Crime, Transitory Poverty, and Isolation: Evidence from Madagascar*

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Abstract

This paper investigates the relationship between poverty and crime. Following a disputed presidential election, fuel supply to the highlands of Madagascar was severely curtailed in early 2002, resulting in a massive increase in poverty and transport costs. Using original survey data collected in June 2002 at the height of the crisis, we find that crop theft increases with transitory poverty. Theft thus appears to be used by some of the rural poor as a risk coping strategy. Increased transport costs led to a rise in cattle and crop theft, confirming earlier findings that, in Madagascar, geographical isolation is associated with certain forms of crime. We also find that an increase in law enforcement personnel locally reduces cattle theft which, in Madagascar, is a form of organized crime.

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1. Introduction

There has long been a suspicion that poverty favors criminal activity, but hard evidence of this relationship is difficult to come by. There are several reasons for this state of affairs, all having to do with the joint causality between poverty and crime (Ehrlich 1973). First, the prevalence of crime in an area discourages business, hence contributing to poverty. Secondly, high crime areas may also attract criminals because they find it easier to elude detection or because these areas constitute focal points for customers of illegal goods and services – think of gambling, prostitution, or the drug trade, for instance (Freeman 1996b). Finally, individuals with a high predisposition for crime are likely to have unobservable traits (e.g., lack of discipline) that make them less employable and thus would make them poorer even if they did not resort to crime.

For all these reasons, analyses of the relationship between crime and poverty are often regarded with skepticism (e.g. Bourguignon 2000, Fajnzylber, Lederman and Loayza 2002a). Except for Miguel (2003) who shows that the killing of 'witches' increases in times of drought, most of existing studies also look only at the effect of structural inequality and poverty on crime. This paper is different in that we look at the effect of transitory poverty on crime by taking advantage of an unusual sequence of events in Madagascar. Following a disputed presidential election, fuel supply to the central highlands of the country was severely curtailed in early 2002, resulting in a massive – if temporary – increase in poverty, defined here as households' inability to feed themselves. The stand-off between the two presidential candidates remained peaceful, however. The police and army remained largely outside the conflict and it is estimated that less than 100 people were killed due to fighting over the six month crisis.[1] There was no widespread looting.

This situation, however dramatic it was for the population, enables us to ascertain the

[1] Moreover, most of the killing took place in the Northern part of the country which is not included in the survey presented here.

immediate effect of transitory poverty on crime. Using data on crime and poverty before and during the crisis in a number of administrative divisions called *communes*, we examine whether communes where transitory poverty increased more also experienced a higher increase in crime. The originality of this approach is that it controls for many of the factors that plague cross-section analysis, since the shock was too swift for reverse causation to manifest itself in the data. Moreover, because fuel prices skyrocketed, there was no massive relocation of population over the time period considered. The large magnitude and unpredictable nature of the shock also are advantages relative to studies that focus on small transfer increments. As is well known, panel data analysis is sensitive to measurement error. As a result, it is often difficult to identify the effect of slow changing factors, such as poverty. The data used here suffer less from this kind of problem because the magnitude of the poverty shock was very large.

Results indicate that reported increases in one type of crime – crop theft – are systematically related to increases in transitory poverty. Other forms of crime such as burglaries and homicides show a less systematic relationship with transitory poverty. We also find a strong association between changes in isolation – measured by changes in transport cost to the nearest town – and crop theft. These findings survive even after we control for changes in law enforcement.

This work fits within a growing economic literature on crime and conflicts (e.g. Levitt 1997, Ayres and Levitt 1998, Cullen and Levitt 1999). While economic analysis of criminal activity in advanced countries is well developed (e.g. Becker 1968, Morgan 2000, Krueger and Pischke 1997, Imrohoroglu, Merlo and Rupert 2000, Doyle, Ahmed and Horn 1999), this literature started only recently to take off for developing countries. There is now a growing recognition among economists that crime and conflicts take a heavy toll on the welfare of the poor in developing countries (e.g. Bourguignon 2000, Stewart, Humphreys and Lea 1997, Anderson 1999). Pradhan and Ravallion (1999), for instance, show that poor families have a greater desire to improve

public safety than do rich people. In inter-country comparisons, Fajnzylber, Lederman and Loayza (1998) show that many developing countries have crime rates equal to or higher than that of developed countries.

The literature on developing countries has looked at different issues related to crime. For example, using cross-country evidence, Collier and Hoeffler (2004) compare the relative determinants of civil war and homicides. They find that although a higher homicide rate does not increase the likelihood of civil war, civil wars leave a legacy of post-conflict increased homicide rates. Other authors look at patterns of crime victimization – e.g., Gaviria and Pages (2001) for Latin American cities. In a related vein, Bloch and Rao (2002) show in India that women who come from a wealthy background are more likely to be beaten by their husband, possibly to extract higher transfers from her parents.

In this paper, we focus on the effect of poverty on crime. In efforts to bypass the causality problem, previous analysis has focused on natural experiments such as income transfers (e.g. Imrohoroglu et al. 2000, Rephann 1999) or indirect measures such as unemployment (e.g. Tauchen, Witte and Griesinger 1994, Raphael and Winter-Ember 2001). At this juncture, the conclusion from the empirical literature is that poverty has little effect on crime (e.g. Dreze and Reetika 2000, Krueger and Pischke 1997, Doyle et al. 1999, Morgan 2000, Blau and Blau 1982, Jarell and Howsen 1990, Freeman 1996a, Oreopoulos 2003, Ludwig, Duncan and Hirschfield 2001, Katz, Kling and Liebman 2001, Chiu and Madden 1998). The available evidence is largely based on data from rich countries where much crime is related to the drug trade (e.g. Levitt and Venkatesh 2000, Newman 1999).

More evidence of the effect of inequality and poverty on crime is becoming available in developing countries. Fajnzylber, Lederman and Loayza (2000) show that differences in crime rates are related to growth and poverty and partly driven by demographic factors. Using cross-

section data from South Africa, Demombynes and Ozler (2002) shows that local inequality is strongly correlated with both property crime and violent crime. A similar relation was found in cross-country studies Soares (2004). Bourguignon, Nunez and Sanchez (2003) develop a structural model of the link between crime and inequality in Columbia. Dreze and Reetika (2000) on the other hand show that murder rates in India show no relation with urbanization or poverty.

In Madagascar, Fafchamps and Moser (2003) find that crime is higher in isolated, less populated areas, not in urban areas as is common in rich countries. This suggests that the geographical pattern of crime in poor countries might be quite different from that in rich countries. Programme Ilo (2003) provides evidence that security is one of the major concerns among the Malagasy people. In 2001, security conditions in the country were perceived to be bad or very bad by two thirds of rural households. When asked whether security is important to improve living conditions, 83% of the country's rural households stated that security was important or very important. Security in general and crime in particular thus were at the top of citizens' concerns, even before the political crisis that would unfold in the first half of 2002.

The paper is organized as follows. The conceptual framework is introduced briefly in Section 2. The context is presented briefly in Section 3. The data are presented in Section 4. Empirical analysis appears in Section 5 where we report fixed effect least squares and Poisson regression results. We finish with the conclusions.

2. Conceptual framework

The economic literature on crime has focused primarily on incentives and deterrence arguing that, if criminals are rational, they should respond to economic incentives such as the income that can be made from crime, the likelihood of being caught, and the severity of punishment

(e.g. Becker 1968, Levitt 1997). This is particularly true for 'service' activities such as the drug trade, gambling, and prostitution. Within this general conceptual framework, a relationship between poverty and crime arises because, for poor people, income from criminal activities is relatively more attractive since the alternative is lower (Ehrlich 1973). Moreover, among the poor the stigma associated with crime is lower and hence the loss of future earnings is less (e.g. Blume 2002, Rasmusen 1996). Non-economists, in contrast, have often emphasized the non-rational aspect of crime – criminal impulses, conformism to a sub-culture – as well as its moral dimension – guilt and upbringing (e.g. Sah 1991, Barak 2000, Freeman 1996a, Garoupa 2003). Within this literature, the correlation between poverty and crime results largely from environmental and cultural factors, such as disenfranchisement and loss of legitimacy, exposure to crime as a child, loss of moral anchor in mobile populations, or upbringing in a single parent household (e.g. Blau and Blau 1982, Glaeser and Sacerdote 1999).

Here we focus on the effect that a transitory change in poverty has on crime. Given the dramatic but short-run nature of the changes we investigate, many environmental, legal and cultural factors can be regarded as constant.[2] A fixed-effect approach should therefore control for all of them. If a relationship between crime and transitory poverty is found, it is thus likely to be due to an increase in the relative profitability of crime or to a fall in the probability of detection. The existing literature suggests that in Madagascar crime deterrence by the law enforcement apparatus is not very effective (e.g. Ministere de la Justice 1999, Razafitsiamidy 1997, Rasamoelina 2000, Fafchamps and Moser 2003). In the case of Madagascar, it is therefore likely that any empirical relationship between crime and a transitory poverty shock is due to an increase in the differential between legitimate and illegitimate earnings, inducing some people

[2] Except for a possible loss of legitimacy during the political crisis. As we shall see, this did not happen in the area studied for reasons discussed in the following section.

to turn to crime.[3]

Take the above observations as starting point, our empirical analysis begins by positing a relationship between crime and population. Let C_{it} denote crime in location i at time t and let P_{it} be total population. We expect crime to be roughly proportional to population.[4] We wish to test whether crime increases with a rise in the proportion H_{it} of the population that cannot feed itself. Since Fafchamps and Moser (2003) have shown that, in Madagascar, crime increases with isolation, we also need to control for changes in isolation over time. Failing to do so may introduce an omitted variable bias if, as is likely, poverty is correlated with isolation. Let isolation be measured by T_{it}, the travel cost from location i to the nearest major town. The starting point of our analysis is:

$$E\left[\frac{C_{it}}{P_{it}}\right] = \gamma H_{it} + \beta T_{it} + \lambda_i + \sigma_t \tag{2.1}$$

where λ_i is a location-specific effect capturing time-invariant determinants of crime and σ_t is a time dummy. The parameters of interest are β and γ. Parameter γ captures the effect of poverty on crime: if the poor and non-poor have the same crime rate, then γ should be zero once we control for total population. In contrast, if crime is more prevalent among the poor, we expect γ to be larger than one. Since poverty is estimated directly, interpretation of the poverty coefficient does not depend on the exact cause of the variation in poverty over time – i.e., whether from the political crisis, bad weather, or government policy. If crime increases with isolation, perhaps because law enforcement is more difficult, then β should be positive.

Equation (2.1) is estimated in Section 4. Two estimation methods are used. The first adds

[3] Of course, we cannot fully rule out other explanations, such as a loss of legitimacy for legal institutions. But loss of legitimacy should affect all regions more or less in the same manner and need not be associated with differences in increases in poverty between locations.

[4] For our regression results based on fixed effects, this assumption is inessential since available population data does not change over the short duration of our panel.

zero-mean errors to equation (2.1) and uses fixed effects to eliminate λ_i. The attractiveness of this approach is that it is robust and simple to implement. It need not be efficient, however, because it does not take into account that crime statistics are count data: variable C_{it} only takes a small range of integer values which measure how many times an event occurred. In these models, efficiency can be improved by using a Poisson regression. We therefore reestimate the model by considering the number of crime incidents C_{it} as following a Poisson process with mean given by:

$$E[C_{it}] = P_{it}e^{\gamma H_{it}+\beta T_{it}+\lambda_i+\sigma_t} \tag{2.2}$$

Equation (2.2) is estimated using a conditional fixed effect Poisson regressions to eliminate λ_i. Population is included in the regression as an offset variable.

We expect different types of criminal activity to respond differently to changes in transitory poverty. Certain categories of crime can be seen as a desperate response to poverty, as when someone steals food to feed himself and his family. We expect these types of crime to rise with an increase in the proportion of the population who cannot feed itself. Other crimes are largely affected by the demand for illegal commodities and services such as drugs and prostitution. In this case, a rise in poverty would increase the supply of criminals but at the same time reduce demand for illegal goods and services. The combined effect on crime may be an increase or a decrease, depending on the relative strength of the two effects. Finally, certain criminal activities may take place within well organized networks and other mafias that restrict entry in crime, at least in the short run. Because the poor cannot enter these activities easily, we expect organized crime not to respond to poverty shocks, or at least not immediately. In Madagascar, cattle theft is a serious endemic problem that plagues specific parts of the country and is facilitated by geographical isolation. According to Rasamoelina (2000) and Razafitsiamidy (1997), cattle thieves are well organized groups that often operate with the complicity of local authorities.

Because this form of organization is likely to restrict entry, we expect cattle theft to be relatively insulated from poverty shocks.

In contrast, burglaries and crop theft are expected to increase with poverty as people turn to crime to mitigate the effect of the shock on their lives. In Madagascar, crop theft affects primarily standing crops in the fields, and much crop theft affects cash crops (e.g., vanilla, coffee) which are stolen for resale. The incidence of crop theft should therefore not be automatically equated with theft out of hunger. What remains unclear is whether these forms of crime respond more to deep poverty – e.g., chronic lack of food – or whether it is the moderately poor who temporarily turn to crime as a consumption smoothing strategy. Some empirical evidence to this effect is provided in Section 5.

Regarding homicides, we have no strong expectations one way or another. Poverty may increase desperation and hence violence. But if homicides are primarily driven either by idiosyncratic events (e.g., family feuds) and by organized crime (e.g., cattle theft), the number of homicides may respond little to changes in poverty. In Madagascar, there is no drug trade to speak of and we have no data on prostitution, which is illegal but widely tolerated. We cannot therefore document types of crime that may decrease as poverty increases and hence demand for illegal goods and services falls.

So far we have ignored law enforcement. Much of the literature, however, assumes that crime is a decreasing function of law enforcement (e.g. Becker 1968, Henderson and Palmer 2002, Levitt 1997, Levitt 1998, Levitt 1996). In the case of Madagascar, Fafchamps and Moser (2003) have shown that this is hardly the case; if anything, the presence of law enforcement personnel appears to be associated with an increase in the reporting of crime, even after instrumenting.[5] However,

[5] The reason why more crime is reported in areas with more law enforcement is unclear, but it may be due to better reporting. It is also conceivable that some law enforcement personnel are involved in criminal activities, especially organized crime (e.g. Razafitsiamidy 1997, Rasamoelina 2000). See Fafchamps and Moser (2003) for a discussion.

changes in law enforcement over time may have a deterrent effect on crime even if levels of law enforcement do not. For this reason, we reestimate the model controlling for law enforcement personnel L_{it}, in which case the model becomes:

$$E\left[\frac{C_{it}}{P_{it}}\right] = \tau L_{it} + \gamma H_{it} + \beta T_{it} + \lambda_i + \sigma_t \tag{2.3}$$

If law enforcement is effective at deterring crime, τ should be negative. Since changes in law enforcement may be a response to changes in criminality, we instrument L_{it} with living conditions. The idea is that law enforcement personnel may have relocated away from communes where the cost of living or living conditions deteriorated more as a result of the political crisis. Since we control for transitory poverty directly, such changes are unlikely to have a direct effect on crime.

3. The context

We estimate the model using data collected in rural Madagascar.[6] The data set is small but this drawback is more than compensated by the unusual set of circumstances under which the data were gathered. In December 2001, the first round of a presidential election witnessed the success of the former mayor of the capital city over the incumbent and long-time president of the country. Two independent vote counts gave the challenger an absolute majority and declared him the winner. But the official ballot count gave the challenger less than 50% of the votes and called for a second round. Suspecting that official results had been rigged, the challenger disputed the official ballot count.

What followed were six months of tension between the two candidates. The challenger reinforced his political control over the capital while the incumbent retreated to Toamasina, the

[6] Similar data were collected in urban areas, but questions on poverty could not be adequately answered by focus groups because the population of urban communes is much larger and more heterogeneous than that of rural communes. Urban data is ignored in the analysis presented here.

major port city. Rallying under his banner the governors of most provinces except the central highlands, the incumbent then proceeded to blast key road bridges and to blockade the capital city and its hinterland. By the summer of 2002, however, most of the army had rallied the challenger's cause and the incumbent president fled the country in late June. On June 26, the US government recognized the new government. Three days later, France followed suit. By then, the crisis was over.

The blockade period is the focus of our empirical investigation. The immediate consequence of the blockade was a sixfold increase of gasoline prices in the highlands and a doubling of transport costs (Ilo Program 2002). The ensuing disruption of the economy raised havoc among farmers who could not sell their surplus, as well as among urban dwellers who faced sharp increases in food prices (Programme Ilo 2003). As a result, the country experienced a dramatic – but temporary – increase in rural poverty, measured as the proportion of inhabitants in a commune who experienced difficulties to feed themselves (e.g. Programme Ilo 2002, Ilo Program 2002).

Fortunately, the political conflict did not lead to institutional collapse. To show their support for the challenger, many people – especially civil servants in the central highlands which are the focus of our empirical analysis – sought to behave in a responsible manner by continuing to work normally. Public services such as schools and health centers continued to operate throughout the troubled period (Fafchamps and Minten 2004). There was a short period of strikes by civil servants, but it affected primarily the capital city, which is not included in the analysis presented here.

The same is true of law enforcement. The political conflict did not degenerate into an all-out civil war. It is estimated that less than 100 people were killed due to fighting over the six months crisis, most of them in the Northern part of the country which is not covered by our analysis.

This compares to episodes of civil unrest in other parts of Africa, e.g., Cote d'Ivoire or Nigeria, where deaths number in hundreds per day. Although the army and police changed allegiance over the duration of the conflict, they essentially did not get involved in the fighting and there was no widespread looting or violence. It is thus fair to assume that in the rural highlands of Madagascar the state's presence and effectiveness were not significantly affected by the political conflict, relative to their normal (low) level. Indeed, as Fafchamps and Moser (2003) have shown, there is no evidence of crime deterrence by law enforcement personnel in Madagascar.

The dramatic increase in poverty that occurred during the crisis serves as quasi-natural experiment. The effect of the blockade on fuel prices was so large and systematic across communes that the observed variation in poverty over such a short time period is not due to measurement error. This is important for estimation purposes since, in fixed effects regression, measurement error tend to bias estimated coefficients towards zero.

The increase in transport costs affected the economy by isolating supply and demand areas. There was no increase in the average price of staple foods: the overall rice and maize prices in June 2002 were the same as in the previous year (Programme Ilo 2002). This is because Madagascar is basically self-sufficient in rice and maize during this period of the year. There were, however, large changes in relative prices across regions as increased marketing margins raised prices in importing communes and lowered them in exporting communes. In contrast, the price of most other basic needs goods (e.g., sugar, oil, soap) at least doubled over the period, in rural as well as urban areas (Programme Ilo 2002).

Self-sufficiency at the national level does not imply self-sufficiency at the individual level. Barrett and Dorosh (1996) and Minten (2003) show that, based on two different datasets, 60% of the rural population are net buyers of rice, the main staple food. Part of the rural population relies on wage labor for food expenses. The crisis reduced demand for wage labor and hence

increased poverty among wage laborers. The worst increases in transitory poverty were felt in terms of inability to feed one's family and in terms of difficulties paying for school fees and health care.

4. The data

The data used here were collected during the month of June 2002, just before roadblocks were lifted between the major port city of Toamasina and the rest of the country. Of the six regions comprising Madagascar, the survey focuses on three of the worst affected regions of the country – the two provinces of Antananarivo and Fianarantsoa located in the central highlands where the majority of the population lives, and the coastal province of Mahajanga which depends on the highlands for supply of consumer goods and outlet for its agricultural surplus. Together these three areas account for the large majority of the rural population. The Northern part of the country where some fighting took place is not included in the survey.

A stratified sampling frame was set up in such a way to be as representative as possible of the situation in these three provinces. Districts (*fivondronanas*) were divided into six strata depending on the distance to the provincial capital and on the availability of a tarred road. In each strata, one district or fivondronana was selected for every province. In each district, four communes were then selected at random, resulting in a total sample of 72 communes. The small size of the sample is primarily driven by the heroic conditions under which the survey was undertaken, i.e., in the midst of a serious and volatile political crisis that made vehicle transport difficult and movements of enumerators costly.

Data collection was undertaken by the USAID-funded Ilo project in collaboration with INSTAT and FOFIFA.[7] This project has a long experience collecting data in Madagascar and

[7]INSTAT is the statistical institute of the Ministry of Economy and Planning. FOFIFA is a the agricultural research institute within the Ministry of Scientific Research.

had just completed a census of all communes in the country before the December elections. The census could thus be used as sampling frame for the survey discussed here. All data were gathered during structured group interviews. On average, there were around ten participants in each group. The enumerators were well trained in structured group interview methods, having just completed a similar national census at the national level. Groups discussed their responses among themselves and the enumerator recorded the answer once a consensus was reached. Each group was composed of key informants and hence was not meant to be statistically representative. Participants were nevertheless carefully chosen so as to capture the diversity of the resident population. Groups typically included local administrators, public servants, traders, and farmers.

We are fairly confident that the collected data is of reasonable quality. In the poor rural communities that we study, serious crimes are salient events that attract a lot of discussion and interest. Consequently, we are fairly confident that focus group respondents have a pretty good idea of the number of serious crimes in their location. We think that this data collection method has yielded more accurate crime statistics than those that could be obtained from law enforcement agencies, who are subject to various forms of reporting bias (by victims, to political authorities, etc). We nevertheless recognize that our reliance on focus groups means that our data are not entirely free of recall bias.[8] However, no other reliable data were collected during

[8] As in all surveys, respondent bias is a concern. In this case, the fear is that respondents might have mistakenly reported that people have difficulties feeding themselves because they observed crop theft on the rise. This would generate a reporting bias in poverty figures that is correlated with reported crime.

While we cannot entirely rule out this possibility, we are confident that it is extremely unlikely that our results would be entirely due to such bias. First, given the magnitude of the macro shock, it is extremely unlikely that poverty did not increase. Second, the questionnaire was sufficiently long and diverse (it covered many issues other than poverty and crime) that respondents were not led to making a connection simply by faulty questionnaire design. Third, the number of crop thefts in each commune remains very small (see Table 1). Respondents may have inferred from these few cases of theft that a handful villagers were going hungry, but this alone would not have justified reporting poverty increases of several percentage points. Fourth, similar regression results are obtained if we use other poverty measures less related to food, such as the proportion of villagers experiencing difficulties paying school fees. Finally, we do not observe a similar relationship between transitory poverty and other forms of theft, which are just as indicative of financial difficulties as crop theft. It therefore does not appear that respondents mistakenly interpreted an increase in various forms of crime as indicative of a rise in poverty.

the period that are comparable over time and representative at the commune level. We are therefore constrained to work with the data available.

The survey collected detailed information on crime incidence in the period immediately preceding the survey, namely, April-May 2002. Similar information was also collected for April-May 2001. Given the high seasonality in incidences in crime (Razafitsiamidy 1997) and in poverty (Minten and Zeller 2000), data were gathered for comparable periods during the year. Focus group respondents were also asked to evaluate the proportion of the population experiencing difficulties feeding themselves during the same period.[9] Two measurements were taken: in the period immediately preceding the survey, and one year earlier. Given that poverty is typically defined as the inability to pay for basic food and shelter, facing difficulties feeding oneself can be considered a good indicator of poverty.[10] Although our measure is different from more standard measures of poverty based on current income and an estimated poverty line, it has the advantage of capturing temporary poverty in a simple and straightforward manner. It is the poverty indicator used in the econometric analysis.[11] Data on transport costs was also gathered.

Answers are summarized in Table 1, together with t-tests for the difference between 2001 and the corresponding period in 2002. All crime level and crime rate variables have a skewed distribution, with a high standard error and a median well below the mean. This is largely due to the fact that serious crimes are relatively rare events. Hence many communes, which

[9] The exact questions were: 'What proportion of the population of this commune faces (1) continuous difficulties to get enough to eat; and (2) temporary or seasonal difficulties to have enough to eat', the question being asked so that the two categories are mutually exclusive. In the analysis presented here, the two categories are combined into one.

[10] Mistiaen, Ozler, Razafimanantena and Razafindravonona (2002) have produced a poverty map of Madagascar using data collected prior to the political crisis. Fafchamps and Moser (2003) show that these poverty figures help predict crime incidence at the local level. These poverty estimates, however, only exist for a single year. Given the unusual conditions under which the data were collected, it would not have been possible to gather all the detailed information necessary to measure individual incomes and construct a poverty line. Moreover, the situation of prices and incomes during the crisis was unusual, so that it is not possible to use pre-existing survey data to construct an estimate of povery incidence during the crisis.

[11] We also experimented with alternative measures of poverty such as the proportion of commune residents who face chronic and occasional difficulties paying for health care and school fees. Survey results display a similar pattern, with a large and significant increase in the share of the population experiencing occasional difficulties paying for health and education. Econometric results are basically the same as those reported here.

are small administrative units, experience little or no crime in most years. This justifies using Poisson regressions to deal with this kind of data.

We find that the average number of crimes remained broadly constant over time, with the possible exception of crop theft which went up – but the t-statistic is not significant. Except for cattle theft, crime rate figures – that is, the number of crimes per 100,000 inhabitants – appear to have increased somewhat, but the change is not significant. Taken together, these figures suggest that the political crisis did not, by itself, trigger an increase in crime. The Table nevertheless shows that poverty, measured in the fashion described here, went up significantly with the crisis. The magnitude of the effect is quite large. The bottom portion of the Table shows that transport costs rose dramatically due to the blockade and lack of fuel for transport. Like poverty, the difference in transport costs is strongly significant.

Information was also collected on the number of law enforcement personnel operating in the commune. The next section of Table 1 reports changes in law enforcement personnel between 2001 and 2002. The reported figures combine four categories of law enforcement personnel: gendarmes, police, quartiers mobiles, and the military. Law enforcement issues in Madagascar are discussed in details in (Fafchamps and Moser 2003). The figures show no change in the average over time, but there are changes across communes between the two years.

5. Empirical results

We are now ready to turn to our estimates of equation (2.1). A 2002 year dummy is included to control for the possible presence of a common shock, such as lawlessness induced by the deleterious political climate. As explained in Section 2, transport cost enters the regression to control for the direct effect of increased isolation on crime. Once we control for poverty directly, transport costs capture the effect of isolation which, in the case of Madagascar, Fafchamps and

Moser (2003) have shown to be associated with higher crime incidence. To the extent that poverty is not measured adequately but is correlated with transport cost, including this variable also controls for possible omitted variable bias in measuring the effect of transitory poverty on crime. Given the special circumstances surrounding the survey, the quadrupling of fuel costs resulting from the blockade could not have been foreseen – and has no precedent in the history of the island.

Before introducing fixed effect, we first take a look at regression results where unobserved heterogeneity is assumed uncorrelated with regressors. Table 2 presents OLS and Poisson regression results that control for population but not for commune fixed effects. While unobserved heterogeneity enters the Poisson regression via random effects, we report OLS results with robust standard errors corrected for clustering. This approach is preferable to standard random effects since it allows for an arbitrary error covariance structure.

Results show a strong effect of our poverty measure on crop theft but no positive effect on other forms of criminal activity. Our poverty variable even has a negative significant effect on cattle theft in the Poisson regression – possibly because poorer communities have less cattle to start with. Geographical isolation appears to be positively correlated with cattle theft and, in the Poisson regressions only, with crop theft and homicides. The time dummy, which captures other effects of the political crisis, surprisingly has a negative sign in all Poisson regressions, significantly so for cattle theft. This suggests that the deleterious effects of the political crisis on crime occurred primarily through the massive effect that the crisis had on poverty and isolation. Once we control for these effects, the crisis, if anything, appears to have reduced crime. One possible explanation is political support: the effort to oust the incumbent president and long-time autocrat may have boosted the legitimacy of government institutions in the areas controlled by the presidential challenger, thereby resulting in less tolerance for crime among the population.

Table 3 introduces fixed effects. In the case of Poisson regressions, introducing fixed effects eliminates all observations with zero crime in both periods. This results in a massive loss of observations, especially for burglaries and homicides which are relatively infrequent in the study area. Once we control for fixed effects, we no longer need to offset for population. In the case of cattle theft, fixed effects also control for differences in cattle population across communes.

Our strongest and most consistent results are for crop theft, where earlier results are confirmed and even strengthened: other things being equal, an increase in transitory poverty and in transport costs resulted in more crops being stolen. The effect of transport costs is particularly strong: using the linear regression results, we find that a one standard deviation increase in the log of transport costs results in an additional 37 crop thefts – the equivalent of a 231% increase relative to the 2001 average. The effect of poverty is also large: a one standard deviation increase in our measure of poverty results in 27 more crop thefts – a 170% increase. The year dummy is also very large, suggesting that between the two years communes that experienced a large increase in poverty and isolation experienced more crime while the others in fact experienced *less* crime.

Other results of interest is the positive and significant effect of a change in poverty on the incidence of burglaries, but the effect is not significant in the Poisson regression. Regarding cattle theft, we again find a positive effect of isolation and a negative time dummy but, as in Table 2, results show a negative effect of poverty on crime. This may be because communes where poverty increased a lot either spent more time and effort protecting their livestock from thieves, or sold livestock to finance consumption – in which case there was less livestock to steal.

As mentioned in Section 2, failure to control for law enforcement may bias our results. To verify this, we introduce law enforcement personnel as additional regressor. Given that we already control for fixed effects, the possible correlation between unobserved heterogeneity and the

placement of law enforcement personnel is not an issue. In general, we fear that changes in law enforcement over time may be endogenous to changes in crime incidence although, in our specific case, law enforcement personnel are more likely to have moved for reasons having to do with the political situation. We nevertheless correct for possible endogeneity bias by instrumenting law enforcement with two instruments. Since all estimation is conducted in fixed effects, we chose as instruments two variables that measure the attractiveness of various locations to law enforcement personnel: the price of kerosene (a lamp fuel) and the availability of agricultural inputs. Kerosene is imported and is used here as proxy variables for year-to-year changes in living conditions: if kerosene is expensive, this probably means that other imported consumption goods are also expensive and hard to find. In the Malagasy context, the availability of agricultural inputs is used as indicator of accessibility. Given the very low levels of agricultural inputs in a normal year, locations that complained most about the lack of agricultural inputs are probably those that are normally well served. Less accessible communes, in contrast, hardly receive anything in a normal year and thus did not experience a deterioration.

The instrumenting equation is presented in Table 4. We immediately note that transitory poverty and isolation have no effect on the placement of law enforcement personnel and consequently are unlikely to have caused a bias in the crime regressions. Kerosene price has the anticipated negative effect on law enforcement while the lack of agricultural input is seen to raise law enforcement presence. This is consistent with the idea that law enforcement personnel relocated to more accessible areas during the crisis. The two instruments are jointly significant and, as shown at the bottom of the first panel in Table 5, in all cases they pass the overidentification test. Similar results are obtained using other instruments, such as changes in the availability of agricultural credit, agricultural input usage, or the functioning of rice irrigation systems.

Results with law enforcement are presented in Table 5. For least squares regressions, the

endogeneity of changes in law enforcement personnel over time is rejected in all cases. In the Poisson regressions, we follow the standard Smith and Blundell approach to instrumentation in limited dependent variable regressions and insert the residuals from the instrumenting regression as additional regressors. This procedure yields a test of exogeneity as a by-product which, in all cases, fails to reject the null hypothesis of no endogeneity. Uninstrumented results are reported as well, for comparison purposes. They are basically identical as far as poverty and isolation are concerned.

We find that law enforcement has a negative but generally non-significant effect on crime. The only possible exception is cattle theft, where an increase in law enforcement personnel is associated with a fall in cattle theft. This may be due to the fact that cattle thieves, who operate over a large territory, shift their operations to other communes in response to movements in law enforcement personnel.[12] Including law enforcement leaves other results regarding poverty and isolation basically unaffected. From this evidence we conclude that our earlier estimates are not an artifact of failing to control for law enforcement.

Before concluding, we seek to improve upon our results by better controlling for possible multicollinearity. Given the small size of the sample, this is a possible consideration. To this effect, we reestimate the fixed effect linear model using an estimator known to be more robust to multicollinearity than the least squares method, namely, generalized cross-entropy (Golan, Judge and Miller 1996). This estimator has been shown to yield low mean square errors in small samples and to be particularly good at dealing with multicollinear regressors.[13] Results are not

[12] This result appears to contradict (Fafchamps and Moser 2003) who find that the presence of law enforcement personnel, if anything, raises reported crime in all categories. The difference in results may be due to the fact that (Fafchamps and Moser 2003) do not control for fixed effects: since it may take a while for criminals to involve law enforcement personnel in their cattle rustling activities, the recent arrival of law enforcement in a commune may temporarilly discourage thieves.

[13] The generalized cross-entropy estimator (GCE) belongs to a class of maximum entropy estimators derived from an information theoretic approach. This class of estimators is customarily used in engineering and physics (Golan et al. 1996).

shown here to save space.

We find point estimates that are in general similar to those obtained by ordinary least squares. Inference remains unchanged: poverty and isolation have no noticeable effect on crime except for crop theft, where the effect is large. These results suggest that our findings are not an artifact of multicollinearity since essentially the same coefficient estimates are obtained using OLS and GCE.

6. Conclusion

In this paper we use data resulting from an unusual sequence of events to investigate the relationship between crime and transitory poverty in rural Madagascar. What makes the investigation unique is the timing of data collection: right in the middle of a serious and volatile political crisis that led to a blockade of the heartland of the country. Disruption to road transport and economic activities was massive and it resulted in a dramatic – if only temporary – increase in poverty. Because the political crisis was resolved with little bloodshed, there was no refugee crisis and the damage is nearly exclusively economical. This unusual sequence of events provides a unique opportunity of assessing the effect of transitory poverty on crime while keeping other crime determinants basically unchanged. The large magnitude of the shock compensates for the small size of the sample.

Fixed-effect regressions are estimated for a least squares and a Poisson model. Results suggest that certain forms of crime increase with transitory poverty. Our most conclusive results are for crop theft where transitory poverty is shown to have a significant effect in all our regressions. This result is consistent with Fafchamps and Minten (2005) who report that 23% of Malagasy farmers refrains from expanding upland cultivation away from the village for fear of insecurity.

We find similar evidence regarding burglaries, but the evidence is not robust, probably

because of the small size of the sample and the relatively low frequency of burglaries in our data. In contrast, we do not find a positive association between transitory poverty and other forms of crime such as homicides and cattle theft. If anything, more cattle theft is associated with less poverty, possibly because poor people do not have livestock. In agreement with Fafchamps and Moser (2003), we also find that locations which became more isolated – i.e., experienced a higher increase in transport costs – incur more crime. All these results are not affected by whether or not we control for law enforcement, but we find that an increase in law enforcement personnel reduces cattle theft, possibly because thieves move their activities elsewhere.

Results presented here suggest that crop theft – and perhaps burglaries – may be used by some of the rural poor as a risk coping strategy. Other forms of crime such as homicide and cattle theft do not appear to respond to a transitory increase in poverty. These findings are consistent with the idea that certain forms of crime responds to economic incentives while other do not. In this case, loss of earnings and the difficulty to feed oneself must have made theft look more attractive to some people. In contrast, we find that an increase in transitory poverty did not result in more homicides, suggesting that factors other than transient poverty play an important role in determining homicide rates. This latter result may be specific to rural Madagascar where trade in illegal goods (drugs, gambling, prostitution) – and the resulting conflicts around property rights – are not a major cause of crime. It is surprising to find that livestock theft did not respond to an increase in transitory poverty. This may be due to the fact that, in Madagascar, cattle raiding is in the hands of organized crime, thereby restricting casual entry by the transitory poor.

It is perilous to draw policy conclusions from an exercise not designed to test the effect of various policies. The results presented here nevertheless suggest that an insurance safety net against transitory poverty may, as a by-product, result in a reduction in certain forms of theft,

though not all. This issue deserves further research.

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Table 1: Descriptive statistics

Item	Unit	April/May 2001			April/May 2002			Paired t test	
		Mean	Median	St. Dev.	Mean	Median	St. Dev.	t-value	P>t
Incidences of crime									
Cattle theft	Number per month per commune	27.03	1.50	86.16	33.90	0.50	93.60	-0.458	0.647
Burglary	Number per month per commune	0.13	0.00	0.37	0.14	0.00	0.45	-0.174	0.862
Murders	Number per month per commune	0.14	0.00	0.42	0.18	0.00	0.76	-0.401	0.689
Crop theft	Number per month per commune	1.85	0.00	3.44	2.65	1.00	4.87	-1.146	0.254
Crime rate									
Cattle theft	Number per month per 100,000 habitants	297.20	10.50	169.47	277.68	3.96	102.04	0.099	0.922
Burglary	Number per month per 100,000 habitants	0.68	0.00	0.28	1.57	0.00	0.73	-1.125	0.262
Murders	Number per month per 100,000 habitants	0.73	0.00	0.29	3.35	0.00	2.67	-0.973	0.332
Crop theft	Number per month per 100,000 habitants	15.95	0.00	3.47	26.71	3.73	6.41	-1.48	0.142
Measures of poverty									
Poor	% of population that face temporary/chronic problems to find enough to eat	44.12	40.00	31.00	58.25	70.00	30.97	-2.735	**0.007**
Law enforcement personnel									
	Number per commune	54.04	44.00	43.64	54.34	43.00	42.47	-0.041	0.967
Transport costs									
Transport costs of a person one way to a major city (Fmg)		26687	20000	27717	52979	37500	48536	-3.991	**0.000**
Transport costs of a bag of 50 kg one way to a major city (Fmg)		8973	6750	7630	16778	13750	11723	-4.735	**0.000**

Number of communes in the survey=72

Table 2: Link of crime and poverty - cross-section results

		Cattle theft		**Burglary**		**Homocides**		**Crop theft**	
Determinants	Unit	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
					Dependent variable: crime rate				
Non-fixed effect OLS with cluster correction									
poor	% of pop.	5.320	1.630	0.019	1.340	0.033	0.790	0.301	**2.740**
transport costs to major city	log(Fmg)	65.261	**1.820**	-0.158	-0.390	1.265	1.040	1.592	0.550
time dummy	2002=1	-143.061	-0.950	0.721	1.070	1.208	0.860	5.312	1.250
population in commune	log(number)	-204.664	-0.850	-0.775	-0.990	-3.386	-0.950	-15.072	**-2.390**
intercept		1362.729	0.610	8.654	1.020	19.002	0.900	129.199	**2.270**
number of observations		144		143		144		144	
F(4,71)		1.58		0.48		0.29		2.32	
Prob>F		0.19		0.75		0.88		0.07	
		Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
					Dependent variable: incidences of crime				
Poisson random effects									
poor	% of pop.	-0.004	**-1.920**	0.012	1.180	-0.003	-0.290	0.010	**2.800**
transport costs to major city	log(Fmg)	1.183	**8.360**	-0.096	-0.340	0.467	**1.830**	0.321	**1.850**
time dummy	2002=1	-0.576	**-4.900**	-0.094	-0.170	-0.017	-0.030	-0.109	-0.540
population in commune	log(number)	(offset)		(offset)		(offset)		(offset)	
intercept		-17.120	**-12.250**	-11.184	**-4.010**	-15.573	**-6.370**	-12.165	**-7.280**
number of observations		144		143		144		144	
Wald chi2(3)		149.05		1.59		3.76		18.99	
Prob>chi2		0.00		0.66		0.29		0.00	

Table 3: Link of crime and poverty - fixed effect results

		Cattle theft		**Burglary**		**Homocides**		**Crop theft**	
Determinants	Unit	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
					Dependent variable: crime rate				
Fixed effect OLS									
poor	% of pop.	-0.170	-0.030	0.099	**2.830**	-0.011	-0.080	0.853	**3.320**
transport costs to major city	log(Fmg)	140.436	0.480	2.369	1.180	7.333	0.950	28.855	**1.980**
time dummy	2002=1	-121.219	-0.450	-2.271	-1.250	-2.665	-0.380	-22.681	**-1.710**
intercept		-1040.552	-0.360	-26.416	-1.340	-69.026	-0.910	-298.078	-2.080
number of observations		144		143		144		144	
F(3,69)		0.10		3.29		0.65		5.59	
Prob>F		0.96		0.03		0.59		0.00	
		Coefficient	z-value	Coefficient	z-value	Coefficient	z-value	Coefficient	z-value
					Dependent variable: incidences of crime				
Poisson fixed effects									
poor	% of pop.	-0.005	**-2.010**	0.015	1.050	-0.077	-1.200	0.015	**3.430**
transport costs to major city	log(Fmg)	1.276	**7.830**	-0.117	-0.090	1.934	1.400	1.534	**3.310**
time dummy	2002=1	-0.638	**-4.760**	-0.276	-0.260	-0.073	-0.060	-1.178	**-2.690**
number of observations		92		24		24		80	
Wald chi2(3)		146.50		1.24		3.44		22.95	
Prob>chi2		0.00		0.74		0.32		0.00	

Table 4: Instrumenting equation on law enforcement

		Coefficient	t-value
Fixed effect OLS			
poor	% of pop	0.001	1.070
transport costs to major city	log(Fmg)	0.005	0.180
time dummy	2002=1	0.011	0.430
availability of agricultural inputs	scale 1-4	-0.044	**-3.520**
price of kerosene		0.000	**-2.080**
intercept		3.777	13.740
Number of observations		141	
F(5,65)		3.78	
Prob>F		0.0046	
Test that instruments (avail. of agr. inputs, price kerosene) are jointly significant			
		F-value	p-value
F(2,65)		6.99	0.0018

Table 5: Link of crime and poverty - fixed effect including law enforcement

		Cattle theft		**Burglary**		**Homocides**		**Crop theft**	
Determinants	Unit	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
		Dependent variable: crime rate							
Fixed effect OLS regression									
law enforcement	log(number)	-1952.273	-1.590	-4.777	-0.560	-10.286	-0.310	-43.882	-0.710
poor	% of pop.	1.181	0.230	0.103	**2.850**	-0.007	-0.050	0.885	**3.360**
transport costs to major city	log(Fmg)	121.126	0.410	2.328	1.140	6.862	0.870	28.635	**1.930**
time dummy	2002=1	-99.226	-0.370	-2.225	-1.190	-2.106	-0.290	-22.443	-1.650
intercept		6317.219	1.150	-8.557	-0.230	-26.964	-0.180	-135.320	-0.490
number of observations		142		141		142		142	
F(4,67)		0.71		2.49		0.5		4.24	
Prob>F		0.59		0.05		0.74		0.00	
Fixed effect IV regression									
law enforcement*	log(number)	-319.758	-0.110	-25.29	-1.210	-15.697	-0.200	-65.981	-0.450
poor	% of pop.	0.059	0.010	0.117	**2.900**	-0.005	-0.030	0.897	**3.190**
transport costs to major city	log(Fmg)	140.645	0.460	2.109	0.970	6.985	0.870	28.691	**1.900**
time dummy	2002=1	-120.530	-0.430	-1.962	-0.990	-2.069	-0.280	-22.213	-1.610
intercept		130.877	0.010	68.685	0.840	-8.284	-0.030	-54.865	-0.090
number of observations		141		140		141		141	
Wald chi2(4)		30.75		19.38		4.07		84.08	
Prob>chi2		0.00		0.00		0.54		0.00	
Overidentification test statistic		0.82		0.17		0.60		1.09	
p value		0.37		0.68		0.44		0.30	
		Coeff.	z-value	Coeff.	z-value	Coeff.	z-value	Coeff.	z-value
		Dependent variable: incidences of crime							
Fixed effect Poisson regression									
law enforcement	log(number)	-6.119	**-12.380**	29.818	0.990	-20.173	-0.930	-2.187	-1.410
poor	% of pop.	-0.003	-1.160	0.020	1.290	-0.067	-1.220	0.018	**3.700**
transport costs to major city	log(Fmg)	0.992	**5.950**	0.189	0.140	1.037	0.720	1.668	**3.490**
time dummy	2002=1	-0.149	-1.050	-0.865	-0.680	0.728	0.480	-1.332	**-2.940**
number of observations		92		24		22		78	
Wald chi2(4)		272.91		2.25		3.83		24.53	
Prob>chi2		0.00		0.69		0.43		0.00	
Fixed effect Poisson regression IV									
law enforcement*	log(number)	-4.780	**-4.350**	-14.13	-0.300	-75.949	-1.080	-2.598	-0.780
poor	% of pop.	-0.005	-1.650	0.040	1.620	-0.049	-0.080	0.018	**3.430**
transport costs to major city	log(Fmg)	1.043	**6.080**	-0.340	-0.210	0.653	0.440	1.662	**3.470**
time dummy	2002=1	-1.169	-1.180	-0.437	-0.320	1.282	0.720	-1.331	**-2.940**
error term**		-1.541	-1.360	48.707	1.190	57.936	0.830	0.524	0.140
number of observations		92		24		22		78	
Wald chi2(5)		273.00		3.14		4.33		24.56	
Prob>chi2		0.00		0.68		0.50		0.00	

*instrumented; instruments price of kerosene and availability of ag. inputs

** Smith-Blundell method for correction of endogeneity; error term out of instrumenting regression