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Insecurity and Welfare *

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Abstract

Using original survey data, we examine how insecurity affects welfare. Correcting for unobserved heterogeneity and possible endogeneity, we find a strong effect on incomes, school enrollment and health status, but no effect on infant mortality. The effect of insecurity is robust to the inclusion of various shocks potentially affecting both welfare and insecurity. We further find a significant effect of insecurity on the provision of certain public services, notably schooling and health care, and in the placement of development projects. Taken together, the evidence suggest that insecurity is an important determinant of welfare in the country studied.

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1 Introduction

It is increasingly recognized that insecurity affects welfare (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 insecurity on incomes and public services. We test whether insecurity reduces various welfare indicators. Attempt to test the effect of insecurity are typically hindered by the need to control for unobserved heterogeneity. We overcome this difficulty by using what amounts to 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 and collected at the same time using the same questionnaire. The risk of selection bias is minimized by the fact that the data we use covers the whole country. The problem of controlling for possible spillover of insecurity and crime across the border does not arise because the country studied is an island.

Results show that an increase in insecurity generates a significant – and often dramatic – reduction in incomes and in access to health centers and schools. The effect is robust to endogeneity correction and the inclusion of different controls. Once we control for possible endogeneity, the magnitude of the effect is shown to be rather large. Insecurity as perceived by survey respondents is significantly related to the prevalence of crime which, in the studied country, has been shown to increase with isolation (Fafchamps and Moser 2003) and with poverty (Fafchamps and Minten 2004).

We also investigate possible channels through which insecurity may affect welfare. We find that a rise in insecurity in a given location reduces the chance that a new school or health center be built there. Furthermore, we provide evidence that insecurity reduces the likelihood of attracting a development project. Results also indicate that certain types of economic activities such as mining are less sensitive to changes in insecurity than others – most notably large manufacturing firms.

These effects 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 can have large welfare effects through economic activity and the provision of public services.

Since Becker (1968)'s initial forray, 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). Pradhan and Ravallion (1999) 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 perdure. The relationship between crime and conflicts is examined by Collier and Hoeffler (2004) who provide evidence that conflicts fuel crime but not the reverse.

In contrast to the existing literature, this paper empirically tests the welfare effects of insecurity and investigates the channels through which these effects 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 effect of insecurity on 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. In doing so, we must be careful to allow for the possibility of reverse causation, i.e., that ΔW_{it} may also affect ΔS_{it}. To this effect, we must instrument ΔS_{it} with variables that are correlated with changes in welfare only through their effect on insecurity.

We also wish to investigate how insecurity affects welfare. To do so, we examine whether insecurity influences 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 a change in insecurity hinders the 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, diffentiating 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 comprensive survey data on Madagascar. Madagascar constitutes a perfect test case for an investigation of insecurity and welfare. Since the country is an island, there is no need to control for possible spillover effects of insecurity and crime across the border. This simplifies the analysis considerably. Madagascar 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).

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

[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.

equivalent to a 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]

The commune 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). 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 commune survey gathered 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 prominent residents of the commune. The survey was conducted at the commune's administrative center. A total of 1385 communes were surveyed, all but 9 currently functioning communes.[3]

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. While a majority of respondents felt that health status and school enrollment have improved, infant mortality has not.

[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.

[3] Nine communes in question were missed in the survey, either because they are too isolated or too insecure or both. The number of missing communes is nevertheless sufficiently small to assuage fears of selection bias.

Many of the nefarious effects of insecurity depend on perceived risk and thus on perceptions of insecurity. 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 first or second development priority in communes representing 43% of the country's area.

To ascertain the validity of the subjective assessment of the security situation by survey respondents, we regress this ranking on crime statistics. These statistics, shown in the bottom of Table 2, 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.

Table 3 reports an ordered probit regression of the subjective insecurity ranking on the five crime rate variables and the red zone dummy. Results demonstrate that insecurity as perceived by focus group respondents largely reflects actual crime: the red zone dummy and four of the five crime variables are significant – often at the 1% level. Car theft is not significant, most probably because it is very rare. From this 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.

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. They 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 – which did not improve much or even worsened in many of the communes – remained unaffected. These results suggest that insecurity has a significant negative effect on several dimensions of welfare. The question

that immediately follows is through what channel(s) does insecurity affect welfare.

Before we turn to this question, 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 minimize such omitted variable bias, we include as additional regressors a number of variables capturing a wide variety of shocks .

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 such as malaria are endemic in most of the country while others such as plague are less frequent.

Table 6 presents ordered probit regressions of changes in welfare indicators on changes in insecurity and on the various shock and disease variables listed in Table 5. Results indicate that the significance of the insecurity variable is not due to the omitted effect of any of the additional controls: coefficients remain negative and significant in the same three regressions, although the magnitude of the coefficients falls a little bit.

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. Locust attacks and typhoid are associated with a fall in health status and school enrollment. Higher incidence of malaria than average is associated with higher infant mortality; this result is not surprising given that malaria is a leading cause of death among children. Other results are more puzzling, such as the positive association between Newcastle disease (a chicken disease) and improvement in three of our welfare indicators. In this case, it

is possible that higher prosperity leads households to buy, sell, and keep more chicken, thereby creating conditions favorable to epidemics. The positive association between income and plant diseases may be due to the fact that plant diseases are more common in humid years when yields are high.

We also wish to verify that the significance of the insecurity variable is not due to endogeneity bias. It is indeed conceivable that changes in insecurity are due to changes in welfare; indeed Fafchamps and Minten (2004) for instance find a positive relationship between poverty and crop and cattle theft in Madagascar. To correct for possible endogeneity, we need instrumental variables that help predict changes in insecurity in ways that do not depend on changes in welfare occuring during the same period. As often mentioned in the literature, it is difficult to find contemporaneous variables that could not be, in one way or another, involved in a reverse causality from welfare to crime and insecurity. In particular, we cannot use crime statistics as instruments since reverse causation may affect them as well. To overcome this difficulty, we use predetermined variables in levels to predict the growth rate of insecurity. The justification for doing so is that the chosen variables are likely to have lasting effects on crime.

The instrumenting regression is shown in Table 7. Two instruments are used. The first one is the proportion of young males in the population, as measured by the 1993 population census. The presence of young males coming of age during the period covered by our analysis may have an worsening effect on crime and insecurity, as crime (especially violent crime) is often correlated with testoterone levels. It is also possible, however, that the presence of young men in the village improves the security situation. Indeed, in Madagascar insecurity is often linked with gangs that attack villages to steal cattle. A large proportion of young males makes communities less vulnerable to such attacks and might serve as a deterrent for thieves. The second instrument is a dummy variable that takes value 1 if French settlers were present in the commune during colonial times. This variable is used to capture a colonial legacy that may have lasting deleterious effects on the social fabric and thereby on crime. Although these instruments may not explain much of the variation in insecurity, they are clearly pre-determined and are thus quite unlikely to be subject to reverse causation.

Regression results for the instrumenting equation shown in Table 7 show that both instruments are significant. A joint F-test strongly rejects the null hypothesis that instruments are jointly non-significant.

A higher proportion of young males is associated with a smaller increase in insecurity, a result that is consistent with our second interpretation. The R^2 of the instrumenting regression is 0.05 – sufficiently low to ease any fear of overfitting but, as we will see, sufficient to deliver strong results. We also find little relationship between changes in insecurity and the shock variables, also easing fears that the relationship between changes in insecurity and welfare are driven by the effect of shocks on both.

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.[5] To deal with instrumentation in limited dependent variable estimation we use the method developed by Smith and Blundell (1986) and by Rivers and Vuong (1988), i.e., we include the residuals from the instrumenting equation in the ordered probit regression. Results continue to show a strong negative relationship between insecurity and welfare although, in all three cases where insecurity is significant, we can reject the null hypothesis that insecurity is exogenous. The endogeneity correction is thus appropriate. Because the magnitude of the insecurity coefficient increases dramatically after the endogeneity correction, it is likely that in this case endogeneity is at least in part due to measurement error. 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).

5 Possible channels

Having documented a strong and 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.[6] Insecurity is

[5] The overidentification test is implemented by regressing the residuals from a *linear* instrumental variable estimation of the main regression on all exogenous variables and all instruments. To our knowledge, there does not exist an overidentification test for the ordered probit case.

[6] Unfortunately, we do not have longitudinal information on agricultural prices at the commune level and cannot therefore

listed as the main reason for change in income by 8% of the communes. This is a fairly remarkable result 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 potable water. The increase in agricultural input and output markets was less pronounced.

Based on the information presented in the first part 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,

test whether communes that became more insecure experienced a fall in agricultural prices.

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.

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 potable water and agricultural markets appear not to be affected. The conclusion we 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 strong 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 shows 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.[7] We also find that 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. Correcting for unobserved heterogeneity and possible endogeneity, we find a strong effect of insecurity on incomes, school enrollment and health status, but no effect on infant mortality. The effect of insecurity is robust to the inclusion of various shocks potentially affecting both welfare and insecurity.

We then turn to the channels through which insecurity may affect welfare. We find a significant effect of insecurity on the provision of certain public services, notably schooling and health care, and in the placement of development projects. We also find some evidence that insecurity reduces employment in large manufacturing firms – but not in mining – and that it discourages farmers from expanding cultivated acreage.

[7] 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.

Taken together, the evidence suggest that insecurity is an important determinant of welfare in the country studied. Insecurity affects 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 fail effectiveness was asked to focus group respondents in a follow-up survey.[8] 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 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.

What these findings suggest is 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 insecurity that crime generates, especially in remote rural areas, discourages economic activity and even more importantly makes it difficult to provide essential public services such as health care and schooling.

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

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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**
Improved a lot	3%	10%	12%	14%	4%
Improved a bit	27%	40%	61%	55%	20%
Stayed the same	19%	15%	16%	14%	17%
Worsened a bit	39%	28%	7%	12%	46%
Worsened 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

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

Regressors	**Unit**	**Coefficient**	**z-value**
Comm. within "zone rouge"	1=yes	-0.970	-10.48
Number of stolen cattle annually	log(x+1)	-0.104	-8.24
Number of cars stolen annually	log(x+1)	0.016	0.13
Number of homicides annually	log(x+1)	-0.058	-1.90
Number of burglaries annually	log(x+1)	-0.115	-6.00
Number of rapes annually	log(x+1)	-0.080	-2.16
cutoff points			
1		-2.743	
2		-1.680	
3		-0.074	
4		1.087	
Number of observations		1364	
Wald chi2(5)		332.53	
Prob > chi2		0	
Pseudo R2		0.1437	

Dependent variable takes values from 1 (very bad) to 5 (very good)

Table 4: Univariate ordered probit regressions

	Changes in:					
	Average income		**Health status**		**School enrollment**	
Variable	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Change in insecurity	-0.079	**-2.91**	-0.102	**-3.54**	-0.076	**-2.72**
cutoff points						
1	-1.692		-1.954		-1.928	
2	-0.587		-1.476		-1.173	
3	-0.207		-0.874		-0.705	
4	1.091		0.915		0.857	
Number of observations	1345		1343		1341	
Wald chi2(1)	8.49		12.54		7.37	
Prob > chi2	0.0036		0.0004		0.0066	
Pseudo R2	0.0023		0.0043		0.0023	

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

To facilitate interpretation, the level of insecurity variable takes values from 1 (improved a lot) to 5 (worsened a lot).

Table 5: Diseases and shocks

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

	Mean	Std. Dev
Climatic and agricultural shocks		
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	

Table 6: Ordered probit regressions with controls

	Changes in:							
	Average income		Health status		School enrollment		Child mortality	
Regressors	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Change in insecurity	-0.060	**-2.12**	-0.081	**-2.77**	-0.055	**-1.90**	0.039	1.39
Climatic and agricultural shocks								
Cyclone	0.071	1.69	-0.019	-0.44	0.065	1.47	-0.054	-1.31
Flood	-0.089	**-3.07**	0.028	0.96	0.061	**2.14**	-0.025	-0.89
Broken bridge or cut road	-0.013	-0.55	-0.034	-1.37	-0.047	**-1.88**	-0.058	**-2.40**
Dought	-0.137	**-4.60**	-0.036	-1.19	-0.044	-1.53	0.000	0.00
Rice fleas	-0.040	-1.58	-0.053	**-2.01**	-0.041	-1.60	-0.004	-0.16
Phytosanitary diseases	0.047	**2.03**	0.044	**1.82**	0.005	0.23	-0.004	-0.19
Frost	0.017	0.46	0.070	**1.91**	0.035	0.93	0.053	1.45
Locusts	0.037	0.97	-0.055	-1.42	-0.076	**-2.02**	-0.006	-0.17
Late start of rains	-0.121	**-4.30**	-0.049	-1.72	0.038	1.32	0.040	1.45
Human diseases								
Malaria	-0.004	-0.12	-0.033	-0.78	-0.095	**-2.27**	-0.095	**-2.29**
Tuberculosis	-0.025	-1.03	0.006	0.26	0.026	1.10	0.036	1.52
Typhoid	0.040	1.51	-0.070	**-2.56**	-0.066	**-2.49**	0.013	0.50
Cholera	0.063	1.54	-0.004	-0.09	0.081	**2.12**	-0.089	**-2.31**
Plague	0.086	**2.45**	0.027	0.68	0.012	0.31	-0.014	-0.34
Livestock diseases								
Distomatosis	-0.056	**-1.91**	-0.003	-0.09	0.004	0.12	0.007	0.23
Maladie du charbon bacterien	0.046	**1.85**	-0.031	-1.18	-0.015	-0.58	-0.003	-0.12
Maladie du charbon symptomatique	0.006	0.20	0.002	0.05	0.003	0.10	-0.013	-0.45
Pig plague	0.012	0.47	-0.004	-0.17	0.006	0.24	0.005	0.18
Newcastle disease (chicken)	0.066	**2.05**	0.036	0.96	0.075	**2.14**	0.077	**2.08**
Other livestock epidemic	0.012	0.47	0.032	1.18	0.036	1.40	-0.017	-0.67
cutoff points								
1	-1.864		-2.141		-1.942		-1.186	
2	-0.682		-1.649		-1.164		0.216	
3	-0.276		-1.025		-0.687		0.702	
4	1.069		0.805		0.913		1.788	
Number of observations	1328		1326		1324		1273	
Wald chi2(1)	139.7		66.11		68.96		35.93	
Prob > chi2	0.0000		0.0000		0.0000		0.0222	
Pseudo R2	0.0341		0.0205		0.0198		0.0097	

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

To facilitate interpretation, the level of insecurity variable takes values from 1 (improved a lot) to 5 (worsened a lot).

Table 7: Instrumenting regression of "change in insecurity" variable

Regressors	**Coefficient**	**t-value**
% of male pop. age 6-14 (1993)	-0.162	**-4.63**
French presence in colonial times (yes=1)	-0.114	**-1.87**
Climatic and agricultural shocks		
Cyclone	-0.052	-1.28
Flood	-0.009	-0.31
Broken bridge or cut road	0.022	0.86
Dought	0.016	0.57
Rice fleas	0.028	1.12
Phytosanitary diseases	0.011	0.50
Frost	-0.077	**-1.97**
Locusts	-0.032	-0.83
Late start of rains	-0.018	-0.64
Human diseases		
Malaria	0.061	1.60
Tuberculosis	0.019	0.82
Typhoid	-0.009	-0.35
Cholera	0.017	0.43
Plague	-0.037	-1.01
Livestock diseases		
Distomatosis	0.072	**2.54**
Maladie du charbon bacterien	-0.006	-0.25
Maladie du charbon symptomatique	0.006	0.25
Pig plague	0.018	0.72
Newcastle disease (chicken)	-0.011	-0.31
Other livestock epidemic	-0.025	-0.98
Intercept	4.337	**9.86**
Number of observations	1338	
F(22, 1315)	3.470	
Prob > F	0.000	
R-squared	0.0514	
Root MSE	1.0706	

	F(2, N)	**Prob>F**
Test that instruments are jointly significant	12.58	0.00

Dependent variable takes values from 1 (worsened a lot) to 5 (improved a lot)

Table 8: Instrumented regressions

	Changes in:							
	Average income		Health status		School enrollment		Child mortality	
Regressors	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**	**Coef.**	**z-stat.**
Change in insecurity	-0.411	**-2.08**	-0.633	**-3.06**	-0.617	**-3.12**	0.077	0.40
Residual from instrumenting regr.	0.360	**1.80**	0.561	**2.69**	0.573	**2.87**	-0.040	-0.20
Climatic and agricultural shocks								
Cyclone	0.058	1.36	-0.058	-1.30	0.041	0.93	-0.046	-1.07
Flood	-0.094	**-3.26**	0.014	0.48	0.059	**2.01**	-0.022	-0.75
Broken bridge or cut road	-0.006	-0.26	-0.018	-0.69	-0.034	-1.32	-0.063	**-2.42**
Dought	-0.129	**-4.47**	-0.028	-0.94	-0.034	-1.16	-0.006	-0.19
Rice fleas	-0.029	-1.14	-0.030	-1.10	-0.022	-0.85	0.000	-0.01
Phytosanitary diseases	0.050	**2.18**	0.045	1.88	0.010	0.44	-0.005	-0.21
Frost	-0.007	-0.18	0.026	0.62	-0.012	-0.29	0.056	1.42
Locusts	0.024	0.64	-0.074	**-1.87**	-0.101	**-2.63**	-0.011	-0.27
Late start of rains	-0.128	**-4.48**	-0.060	**-2.00**	0.023	0.80	0.047	1.58
Human diseases								
Malaria	0.022	0.51	0.006	0.12	-0.056	-1.28	-0.097	**-2.22**
Tuberculosis	-0.014	-0.61	0.018	0.74	0.041	**1.71**	0.033	1.35
Typhoid	0.038	1.52	-0.071	**-2.73**	-0.071	**-2.76**	0.011	0.42
Cholera	0.073	**1.89**	0.008	0.20	0.091	**2.34**	-0.089	**-2.28**
Plague	0.053	1.24	-0.014	-0.32	-0.035	-0.81	-0.012	-0.27
Livestock diseases								
Distomatosis	-0.030	-0.92	0.037	1.09	0.041	1.22	0.003	0.08
Maladie du charbon bacterien	0.042	1.69	-0.029	-1.10	-0.013	-0.52	0.000	0.00
Maladie du charbon symptomatique	0.013	0.46	0.003	0.11	0.014	0.49	-0.011	-0.38
Pig plague	0.009	0.36	-0.003	-0.13	0.000	0.00	0.003	0.13
Newcastle disease (chicken)	0.064	**1.82**	0.028	0.77	0.070	**1.94**	0.072	**1.94**
Other livestock epidemic	0.001	0.03	0.013	0.48	0.019	0.72	-0.018	-0.67
cutoff points								
1	-2.69357		-3.4705		-3.2981		-1.10095	
2	-1.51212		-2.9861		-2.51238		0.295839	
3	-1.10503		-2.35676		-2.03143		0.779013	
4	0.240565		-0.5221		-0.41993		1.868177	
Number of observations	1306		1305		1302		1251	
Wald chi2(1)	127.92		70.68		79.24		32.56	
Prob > chi2	0.0000		0.0000		0.0000		0.0683	
Pseudo R2	0.0345		0.0230		0.0238		0.0095	
Overidentification tests								
	Test-stat	p-value	Test-stat	p-value	Test-stat	p-value	Test-stat	p-value
Wald chi2	0.302	0.582	1.681	0.195	0.407	0.523	0.040	0.841

Each dependent variable takes values from 1 (worsened a lot) to 5 (improved a lot)
To facilitate interpretation, the level of insecurity variable takes values from 1 (improved a lot) to 5 (worsened a lot).

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%
Potable 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: Heckman probit regressions

	Construction of school		Construction of health center		Provision of potable 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.**
Level of insecurity	-0.088	**-1.70**	-0.113	**-1.85**	-0.031	-0.83	0.055	0.95	-0.016	-0.33
Intercept	-1.259	-9.00	1.526	1.70	-0.974	-8.81	-1.807	-10.57	-1.464	-10.28
Selection equation: no service in 1996										
Longitude	0.036	0.74	-0.108	**-1.88**	-0.095	-1.61	0.143	**2.67**	-0.025	-0.23
Latitude	-0.108	**-2.19**	-0.066	-1.23	-0.015	-0.25	0.089	**1.72**	0.080	0.97
Mean elevation	0.000	-0.11	0.000	0.09	0.000	-0.41	0.000	-0.08	-0.001	-0.54
Mean elevation squared	0.000	0.99	0.000	0.00	0.000	0.96	0.000	-0.91	0.000	-1.16
Mean rainfall	0.000	0.11	-0.001	-1.42	0.001	1.09	-0.001	-1.02	0.000	-0.18
Mean rainfall squared	0.000	-0.36	0.000	1.25	0.000	-0.79	0.000	0.83	0.000	0.34
Mean temperature	0.062	0.99	0.034	0.46	-0.084	-1.19	-0.091	-1.31	-0.140	-1.50
Mean temperature squared	0.000	-0.79	0.000	-0.43	0.000	1.46	0.000	1.15	0.000	1.10
Soil type 2	0.001	0.66	-0.001	-0.60	0.009	**3.48**	0.002	1.05	0.001	0.31
Soil type 3	0.001	0.26	-0.006	-1.44	0.005	1.38	0.001	0.34	-0.008	-1.55
Soil type 4	0.003	1.21	-0.001	-0.41	0.008	**3.16**	0.007	**2.95**	0.010	**2.20**
Soil type 5	0.009	**2.95**	0.005	**1.96**	0.009	**2.79**	0.002	0.82	0.014	**2.40**
Soil type 6	0.006	**2.42**	0.001	0.35	0.009	**2.92**	0.004	1.51	0.000	-0.08
Soil type 7	0.000	0.02	-0.002	-0.85	0.006	**2.31**	-0.001	-0.51	-0.004	-1.19
Log of population density	-0.257	**-5.98**	0.075	1.29	-0.222	**-5.14**	-0.236	**-5.64**	-0.301	**-5.58**
Log of travel time to nearest town	0.075	**1.87**	-0.055	-1.09	0.230	**4.59**	0.107	**2.38**	0.154	**2.09**
Forest ethnic groups	0.005	**2.10**	-0.006	**-2.43**	0.002	0.82	0.000	-0.11	0.010	1.61
Livestock raising ethnic groups	0.002	0.82	-0.003	-1.40	0.002	0.77	-0.003	-1.36	0.002	0.50
Western ethnic groups	0.001	0.23	-0.006	-1.48	-0.001	-0.33	0.003	0.91	0.008	1.59
Eastern ethnic groups	0.005	**2.35**	0.001	0.64	0.005	**1.97**	0.003	1.45	0.009	**2.53**
Province 2	-0.380	**-2.19**	0.010	0.05	0.572	**2.70**	-0.009	-0.05	0.263	1.03
Provide 3	-0.478	**-2.25**	0.541	**1.98**	0.808	**3.39**	-0.405	**-1.82**	-1.045	**-2.30**
Province 4	-0.295	-1.22	0.317	0.95	-0.059	-0.21	0.019	0.07	0.387	0.88
Province 5	-0.550	**-1.94**	-0.679	**-2.19**	0.824	**2.30**	0.135	0.45	-0.036	-0.08
Province 7	0.047	0.15	0.803	**2.37**	0.666	**1.82**	0.036	0.10	0.550	0.81
Intercept	-3.228	-0.48	1.877	0.23	8.190	1.10	5.437	0.73	17.236	**1.78**
/athrho	1.424	8.57	-0.221	-0.20	4.020	3.64	2.037	2.45	2.376	11.67
rho	0.890		-0.217		0.999		0.967		0.983	

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

	Number* of new devel. projects	
Change in 1996-2001 period	**Coef.**	**z-stat.**
Level of insecurity	-0.060	**-3.91**
Intercept	1.152	26.28
Number of observations	1379	
F(1, 1377)	15.28	
Prob > F	0.000	
R-squared	0.011	
Root MSE	0.618	

* expressed as log (number+1)

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

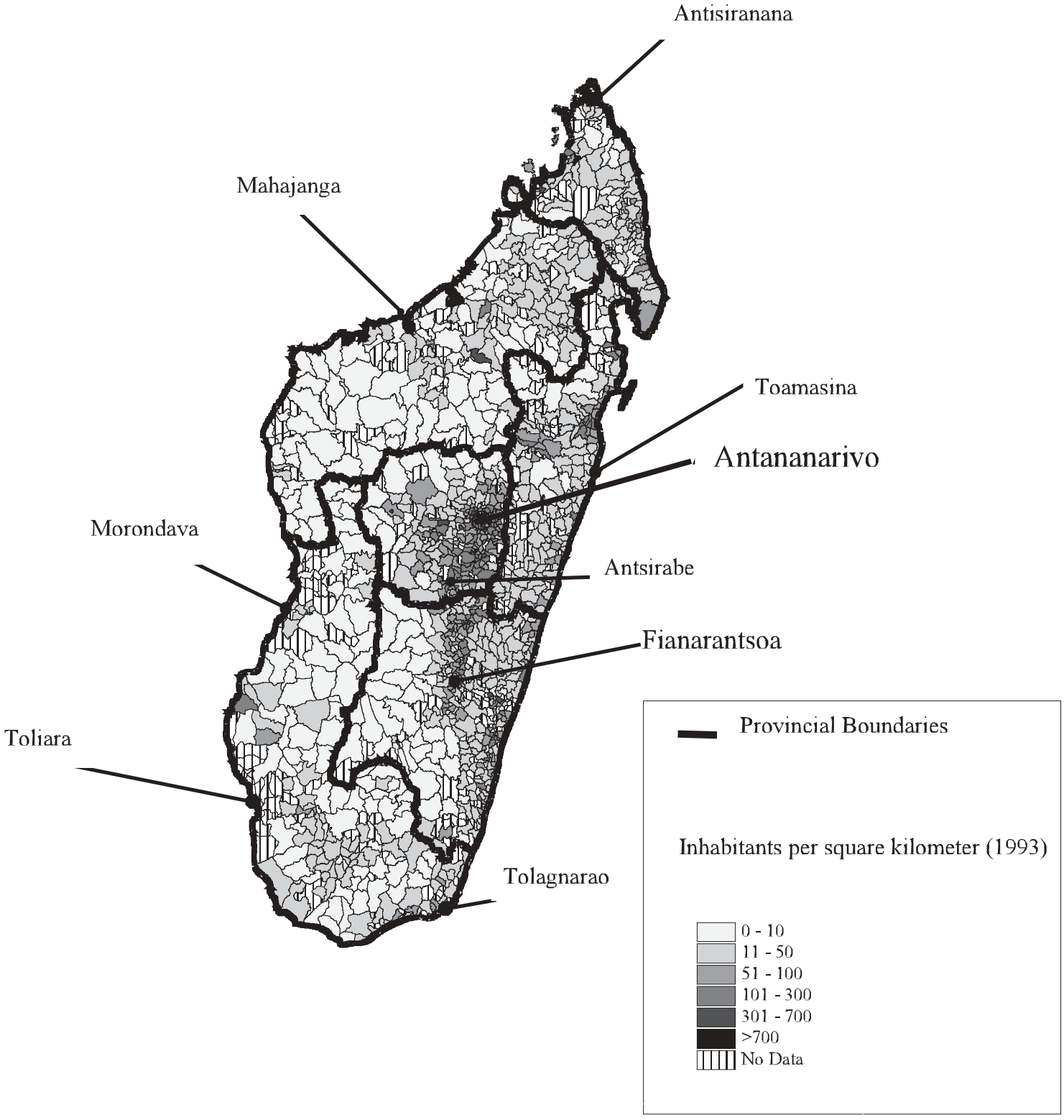

Figure 1. Population density and major cities of Madagascar