essential public services such as health care and schooling.

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Table 1: Evolution of insecurity and welfare

		Evolution compared to five years ago			
Percentage of responses	**Level of insecurity in commune**	**Average income of inhab.**	**Health status of inhab.**	**School enrollment in commune**	**Infant mortality in commune**
Increased a lot	3%	10%	12%	14%	4%
Increased a bit	27%	40%	61%	55%	20%
Stayed the same	19%	15%	16%	14%	17%
Decreased a bit	39%	28%	7%	12%	46%
Decreased a lot	12%	7%	5%	4%	12%
Total	100%	100%	100%	100%	100%
No of valid observations	1379	1351	1349	1347	1294

Table 2: Crime and insecurity statistics

A. Perceptions of insecurity by communal focus groups

Percentage of responses	**Level of insecurity in the commune**
Very bad	9%
Bad	19%
Average	47%
Good	21%
Very good	4%
Total	100%
	Communes in 'red zone'
Yes=1	30%
	Stated first priority for development
1. Agriculture	27%
2. Roads	26%
3. Insecuity	15%
4. Health	14%
5. Education	10%
6. Water	6%
7. Environment	2%
Total	100%
No of valid observations	1379

B. Crime statistics

All figures reported in number of cases per year and per 100,000 inhabitants

	Mean	**Median**	**Std. dev.**
Number of stolen cattle	1496.0	62.0	5754
Number of stolen vehicles	0.2	0.0	2
Number of burglaries	42.8	7.9	97
Number of homicides	8.5	2.1	20
Number of rapes	2.9	0.0	10

C. Composition of focus groups

Average number of participants	8.6
Occupation:	
Communal employees	40%
Social/public service employees	21%
Village (fokontany) heads	6%
Farmers	14%
Others	19%

Table 3: Link subjective and objective insecurity measures
ordered probit regression

Crime	**Unit**	**Coefficient**	**z-value**
Comm. within "zone rouge"	yes=1	-1.001	**-10.60**
Number of stolen cattle annually	log(x+1)	-0.110	**-7.91**
Number of cars stolen annually	log(x+1)	0.001	0.00
Number of homicides annually	log(x+1)	-0.068	**-2.19**
Number of burglaries annually	log(x+1)	-0.089	**-4.51**
Number of rapes annually	log(x+1)	-0.035	-0.89
Composition of focus group			
size of the group	log(x)	0.022	0.17
number of communal employees	share	0.121	0.50
number of social/public employees	share	0.073	0.29
number of village leaders	share	0.279	0.71
number of farmers	share	0.065	0.21
Province dummies		Yes	
cutoff points			
1		-2.649	
2		-1.570	
3		0.053	
4		1.228	
Number of observations		1362	
Pseudo R2		0.15	

Dependent variable takes values from 1 (very bad) to 5 (very good)
Crime statistics: average of three preceding years

Table 4: Ordered probit regressions of welfare indicators on insecurity

	Changes in:							
	Average income		Health status		School enrollment		Child mortality	
Insecurity	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Increase in insecurity	-0.181	**-3.10**	-0.171	**-2.80**	-0.116	**-1.94**	0.085	1.41
Composition of focus group								
Size of the group (in log)	-0.183	**-1.84**	0.028	0.28	0.238	**2.38**	-0.248	**-2.46**
Share communal employees	0.210	0.93	0.080	0.34	0.039	0.17	0.328	1.39
Share social/public employees	0.270	1.05	1.180	**4.38**	0.619	**2.34**	0.254	0.94
Share village leaders	0.352	0.87	0.031	0.07	-0.705	**-1.71**	-0.454	-1.09
Share farmers	-0.099	-0.34	0.217	0.72	0.177	0.60	-0.219	-0.72
Cutoff points								
1	-1.804	-2.39	-1.399	-2.00	-1.151	-1.74	-1.502	-2.10
2	-0.686	-1.27	-0.918	-1.52	-0.396	-0.98	-0.106	-0.70
3	-0.303	-0.88	-0.308	-0.90	0.075	-0.51	0.381	-0.21
4	0.995	0.41	1.503	0.90	1.651	1.06	1.457	0.85
Number of observations	1343		1341		1339		1286	
Pseudo R2	0.0060		0.0117		0.0069		0.0063	

Each dependent variable takes values from 1 (worsened a lot) to 5 (improved a lot)
The insecurity variable takes values from 1 (improved a lot) to 5 (worsened a lot).

Table 5: Descriptive statistics for diseases and shocks

Climatic and agricultural shocks	**Mean**	**Std. Dev**
Cyclone	0.6	0.80
Flood	1.2	1.16
Broken bridge or cut road	1.2	1.29
Drought	1.0	1.17
Rice fleas	1.1	1.36
Phytosanitary diseases	1.7	1.42
Frost	0.4	0.85
Locusts	0.8	0.87
Late start of rains	1.4	1.16
Human diseases		
Malaria	2.8	0.78
Tuberculosis	1.7	1.39
Typhoid	1.0	1.31
Cholera	0.5	0.83
Plague	0.3	0.77
Livestock diseases		
Distomatosis	2.5	1.07
Maladie du charbon bacterien	1.3	1.41
Maladie du charbon symptomatique	1.9	1.33
Pig plague	1.6	1.28
Newcastle disease (chicken)	2.7	0.87
Other livestock epidemic	0.7	1.22
Number of valid observations	1378	

Each variable measures the number of years the commune was affected by a shock or disease in the three years preceding the survey.

Table 6: Ordered probit regressions with additional controls

	Changes in:							
	Average income		Health status		School enrollment		Child mortality	
Insecurity	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Increase in insecurity	-0.073	**-2.42**	-0.078	**-2.54**	-0.032	-1.01	0.042	1.37
Composition of focus group								
Size of the group (in log)	-0.053	-0.47	0.059	0.50	0.160	1.48	-0.070	-0.72
Share communal employees	-0.157	-0.59	-0.244	-0.92	-0.352	-1.35	0.378	1.46
Share social/public employees	-0.070	-0.24	0.888	**3.00**	0.438	1.52	0.429	1.47
Share village leaders	0.231	0.60	0.128	0.31	-0.524	-1.30	-0.395	-0.92
Share farmers	-0.033	-0.10	0.279	0.84	0.235	0.71	0.110	0.33
Gripe proxy from rainfall regression (*)	0.161	1.52	0.101	0.96	0.022	0.22	0.197	**1.83**
Gripe proxy from crime regression (**)	0.025	0.61	0.049	1.22	0.060	1.36	-0.021	-0.48
Climatic and agricultural shocks								
Cyclone	0.078	**1.81**	-0.017	-0.39	0.061	1.35	-0.056	-1.34
Flood	-0.052	**-1.72**	0.032	1.04	0.052	**1.74**	-0.026	-0.90
Broken bridge or cut road	-0.027	-1.06	-0.040	-1.50	-0.039	-1.51	-0.037	-1.43
Drought	-0.121	**-3.99**	-0.019	-0.61	-0.047	-1.54	0.013	0.46
Rice fleas	-0.061	**-2.30**	-0.059	**-2.14**	-0.033	-1.23	0.005	0.19
Plant diseases	0.046	**1.91**	0.040	1.62	0.009	0.39	-0.022	-0.87
Frost/hail	0.033	0.84	0.072	**1.93**	0.015	0.37	0.060	1.54
Locusts	-0.004	-0.10	-0.056	-1.35	-0.036	-0.89	-0.005	-0.13
Late start of rains	-0.158	**-3.82**	-0.094	**-2.39**	0.029	0.71	0.000	0.01
Human diseases								
Tuberculosis	0.023	0.89	-0.031	-1.14	-0.007	-0.25	0.002	0.07
Typhoid	0.004	0.15	0.007	0.23	0.005	0.19	0.026	0.85
Cholera	0.026	1.01	0.011	0.40	0.010	0.39	-0.008	-0.31
Plague	0.020	0.75	0.037	1.38	0.033	1.30	-0.020	-0.78
Livestock diseases								
Maladie du charbon bacterien	-0.018	-0.72	0.021	0.84	0.024	0.96	0.027	1.12
Maladie du charbon symptomatique	0.035	1.29	-0.051	**-1.83**	-0.044	-1.59	0.018	0.66
Pig plague	0.052	1.15	0.008	0.18	0.098	**2.34**	-0.035	-0.78
Other livestock epidemic	0.091	**2.43**	0.025	0.59	-0.016	-0.38	-0.053	-1.18
Province dummies	Yes		Yes		Yes		Yes	
cutoff points								
1	-2.283		-2.041		-1.873		-1.283	
2	-1.072		-1.547		-1.086		0.164	
3	-0.652		-0.901		-0.598		0.666	
4	0.705		0.971		1.028		1.753	
Number of observations	1311		1309		1307		1260	

Each dependent variable takes values from 1 (worsened a lot) to 5 (improved a lot)
The insecurity variable takes values from 1 (improved a lot) to 5 (worsened a lot).
(*) Residual from Table A1.
(**) Residual from OLS regression with same regressors as Table 3.

Table 7. Matching results

Average income	**#Treated**	**#Controls**	**Difference**	**S.E.**	**T-stat**
Unmatched	655	672	-0.220	0.062	**-3.50**
Matched -- Nearest neighbor (*)	646	665	-0.133	0.072	**-1.84**
Matched -- PS Radius (**)	646	664	-0.141	0.066	**-2.13**
Health status					
Unmatched	652	673	-0.167	0.051	**-3.26**
Matched -- Nearest neighbor (*)	643	666	-0.136	0.063	**-2.16**
Matched -- PS Radius (**)	643	665	-0.154	0.053	**-2.88**
School enrollment					
Unmatched	650	672	-0.113	0.056	**-2.03**
Matched -- Nearest neighbor (*)	642	665	-0.016	0.070	-0.23
Matched -- PS Radius (**)	642	663	-0.094	0.059	-1.59
Infant mortality					
Unmatched	620	652	0.049	0.060	0.08
Matched -- Nearest neighbor (*)	612	648	0.015	0.070	0.21
Matched -- PS Radius (**)	612	646	0.060	0.062	0.96

(*) Nearest neighbor matching using a Mahalanobis matrix on the complete X vector (nnmatch stata comman
(**) Propensity score matching using radius method, caliper=0.1 (attr stata command)

Table 8. IV regressions of welfare indicators on insecurity

	Changes in:							
	Average income		Health status		School enrollment		Child mortality	
Insecurity	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Increase in insecurity (instrumented)	**-2.478****	-2.548	**-1.282****	-2.083	-1.048	-1.551	**1.906****	2.154
Composition of focus group								
Size of the group (in log)	0.035	0.197	0.104	0.871	0.189	1.502	-0.157	-0.988
Share communal employees	0.069	0.186	0.072	0.282	-0.066	-0.248	0.124	0.363
Share social/public employees	-0.341	-0.793	**0.709****	2.421	0.389	1.261	0.634	1.606
Share village leaders	-0.440	-0.666	-0.134	-0.300	-0.780	-1.620	0.121	0.200
Share farmers	0.833	1.472	**0.755****	2.019	**0.684***	1.707	-0.574	-1.132
Gripe proxy from rainfall regression (*)	0.244	1.597	0.118	1.139	0.029	0.268	0.184	1.339
Gripe proxy from crime regression (**)	**-0.287***	-1.956	-0.117	-1.216	-0.090	-0.872	**0.246***	1.808
Climatic and agricultural shocks								
Cyclone	0.007	0.097	-0.060	-1.296	0.021	0.436	0.005	0.081
Flood	-0.027	-0.593	0.031	1.020	**0.063****	1.969	-0.048	-1.195
Broken bridge or cut road	-0.015	-0.404	-0.018	-0.690	-0.028	-1.041	**-0.059***	-1.716
Drought	-0.033	-0.589	0.035	0.961	-0.009	-0.231	-0.067	-1.266
Rice fleas	**-0.113*****	-2.691	**-0.076*****	-2.702	-0.044	-1.461	0.045	1.166
Plant diseases	0.053	1.544	0.027	1.152	0.010	0.398	-0.016	-0.513
Frost/hail	0.015	0.264	0.051	1.336	0.005	0.115	0.069	1.397
Locusts	-0.062	-0.976	-0.083*	-1.904	-0.052	-1.151	0.041	0.694
Late start of rains	**-0.223*****	-3.512	**-0.102****	-2.401	0.005	0.104	0.042	0.724
Human diseases								
Tuberculosis	0.019	0.493	0.024	0.933	0.032	1.144	-0.012	-0.347
Typhoid	0.023	0.615	**-0.057****	-2.188	-0.042	-1.564	0.030	0.893
Cholera	0.023	0.349	0.000	0.009	**0.085***	1.829	0.005	0.092
Plague	0.052	0.840	0.004	0.086	-0.015	-0.340	-0.015	-0.272
Livestock diseases								
Maladie du charbon bacterien	0.002	0.061	-0.033	-1.288	-0.019	-0.735	0.006	0.190
Maladie du charbon symptomatique	0.062	1.324	0.041	1.334	0.032	0.978	-0.017	-0.390
Pig plague	0.062	1.550	0.027	0.999	0.021	0.754	-0.033	-0.939
Other livestock epidemic	-0.006	-0.150	0.020	0.757	0.024	0.881	-0.003	-0.088
Province dummies	Yes		Yes		Yes		Yes	
Intercept	4.238***	7.995	3.909***	10.951	3.713***	9.871	2.419***	5.109
	Ch-sq(1)	p-value	Ch-sq(1)	p-value	Ch-sq(1)	p-value	Ch-sq(1)	p-value
Overidentification test	0.161	0.688	0.064	0.800	0.127	0.721	0.002	0.967
	test value	95% crit.	test value	95% crit.	test value	95% crit.	test value	95% crit.
Anderson-Rubin test	13.9213	5.992	6.1229	5.992	3.1942	5.992	8.1227	5.992

Significance levels as follows: .01 - ***; .05 - **; .1 - *;

(*) Residual from Table A1.

(**) Residual from OLS regression with same regressors as Table 3.

Table 9: Stated reasons by focus groups for evolution in welfare

Percentage of responses	Evolution compared to five years ago							
	Average income of inhabitants		Health status of inhabitants		School enrollment in commune		Infant mortality in commune	
	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase
Climatic or environmental shock	10%	1%	1%	0%	1%	0%	0%	0%
Improvement/degradation security	8%	8%	1%	1%	3%	1%	1%	1%
End/start of project from govt ou NGO	1%	6%	1%	3%	1%	2%	5%	3%
Loss of jobs/beneficiary from industrialization	1%	2%	0%	0%	0%	0%	0%	0%
Change in access in transport	3%	2%	0%	0%	0%	0%	0%	0%
Change in ag. income due to change in prices	61%	53%	10%	1%	8%	2%	1%	3%
Change in non-farm income	4%	10%	0%	0%	0%	0%	0%	0%
Change in wage labor	2%	3%	1%	0%	0%	0%	0%	0%
Closing/opening of schools	0%	0%	1%	0%	42%	61%	1%	1%
Closing/opening of health centers	0%	0%	48%	67%	1%	1%	46%	57%
Change in school costs	0%	0%	0%	1%	17%	15%	2%	0%
Change in health costs	1%	0%	17%	14%	0%	0%	22%	16%
Others	10%	13%	19%	13%	27%	16%	22%	19%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Number of observations	479	674	156	979	226	931	762	311

Table 10: Infrastructure, services and projects

Percentage of communes with:	**In 1996**	**In 2001**
Secondary school	46%	53%
Basic health center	65%	94%
Drinking water (government and non-governmental)	25%	39%
Seller of agricultural inputs	10%	17%
Agricultural market	32%	37%

New development projects since 1996:	**Mean**	**Median**
Average number per commune	2.23	2
% of communes where there were none	19%	
Number of observations	1383	

Table 11: Probit regressions with selection correction

	Construction of school		Construction of health center		Provision of drinking water		New market for agricultural output		New supplier of agricultural inputs	
Change in 1996-2001 period	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Increase in insecurity	-0.110	**-2.12**	-0.108	**-2.15**	-0.013	-0.32	0.017	0.27	0.018	0.35
Composition of focus group										
Size of the group (in log)	0.132	0.96	-0.131	-0.76	0.100	0.59	0.206	1.05	-0.308	**-1.86**
Share communal employees	0.275	0.58	-0.433	-0.92	0.284	0.81	-0.037	-0.08	-0.441	-1.01
Share social/public employees	0.740	1.55	2.043	**3.03**	0.516	1.32	-0.437	-0.80	0.425	0.87
Share village leaders	0.643	0.87	-0.402	-0.48	-0.164	-0.28	-0.886	-0.81	-0.008	-0.01
Share farmers	-0.876	-1.42	-1.525	**-2.73**	-0.321	-0.73	0.190	0.40	-0.955	**-1.68**
Gripe proxy from rainfall regression (*)	0.081	0.63	0.129	0.79	0.031	0.30	0.117	0.86	-0.020	-0.16
Gripe proxy from crime regression (**)	-0.045	-0.60	-0.117	-1.28	0.050	0.84	-0.006	-0.08	0.042	0.63
Intercept	-1.702	**-3.29**	2.306	**3.93**	-1.423	**-2.80**	-2.047	**-3.44**	-0.678	-1.26
Selection equation: no service in 1996										
Longitude	0.033	0.65	-0.079	-1.56	-0.093	-1.54	0.155	**2.80**	-0.063	-0.56
Latitude	-0.159	**-3.16**	-0.068	-1.31	-0.026	-0.40	0.067	1.24	0.015	0.18
Mean elevation	0.000	0.34	0.000	0.12	0.000	0.20	0.000	0.58	-0.001	-0.42
Mean elevation squared	0.000	0.90	0.000	0.22	0.000	0.25	0.000	-1.37	0.000	-1.49
Mean rainfall	0.000	0.27	-0.001	-2.28	0.000	0.66	-0.001	-1.02	0.000	0.07
Mean rainfall squared	0.000	-0.35	0.000	1.96	0.000	-0.37	0.000	0.95	0.000	0.25
Mean temperature	0.060	0.91	0.047	0.73	-0.126	**-1.72**	-0.126	**-1.77**	-0.182	**-1.89**
Mean temperature squared	0.000	-0.63	0.000	-0.72	0.000	**2.06**	0.000	1.71	0.000	1.45
Soil type 2	0.000	-0.13	-0.003	-1.18	0.008	**3.28**	0.002	0.99	0.000	0.03
Soil type 3	-0.001	-0.20	-0.006	-1.41	0.005	1.27	0.002	0.41	-0.008	-1.53
Soil type 4	0.002	0.77	-0.001	-0.57	0.007	**2.73**	0.007	**2.86**	0.010	**2.21**
Soil type 5	0.008	**2.82**	0.005	1.93	0.008	**2.56**	0.002	0.78	0.015	**2.40**
Soil type 6	0.006	**2.21**	0.000	-0.10	0.009	**2.89**	0.005	1.68	0.001	0.18
Soil type 7	-0.001	-0.41	-0.002	-0.84	0.005	**2.05**	-0.002	-0.64	-0.004	-1.10
Log of population density	-0.257	**-5.98**	0.047	1.21	-0.222	**-4.84**	-0.245	**-5.78**	-0.293	**-5.23**
Log of travel time to nearest town	0.058	1.42	-0.079	**-1.95**	0.227	**4.54**	0.074	1.61	0.150	**2.03**
Forest ethnic groups	0.004	1.61	-0.006	**-2.67**	0.000	0.14	0.001	0.50	0.013	**1.97**
Livestock raising ethnic groups	-0.001	-0.39	-0.002	-1.33	0.000	0.11	-0.001	-0.27	0.001	0.16
Western ethnic groups	-0.003	-0.92	-0.007	**-2.33**	-0.006	**-1.69**	0.004	1.25	0.006	1.11
Eastern ethnic groups	0.002	0.72	0.002	0.99	0.002	0.69	0.004	**1.80**	0.006	1.70
Size of the group (in log)	-0.242	-1.63	-0.022	-0.15	0.487	**2.80**	0.274	1.73	-0.350	**-1.89**
Share communal employees	-0.392	-1.28	-0.197	-0.66	0.413	1.25	0.525	**1.68**	-0.357	-0.75
Share social/public employees	-1.402	**-4.16**	-0.261	-0.76	-0.022	-0.06	-0.220	-0.62	-1.537	**-2.91**
Share village leaders	1.531	**2.85**	-0.094	-0.18	1.035	**1.71**	2.614	**4.43**	1.620	**2.06**
Share farmers	0.039	0.10	0.299	0.79	1.373	**3.08**	0.554	1.42	0.519	0.76
Gripe proxy from rainfall regression (*)	0.112	1.27	0.194	2.11	0.101	0.97	-0.154	**-1.68**	-0.252	**-1.93**
Gripe proxy from crime regression (**)	0.029	0.61	-0.024	-0.51	0.019	0.33	0.007	0.15	-0.078	-1.14
Province dummies	Included but not shown									
Intercept	-0.545	-0.08	0.712	0.11	11.207	1.46	8.131	1.06	26.279	**2.58**
Number of uncensored observations	701		459		990		890		1171	

(*) Residual from Table A1.

(**) Residual from OLS regression with same regressors as Table 3.

Table 12: Development projects started up over the last five years

Change in 1996-2001 period	**Coef.**	**z-stat.**
Increase in insecurity	-0.071	**-4.33**
Composition of focus group		
Size of the group (in log)	0.279	**4.97**
Share communal employees	-0.090	-0.73
Share social/public employees	-0.028	-0.20
Share village leaders	-1.034	**-4.50**
Share farmers	-0.237	-1.45
Gripe proxy from rainfall regression (*)	-0.049	-1.13
Gripe proxy from crime regression (**)	-0.019	-0.81
Intercept	0.731	**4.20**
Number of observations	1360	

Dependent variable is log(number of new development projects+1)

(*) Residual from Table A1.

(**) Residual from OLS regression with same regressors as Table 3.

Table 13: Confidence in the justice system

Answer to hypothetical question:
"Suppose that a famous cattle thief is caught, will he be sent to prison and will he stay there?"

	Very sure	Sure	Maybe	Probably not	Total
Antananarivo	46%	42%	12%	0%	100%
Fianarantsoa	17%	37%	17%	29%	100%
Toamasina	37%	19%	11%	33%	100%
Mahajanga	21%	8%	54%	17%	100%
Toliara	8%	25%	50%	17%	100%
Antsiranana	0%	12%	21%	67%	100%
Madagascar	22%	24%	27%	27%	100%
Number of valid observations	32	35	40	41	148

Table A1. Regression of own perception of rainfall

	Coeff.	t-value
Average perception of rainfall in contiguous communes	0.739913	**20.87**
Intercept	0.155252	**6.57**
Number of observations	1383	
R-squared	0.240	

Table A2: Propensity score regression

Composition of focus group	**Coefficient**	**t-value**
Size of the group (in log)	0.144	1.019
Share communal employees	0.241	0.809
Share social/public employees	-0.440	-1.290
Share village leaders	-0.827	-1.623
Share farmers	**0.941****	2.493
Gripe proxy from rainfall regression (*)	0.041	0.321
Gripe proxy from crime regression (**)	**-0.391*****	-8.234
Climatic and agricultural shocks		
Cyclone	-0.088*	-1.755
Flood	0.040	1.126
Broken bridge or cut road	0.024	0.767
Dought	**0.095*****	2.707
Rice fleas	-0.046	-1.500
Phytosanitary diseases	0.001	0.040
Frost/hail	-0.031	-0.676
Locusts	-0.057	-1.152
Late start of rains	-0.073	-1.509
Human diseases		
Tuberculosis	**0.049***	1.733
Typhoid	-0.017	-0.550
Cholera	-0.050	-0.963
Plague	-0.044	-0.857
Livestock diseases		
Maladie du charbon bacterien	-0.006	-0.194
Maladie du charbon symptomatique	0.055	1.605
Pig plague	0.042	1.358
Other livestock epidemic	-0.024	-0.778
Province dummies	Yes	
Intercept	-0.862**	-2.069
Number of observations	1352	

Significance levels as follows: .01 - ***; .05 - **; .1 - *;

(*) Residual from Table A1.

(**) Residual from OLS regression with same regressors as Table 3.

Table A3: Instrumenting regression for increase in insecurity

Share of pop. 10-14 - share of pop. 15-19 (1993)	**Coefficient**	**t-value**
In commune	-4.793**	-1.972
In neighboring communes	-6.808*	-1.746
Composition of focus group		
Size of the group (in log)	0.064	1.228
Share communal employees	0.094	0.882
Share social/public employees	-0.133	-1.101
Share village leaders	-0.299*	-1.707
Share farmers	0.326**	2.498
Gripe proxy from rainfall regression (*)	0.015	0.338
Gripe proxy from crime regression (**)	-0.141***	-8.291
Climatic and agricultural shocks		
Cyclone	-0.033*	-1.764
Flood	0.014	1.047
Broken bridge or cut road	0.008	0.748
Dought	0.037***	2.773
Rice fleas	-0.020*	-1.762
Phytosanitary diseases	0.005	0.439
Frost/hail	-0.004	-0.260
Locusts	-0.022	-1.265
Late start of rains	-0.030*	-1.662
Human diseases		
Tuberculosis	0.015	1.466
Typhoid	-0.009	-0.778
Cholera	-0.018	-0.992
Plague	-0.008	-0.504
Livestock diseases		
Maladie du charbon bacterien	-0.002	-0.193
Maladie du charbon symptomatique	0.017	1.375
Pig plague	0.017	1.532
Other livestock epidemic	-0.008	-0.752
Province dummies	Yes	
Intercept	0.286*	1.814
Number of observations	1335	
R-squared	0.1335	

Test that instruments are jointly significant	F(2, 1305)	p-value
	5.98	0.0026

Significance levels as follows: .01 - ***; .05 - **; .1 - *;

(*) Residual from Table A1.

(**) Residual from OLS regression with same regressors as Table 3.