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Consumption smoothing vs. criminal know how: looting after the 2010 Chile earthquake

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Consumption smoothing vs. criminal know how: looting after the 2010 Chile earthquake.

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Abstract

We examine what factors are associated to the incidence of looting after the 2010 Chile earthquake. Two types of looting are considered: the looting of supermarkets and non dwelling burglaries. The patterns of supermarket looting seem consistent with individuals being unable to insure against the economic shock associated to the earthquake: this type of looting is correlated to high poverty rates, high levels of earthquake destruction, high urbanization, and the lack of banking services. By contrast, non dwelling burglaries follow a crime of opportunity pattern, increasing independently of the shock's magnitude and poverty rates, while being strongly associated to past property crime rates.

1 Introduction

On February 27 of 2010, a massive earthquake and tsunami hit the center-south of Chile, bringing about extensive property damage and a large number

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of casualties. As in a number of previous earthquakes in Chile and abroad, the aftermath of the shock witnessed a broad range of behavioral responses as individuals made efforts to cope with the disaster: from an increase in volunteer work and charity donations, to an increase in crime rates that included the looting of supermarkets and shopping malls. We use the 2010 Chile earthquake as a natural experiment to shed light on the conditions that promote the looting of supermarkets, as well as more broadly defined crimes against property.

We propose two distinct, possibly complementary explanations for the phenomenon of looting. [1] First, looting might be the response of individuals to the material deprivation caused by the shock. Second, it could be the response to the lack of law enforcement in days following the earthquake. If looting is a means to smooth consumption, then it should be aimed at certain goods such as food and other necessities; while looting as a crime of opportunity should be directed to items which, in normal times, command high prices. We obtain evidence on these two motivations for looting by examining data on both, the looting of supermarkets, and burglaries in non dwelling locations, a wider definition of looting. Most goods sold by supermarkets are of little individual value, but are essential to fulfill the day to day consumption needs, and we would expect that supermarket looters are primarily driven by a consumption smoothing motive. This is not the case with most other types of looting, the motivation for which would rather be the market value of the goods looted, after the shock has passed.

A number of papers examine the economic consequences of earthquakes. Of particular interest to us are the contributions that examine how individuals cope with the disaster at the microeconomic level. Sawada and Shimizutani [2008] use microdata to examine patterns of household consumption smoothing after the 1995 Kobe earthquake. Consumption insurance is achieved by borrowing for households with large collateralizable assets, while private transfers are used by both high and low net worth households. The authors report that only high net worth households achieved complete consumption insurance in this episode. Kohara et al. [2006] use a panel of households to test for consumption insurance during the same event. They also reject the hypothesis of full insurance.

Kimbrough et al. [2010] study the formation of property rights in an

[1] We take looting as being a burglary -breaking in and stealing- in an non dwelling location in a time of emergency.

experimental setting. In the experiment, property rights emerges as a convention, allowing individuals to reap the benefits of specialization. Interestingly, equilibria with specialization seem to emerge as long as a critical mass of players abstain from stealing. We are guided by these findings to test whether different types of looting can be explained by community characteristics other than criminality, that would make looting a rational response to the type of material deprivation that households experience after a natural disaster of this kind.

We are not aware of any contribution that uses the window provided by a natural disaster to examine the conditions that lead to the -admittedly focalized- weakening of property rights that may occur in these events. And yet, we are not the first to recognize a natural disaster as a unique opportunity to examine the problem. When discussing the prevalence of property rights, Kimbrough et al. [2010] write:

> Although property is generally protected by an impersonal legal system, its efficient operation depends upon voluntary compliance to avoid an excessive burden on enforcement. That voluntary compliance may sometimes break down, as in the aftermath of a hurricane when generally law-abiding citizens turn to looting for sustenance[...]. Yet, breakdowns even in these cited circumstances are relatively uncommon in developed economies.

We assemble a municipality level dataset with information on socio economic characteristics of the municipality, including pre-earthquake housing quality, as well as information on the damages caused by the earthquake, and the physical intensity of the shock in each location. We complete the dataset with data on non dwelling burglaries in the week after, as well as in the year before the shock, and with self collected information on the occurrence of looting in supermarkets during the week after the earthquake. We are interested in examining the roles of poverty and income levels within the municipality, as well as the role played by social capital and pre earthquake criminality rates in the incidence of looting. We are also interested in examining the roles played by the physical destruction brought about by the shock, and the building quality of the housing stock, in provoking looting.

In our data, looting in supermarkets occurred in 9% of the municipalities during the week after the earthquake. Measures of the inability to insure against the shock such as poverty rates, measures of social capital, the proportion of urban vs. rural dwellers, as well as the availability of banking

services, all help explain the incidence of this type of looting. The physical magnitude of the shock and the vulnerability to this shock, given by poor housing quality, also increase its probability, but do so indirectly through the damages caused by the earthquake. At the same time, past crime rates are unrelated to looting in supermarkets. In a more general definition of looting, non dwelling burglaries, neither poverty rates nor measures of the quake destruction help explain the phenomenon, but past crime rates do. We find then evidence for breaking into supermarkets as being the response of otherwise law abiding individuals who faced temporary deprivation, while other forms of looting seem mostly a purely criminal phenomenon.

In the next section, we present the two hypotheses of the origins of looting. Section 3 describes the data, while section 4 presents the statistical model and the estimation results. Concluding remarks are presented in section 5.

2 Who is the looter?

This paper presents evidence of the effects of both socio economic variables and the magnitude of the shock on the prevalence of looting. It is worth then discussing the role played by these variables in an explanation of the phenomenon of interest.

The earthquake that hit Chile on February the 27th, 2010, was the fifth largest shock of its kind since measurements are recorded. It lasted for about three minutes and caused 525 fatalities, about 160 of which were due to the tsunami that hit coastal areas shortly after. This earthquake was not nearly as costly in human lives as similar events of lower magnitude, such as the 2003 Bam, Iran, or the 2010 Haiti earthquakes. The literature on the causes of earthquake destruction finds a robust relationship between per capita income and the effects of the earthquake (see, for instance Kahn [2005] and Kellenberg and Mobarak [2008]). Since earthquakes cannot be anticipated, their destructive force is mediated almost exclusively by the quality of construction, both in private homes and public infrastructure.

Once the earthquake subsides, survivors must cope to different degrees with the lack of markets for certain goods, such as power and telecommunications, and with large price increases in most other goods. Price increases in the aftermath of large disasters seem to be a common occurrence and Chile, just as most US states, have laws against the practice of "price gouging" in the wake of a natural disaster (see, for instance, Davis [2008]). In this par-

ticular episode, we must rely on informal evidence to document the extent of price increases. Newspapers report across the board price increases in affected areas. Underlying the importance of price increases in an explanation of looting in supermarkets, one journalist writes

> looters justified their actions through lack of food, water, and milk, and price gouging by stores.(Radio Universidad de Chile [2010])

In Constitución, one of the most heavily affected cities, a journalist reports price increases of up to 200% for staples such as flour and other groceries (Reuters [2010]).

Looting is always a costly activity. It is, first of all, unlawful, and looters must have been aware that they would be held accountable with some positive probability. Chilean police reports 300 detained on looting related charges in the week after the earthquake (Radio Cooperativa [2011]). There is also a pure moral cost associated to breaking the law, at least for some individuals; and a cost associated to social stigma. Looting also implies, at least for those who lead the process, a degree of organization. In particular, if looting of a supermarket is observed, then a critical mass of individuals must have found it worthwhile to overcome the costs associated to this collective action problem, the alternative being obtaining the goods via markets or social networks, as described above.

A number of explanations can be advanced to account for the phenomenon of looting. The first emphasizes the interaction between the shock, and in particular its effects on the markets for necessities, and the insurance opportunities available to households, or lack thereof. In this story, looting should be observed where the earthquake created enough damage to disrupt the functioning of markets by, for instance, destroying power lines, and damaging roads and supermarket infrastructure; and at the same time a fraction of households could not compensate for this lack of markets through one of several forms of insurance: self insurance through savings or through home production of foodstuffs in the case of rural households, or social insurance through neighbors and extended family members being two possible channels.

Households with highly liquid assets, including cash, will find it easier to smooth consumption in the face of these difficulties. Here, we use household income as a proxy for liquidity. It is likely that the lack of liquidity was particularly severe in this episode, since the earthquake hit on the eve of payday for most workers.

The lack of liquidity is further compounded by the collapse of banking services in many affected areas. Lack of banking services could only worsen the effects of market disruption and price increases, leaving individuals unable to trade in whichever markets remain open.

Besides self insurance, households may resort to mutual insurance through social networks. In this case measures of social capital should negatively predict the incidence of looting. Moreover, social networks provide insurance efficiently if the idiosyncratic component of the shock is large with respect to the systematic component. We should expect that communities with a high poverty rate have a higher incidence of looting in supermarkets, partly because the poor are more vulnerable to experiencing material losses and less able to self insure, but also because the opportunities for social insurance are also compromised if every one in the social network has suffered a similar shock.

An alternative explanation for the phenomenon emphasizes differences in criminality rates across jurisdictions. Looting, as described above, does require somewhat specialized skills and organization, mostly to break open the store, but also to carry away the goods and hide them from the authorities. Looting then falls naturally within a criminal group's specialization, and it could be that the incidence of looting in the aftermath of the earthquake is simply a reflection of the differential prevalence of criminal know-how across municipalities.

Finally, the police presence may have played a role in deterring looting in either of the two scenarios just described. Moreover, it is worth noting that, four days after the earthquake, the army was deployed in and around the city of Concepción, in response to civil unrest that included widespread looting and the destruction of commercial venues.

3 Data description

The unit of observation in this study is the Comuna, or municipality. Our sample comprises 197 of the 281 municipalities from the Valparaiso to the Los Lagos regions. Figure 1 shows a map of the area of interest, which marks the locations of four important cities, and represents the intensity of the earthquake as well as the municipalities where looting in supermarkets took place. Note that our data includes the municipalities at and near the epicenter, along with municipalities where the force of the earthquake was

rather weak.

The dataset was assembled from several sources. We can divide our variables into four groups, according to their origin. First, socio economic characteristics of the municipality are constructed from the CASEN 2009 household survey and the National System of Municipal Information (which we refer to with the spanish acronym SINIM). Second, a number of variables, mostly related to the consequences of the earthquake, were obtained from specialized literature, as well as directly from government institutions. Finally, the variables measuring the incidence of looting were collected by the authors using an email and telephone survey. Appendix A lists all variables definitions and sources.

The CASEN is a nationally representative cross sectional survey run every three years which, on the 2009 wave, interviewed over 246,000 individuals, or 1.45 % of the Chilean population. It is our main source of socio economic information. The main variables obtained are per capita income (*income*), the proportion of individuals under the poverty line (*poverty*), an index of housing quality (*housing quality*), and a measure of social capital given by the proportion of individuals who have lived in the municipality for more than four years (*long term residents*). The second variable used to measure social capital is the (per capita) number of community organizations (*participation*), which we obtained from the SINIM database. A related measure, the proportion of individuals participating in such organizations, is present in the classic contributions on social capital, including Putnam [2000], and intends to capture the degree to which individuals engage in local social activities.

A second type of variables was obtained from administrative data at government institutions, as well as from technical literature. Astroza I. et al. [2010] estimated the physical strength of the quake at different locations spanning most of our area of interest. The authors examine, at each location, earthquake damages in a sample of dwellings, and derive a measure of the peak energy released by conditioning on the quality of construction. We compute all 61 missing observations by using geographically weighted regressions.

We obtain data on closings of bank branches as a consequence of the earthquake from the state owned bank Banco Estado, and use it to construct a measure of bank availability. *Banks closed* is an indicator for a branch of this bank having closed down. We wished to have information on branch closings for all banks, but Banco Estado is the most geographically widespread institution, having branches in 172 of the 197 municipalities in our sample.

We expect that branch closings for all remaining banks are highly correlated with those for Banco Estado.

An indicator variable for the incidence of looting in supermarkets (*supermarkets*) was collected by the authors through an email and telephone survey addressed to the mayor's office in each municipality. The survey was conducted in April and May 2010. A first email message with four short questions on the incidence of looting in a) supermarkets, b) gas stations, c) homes, and d) other locations, was sent in April to the municipality's Finance Director (FD). A second email was sent in early may to non responding municipalities. Finally, telephone interviews with the municipalities FD's were attempted. After this process was completed, we received 206 responses, of which 197 were valid. In 75 cases, the FD was not available for a phone interview. In one single case the FD refused to answer our survey. Ormeno [2010] provides further details of the survey design and implementation.

A measure of property crimes -non dwelling burglaries- reported to the police for the year 2009 (*burglary09*) was obtained from the national police force, and is used as a control for the propensity to engage in unlawful behavior. This variable is a more general definition of looting, which is defined essentially as a burglary in times of emergency, and encompasses looting in supermarkets. The variable measures non dwelling burglaries reported to the police per one hundred thousand habitants. The same measure for the week following the earthquake (*burglary*) is used as a dependent variable to provide a contrast to the results for looting in supermarkets.

Finally, measures of the destruction caused by the shock were obtained from the National Office for Emergencies (ONEMI in what follows). These variables are: the proportion of dwellings with minor damages (*minor damage*), with major damages (*major damage*), destroyed (*destroyed*), per capita earthquake and tsunami victims (*victims*) and fatalities (*fatalities*).

Table 1 shows descriptive statistics for selected variables. We obtained a sample of 197 out of the 281 municipalities in the region. In 9% of the municipalities looting occurred in supermarkets. Lack of data prevents a direct comparison of this figure with other natural disasters. The weight of the evidence points to looting being a rare occurrence after natural disasters (see, e.g. Quarantelli and Dynes [1972] and Quarantelli [2007]; and Frailing [2007] for an opposing view). The two post disaster household surveys discussed in Gray and Wilson [1984], after tornadoes hit Arkansas in 1952 and floods inundated parts of Pennsylvania in 1972, report rates of looting in homes of 9 and 8% respectively.

The table 1 also presents descriptive statistics of variables summarizing the damages caused by the earthquake. On average 10.4% of a municipality's residents were considered victims of the disaster, having suffered physical or material damage. Regarding material damages, on average 1.8% of the homes were destroyed, 1.4% suffered major damages, while 2.7% suffered minor damage. That the number is higher for destroyed rather than for heavily damaged homes may be due to the effect of the tsunami, which leveled large parts of the cities of Constitución and Talcahuano.

Table 2 shows municipality characteristics, including intensity and damages from the earthquake, for municipalities in the sample (70% of the population of municipalities), and out of the sample (30%). In general, both groups appear quite similar, both in terms of the intensity and damages caused by the earthquake, and in terms of socio economic characteristics such as income per capita and poverty rates.

Figure 2 provides a summary description of the relationship between one of our main variable, *supermarkets*, and selected municipality characteristics. For each characteristic, we divide the sample in municipalities above (High) and below the median (Low), and plot the average of *supermarkets* over each group. The north west panel shows that looting was indeed associated to the earthquake intensity. Municipalities who suffered a stronger shock were much more likely to experience looting than those who did not. The north east panel describes looting in municipalities within high vs low social capital, measured here by participation in local organizations. High participation is indeed associated with a much lower incidence of looting. The two bottom panels describe looting by crime rates and poverty levels. Both high crime and high poverty rates are associated to the incidence of looting. Note that these two variables point to different interpretations of the phenomenon: deprivation in the case of poverty, and the availability of skills specific to the task, in the case of crime.

A comparable graphical description is provided in figure 3 for the variable *burglaries*. The figure displays scatterplots of the burglary rate during the week after the quake against the same municipality characteristics discussed above, along with a regression line. Interestingly, neither the earthquake intensity nor the poverty rate are statistically associated to burglaries in our data. Past crime rates are strongly associated to crime rates after the quake, as expected. Finally, we have a puzzling, positive association between our measure of social capital, *participation*, and burglaries. In the next section, we present and estimate a statistical model to assess the quantitative con-

tributions of these and other explanatory variables to both looting in supermarkets and burglaries in non dwelling locations, the more general definition of looting used here.

4 The statistical model and results

The phenomenon under study can be separated naturally into two components. First, an examination of the destruction brought about by the earthquake; and second, the response of households in terms of the incidence of looting.

The first component, the destruction caused by the earthquake, is in turn the result of the seismic shock hitting a housing stock and public infrastructure of insufficient quality. Besides the magnitude of the shock and the quality of housing, being located in a coastal area makes a jurisdiction more prone to destruction, this time through the effects of the tsunami. The tsunami hit coastal areas more heavily close to the epicenter. Two important cities, Talcahuano and Constitución, were particularly affected (see figure 1). Our first equation is then

$$damage = \beta_0 + \beta_1 intensity + \beta_2 housing\ quality + \beta_3 coastal\ area + \epsilon \quad (1)$$

Where *damage* represents either of the several types of destruction caused by the earthquake. The second component of the statistical model is an equation to explain the incidence of looting. The right hand side contains a measure of the destruction caused by the earthquake as the fundamental explanatory variable. Then, the poverty rate and the property crime rate for the previous year are used as baseline tests for the two hypotheses laid out in the previous section, regarding the origins of looting. Variables capturing income levels, the proportion of urban households, the availability of banking services, and measures of social capital, are also used to establish supporting evidence for these hypotheses. A latent variable model for looting is

$$looting^* = \gamma_0 + \gamma_1 damage + \gamma_2 poverty\ rate + \gamma_3 burglary\ rate + \upsilon \quad (2)$$

Where $looting^*$ is the latent variable, and we allow ϵ and υ to be correlated. We use a probit link to define the response probability.

$$\begin{aligned} P(looting = 1) &= \Phi(\gamma' X) && (3) \\ \gamma' X &= \gamma_0 + \gamma_1 damage + \gamma_2 poverty\ rate + \gamma_3 burglary\ rate && (4) \end{aligned}$$

Given that we aim to identify causal effects both in equations 1 and 4, it is worth discussing the limitations of the data for this purpose . In equation 1, one concern might be that poor families tend to live in cheaper, more disaster prone areas, and also inhabit lower quality dwellings. We do not have enough information on land prices and geological characteristics to separately identify the selection effect, if existent. In this case the coefficient on *housing quality* would capture both the quality of housing and the effect stemming from the price of land. With respect to the second equation, we were unable to obtain two potentially important variables: the size of the police force and the availability of electrical power. We are not highly concerned about the former, as the police capacities seemed to be uniformly stretched during that first week after the quake. We believe however that the availability of power might have played a role in the incidence of looting, for instance by increasing the sense of vulnerability across the community, or by preventing large supermarkets from opening for business. This variable is likely to be correlated with the availability of banking services, for instance. With these caveats, we proceed to discuss the estimation results.

4.1 Earthquake damage

Table 3 reports results of estimating equation 1, augmented with interactions, using six different measures of the destruction brought about by the earthquake: proportion of houses with minor and major damage, proportion of houses destroyed, the sum of these three types of damage (*damage*), and proportion of earthquake victims, as well as fatalities, in the population, and fatalities. We show our preferred model in each case. Adding the interaction *intensity* $\times$ *housing quality*, for instance, to columns 1 and 6, makes the coefficients on both intensity and housing insignificant. Our measure of the intensity of the earthquake enters significantly and with the expected sign in regression 1. When an interaction *intensity* $\times$ *housing quality* is added in columns 2 to 5, we obtain that the effects of intensity are positive -as expected- up to about the 80th percentile of housing quality, and are negative thereafter. For an individual living in substandard housing, moving from the city of Santiago, distant 335 kilometers from the epicenter, to the city of Concepción, only 105 kilometers from the epicenter, increases the probability of having the house destroyed by 8.6 percentage points; the chance of it suffering minor damages by 2 percentage points; and the chance of her becoming a victim by 48 percentage points. The second explanatory variable

in the table, capturing the proportion of houses with adequate construction quality, also enters with the expected negative sign in regressions 1 and 6, and with an inverted u-shape in regressions 2 to 5. Here, the effects of housing quality are positive up to the 25th percentile of intensity, and are negative -as expected- thereafter. Computed at the mean level of intensity, a municipality with a proportion of homes of adequate housing quality in the median has 10.9 percentage points fewer houses destroyed than a municipality in the 10th percentile of the distribution. This number is 1.3 and .5 for houses with major and minor damages, respectively, and 6.9 for victims. In our data, *housing quality* and *intensity* have a correlation of -.48 ($p < .01$), so municipalities who experienced a large seismic shock were, in average, those with the lowest building quality.

4.2 Looting in supermarkets

The results of estimating equation 4 (together with equation 1 as a Seemingly Unrelated Equations (SUR) model) with looting in supermarkets as the dependent variable are shown on table 4. The baseline regression, in column 1, includes the poverty rate and the (actual, not imputed) measure of destruction *minor damage*. Both variables enter with the expected positive sign and are significant, although marginally so in the case of minor damage. A one percentage point increase in the poverty rate increases the probability of looting also by .6 percentage points. In the case of minor damage, the increase is 2.7 percentage points. Other types of earthquake damage were not statistically significant when included in the regression.

In the second column we add the crime rate for the previous year, 2009, but find no effects. In fact, a bivariate analysis indicates no correlation between the crime rate and the looting indicator. In our data, the variable *burglary09* has a similar mean for the subsample with and without looting (5.82 and 5.65 respectively), and the difference is not statistically significant. The existence of a criminal know how seems then unimportant in understanding looting in supermarkets. We drop this variable from subsequent regressions, and focus on an explanation based on the ability of households to smooth out the shocks caused by the earthquake.

Column 3 adds the (un)availability of banking services to the specification in column 1. The unavailability of such services increases the probability of looting supermarkets by 41 percentage points. This effect seems extremely large, and we believe that it may be capturing the effects of banks closing

plus all the effects associated to the lack of electrical power, as these variables are probably correlated. Column 4 adds the percentage of households living in an urban area to the estimated equation. Rural households are more likely to have access to either self production of food, or to be closer to farms, and can use these opportunities for self insurance and social insurance between neighbors, respectively. The variable *urban* enters with the expected positive sign, and is highly statistically significant. We also expected to find that interactions of the poverty rate with measures of damage, the indicator for *banks closed*, and *urban*, would be significant when included in the regression, but obtained no significant estimates (results available upon request).

In column 5 we examine the explanatory power of average income levels instead of the poverty rate as a measure of vulnerability, but found it has none: only the proportion of households below the poverty line matters, the rest of the distribution being unimportant. Variables that intend to capture the strength of social networks, or "social capital", such as the number of local clubs and associations (column 6), or the proportion of individuals who are long term residents in the municipality (not shown), are also statistically non significant. To complete the analysis of supermarket looting, note that housing quality has an indirect effect on this type of looting, which operates through the damages caused by the earthquake.

4.3 Non dwelling burglaries

We proceed to contrast the results on looting in supermarkets with a similar analysis of the determinants of burglaries in locations other than homes [2]. This type of crime include looting in supermarkets, but it also includes burglaries with the intent to steal goods other than necessities and that, therefore, are not necessarily driven by a survival motive.

The results of estimating equation 4 with the number of per capita burglaries in non dwelling buildings as a dependent variable are shown in table 5. During the week after the earthquake, burglaries as defined here increased 35% compared to the weekly average of the previous year. The crime rate for the previous year is used as an explanatory variable in all regressions to properly identify the effects of the earthquake, and its effect is positive and significant everywhere. Note the poverty rate is only marginally significant in the first column, and is insignificant when controls for *banks closed* and

[2]The legal labeling of this type of crime translates as "Theft in uninhabited location"

urban are added. Similarly, a measure of damages from the earthquake is insignificant in all regressions. These results are robust to using the difference in burglaries with respect to the previous year as a dependent variable (not shown), so increases in burglary rates are uniform across municipalities with different poverty rates and levels of earthquake damages. We then find no evidence that theft more broadly defined can be explained as a survival strategy.

As in the previous table, we find that bank closings have a positive effect on burglaries (columns 2 to 5). In contrast with the results on looting in supermarkets, the proportion urban dwellers has a negative impact on burglaries, so these were higher on rural areas. In fact, rural municipalities not only showed a higher incidence of burglaries in the previous year in our data, but the increase in burglary rates was also higher: the difference in burglary rates was 1.3 per hundred thousand individuals in the top half of the municipalities, ranked by *urban*, and 3.9 in the bottom half. Finally, as in the graph presented in the previous section, we have a positive and significant effect of our social capital measure, *participation*, on burglaries.

5 Discussion and concluding remarks

We have empirically identified conditions under which at least some individuals will find it rational to incur in the looting of necessities, despite the costs. These conditions relate to rather standard microeconomic principles: looting of supermarkets is associated to a larger proportion of poor households, the group in worst position to self insure against the temporary closing of markets. It is also associated to the absence of opportunities for self insurance and social insurance such as banking services and proximity to agricultural land. The looting of supermarkets can then be constructed as the choice of rational individuals whose alternatives to obtain foodstuffs and other necessities are very costly.

In contrast to this type of looting, we provided evidence that a more general definition of looting is not consistent with a story of responses to deprivation, but rather seems to follow a "crime of opportunity" pattern, increasing by similar amounts across the poverty and earthquake intensity spectra.

The results presented here deserve a number of qualifications, some of which were discussed in the text. An important feature of our data on su-

permarket looting is that it was not provided by the supermarkets themselves, but by third parties. Although the informants were senior officials in each municipality, there is always a risk that they simply relay rumors instead of quality information. This is the main reason why we have not used information on other types of looting available in the survey. We believe that with supermarkets this risk is minimized, as these are large and prominent businesses, and the supermarkets would have shown looting related damages for several days after the incident. A second, related shortcoming of our data is that we do not have individual data on participation in looting and other individual choices after the earthquake, so we must infer such choices from data aggregated at the municipality level.

References

Maximiliano Astroza I., Francisco Cabezas M., María Ofelia Moroni, Leonardo Massone S., Sergio Ruiz T., Elizabeth Parra, Felipe Cordero O., and Anna Mottadelli S. Intensidades sísmicas en el area de daños del terremoto del 27 de febrero de 2010. Technical report, Departamento de Ingeniería Civil, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, 2010.

Cale Wren Davis. An Analysis of the Enactment of Anti Price-Gouging Laws. Master's thesis, Montana State University, US, 2008.

Kelly Frailing. The myth of a disaster myth: Potential looting should be part of disaster plans. *Natural Hazards Observer*, 31(4):Available online at: http://www.colorado.edu/hazards/o/archives/2007/mar07/index.html, 2007.

Jane Gray and Elisabeth Wilson. Looting in disaster: a general profile of victimization. Technical report, Disaster research center. The Ohio state university, wp 71 1984.

Matthew E. Kahn. The death toll from natural disasters: The role of income, geography, and institutions. *The Review of Economics and Statistics*, 87 (2):271–284, 2005.

Derek K. Kellenberg and Ahmed Mushfiq Mobarak. Does rising income increase or decrease damage risk from natural disasters? *Journal of Urban Economics*, 63(3):788–802, 2008.

Erik Olson Kimbrough, Vernon Smith, and Bart J. Wilson. Exchange, theft, and the social formation of property. *Journal of Economic Behavior and Organization*, 74(3):206–229, 2010.

Miki Kohara, Fumio Ohtakeand Fumio, and Makoto Saito. On effects of the hyogo earthquake on household consumption : A note. *Hitotsubashi Journal of Economics*, 47(2):219–228, 2006.

Hector Ormeno. Entendiendo el comportamiento cívico post-terremoto. Universidad de Santiago de Chile, 2010. Undergraduate Thesis.

Robert Putnam. *Bowling alone: the collapse and revival of american community*. New York:Simon and Schuster, 2000.

Edward Quarantelli. Looting after a disaster: A myth or reality? *Natural Hazards Observer*, 31(4):Available online at: http://www.colorado.edu/hazards/o/archives/2007/mar07/index.html, 2007.

Edward Quarantelli and Russell Dynes. When disaster strikes (it isnt much like what youve heard and read about). *Psychology Today*, 5:66–70, 1972.

Radio Cooperativa. Juicios por saqueos tras terremoto no dejaron acusados en la cárcel. pages Downloaded from www.cooperativa.cl on July 7, 2011, March 1st 2011.

Radio Universidad de Chile. Terremoto en chile: Mensaje urgente. pages Downloaded from http://radio.uchile.cl/opiniones/59348, on July 7, 2011, March 2010.

Reuters. Price gouging adds to misery after chile quake. pages Downloaded from http://uk.reuters.com/article/2010/03/03/uk–quake–chile–prices–idUKTRE6225QB20100303, March 2010.

Yasuyuki Sawada and Satoshi Shimizutani. How do people cope with natural disasters? evidence from the great hanshin-awaji (kobe) earthquake in 1995. *Journal of Money, Credit and Banking*, 40(2-3):463–488, 2008.

A Description of Variables

Variable	description	Source
income	Average municipality earnings, in hundreds of thousands of 2009 pesos	CASEN 2009
poverty rate	Municipality level poverty rate, using definition included in CASEN 2009	CASEN 2009
housing quality	Proportion of dwellings were the roof, floor, and walls are build to "acceptable" standards, according to the CASEN methodology	CASEN 2009
participation	Per capita number of community organizations with legal status	SINIM
burglary09	Police reports of theft in non dwelling location, per capita, 2009	National Police
burglaries	Police reports of theft in non dwelling location, per capita, Feb. 27 2010 to March 6 2010	National Police
victims	Per capita victims of the earthquake	ONEMI
minor damage	proportion of dwellings with minor damage	ONEMI
major damage	proportion of dwellings with major damage	ONEMI
destroyed	Proportion of dwellings destroyed by the earthquake	ONEMI
supermarkets	Dummy equal to one if a supermarket was looted in the municipality	Own survey
urban	Proportion of urban dwellers in the municipality	CASEN 2009

banks closed	Dummy for closing of all the Banco Estado branches in the Municipality	Banco Estado
intensity	A measure of the earthquake intensity	Derived from *Astroza et al* (2010)
coastal area	A dummy equal to one if the municipality contains a coastal border	
long term residents	Proportion of households who have resided in the municipality for more than 4 years	CASEN 2009

Note: ONEMI is the National Office of Emergency of the Interior Ministry.

Table 1: Summary statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
supermarkets	0.093	0.291	0	1	194
burglaries	8.098	6.612	0.717	47.657	117
victims	0.109	0.157	0	0.906	172
major damage	0.014	0.023	0	0.143	172
destroyed	0.018	0.032	0	0.221	172
intensity	5.798	1.394	1.504	8	197
housing quality	0.72	0.157	0.182	0.991	200
income	3.104	1.752	1.54	15.762	200
poverty rate	0.173	0.087	0	0.414	200
burglary09	5.686	2.674	1.046	21.666	200
long term residents	0.931	0.05	0.643	0.996	200
participation	0.012	0.008	0	0.049	183

Table 2: Comparing in and out of sample municipalities

	In	**Out**
victims	0.11	0.12
major damage	0.01	0.02
destroyed	0.02	0.01
intensity	5.80	6.82
housing quality	0.72	0.69
income	3.10	2.88
poverty rate	0.17	0.18
burglary09	5.69	5.47
long term residents	0.93	0.94
participation	0.01	0.01

Table 3: Earthquake destruction

	minor	major	destroyed	damage	victims	fatalities
	(1)	(2)	(3)	(4)	(5)	(6)
intensity	.02	.06	.07	.52	.37	.93
	(.004)***	(.01)***	(.01)***	(.07)***	(.05)***	(.96)
housing quality	-.06	.37	.41	3.03	2.17	-13.27
	(.02)***	(.11)***	(.09)***	(.66)***	(.49)***	(5.31)**
coastal area	.01	.10	.0005	.18	.07	4.90
	(.007)*	(.04)***	(.03)	(.23)	(.17)	(1.87)***
intensity× coast		-.02	.0006	-.02	-.006	
		(.006)***	(.005)	(.03)	(.03)	
intensity× housing		-.07	-.08	-.58	-.42	
		(.02)***	(.01)***	(.10)***	(.07)***	
Obs.	197	197	197	197	197	184

Dependent variables: *minor damage* (col. 1);*major damage* (col. 2); *destroyed* (col. 3);*damage* (col. 4);*victims* (col. 5);*fatalities* (col. 6).
Vars. not shown: population
*** significant at 1%,** significant at 5%,* significant at 10%

Table 4: Looting of supermarkets

	base	crime	banks	urban	income	netwk
	(1)	(2)	(3)	(4)	(5)	(6)
poverty rate	3.22	3.43	3.32	3.85		4.81
	(1.56)**	(1.59)**	(1.78)*	(1.83)**		(2.33)**
income					-.23	
					(.23)	
minor damage	14.47	15.19	6.72	15.69	11.84	20.38
	(7.98)*	(7.88)*	(11.79)	(8.08)*	(10.87)	(7.99)**
burglary09		.04				
		(.04)				
urban				2.49	2.67	2.84
				(.96)***	(1.00)***	(1.18)**
banks closed			1.49	.98	1.10	.66
			(.40)***	(.45)**	(.44)**	(.51)
participation						-40.66
						(37.03)
Observations	197	197	197	197	197	197

Dependent variable: *Supermarkets*
Vars. not shown: population
*** significant at 1%,** significant at 5%,* significant at 10%

Table 5: Non dwelling burglaries

	base	banks	urban	income	netwk
	(1)	(2)	(3)	(4)	(5)
poverty rate	10.49	9.38	5.89		5.00
	(6.20)*	(6.10)	(6.17)		(6.33)
income				-.16	
				(.25)	
minor damage	22.16	12.01	-.44	-2.29	2.75
	(27.82)	(26.51)	(27.55)	(28.12)	(27.56)
burglary09	.61	.63	.58	.56	.44
	(.19)***	(.18)***	(.18)***	(.18)***	(.18)**
urban			-6.22	-6.33	-4.70
			(2.64)**	(2.68)**	(2.80)*
banks closed		3.49	4.40	4.49	3.17
		(1.54)**	(1.55)***	(1.55)***	(1.64)*
participation					225.98
					(86.31)***
Observations	217	217	217	217	216

Dependent variable: *Burglaries*
Vars. not shown: population
*** significant at 1%,** significant at 5%,* significant at 10%

Figure 1: earthquake intensity and supermarket looting

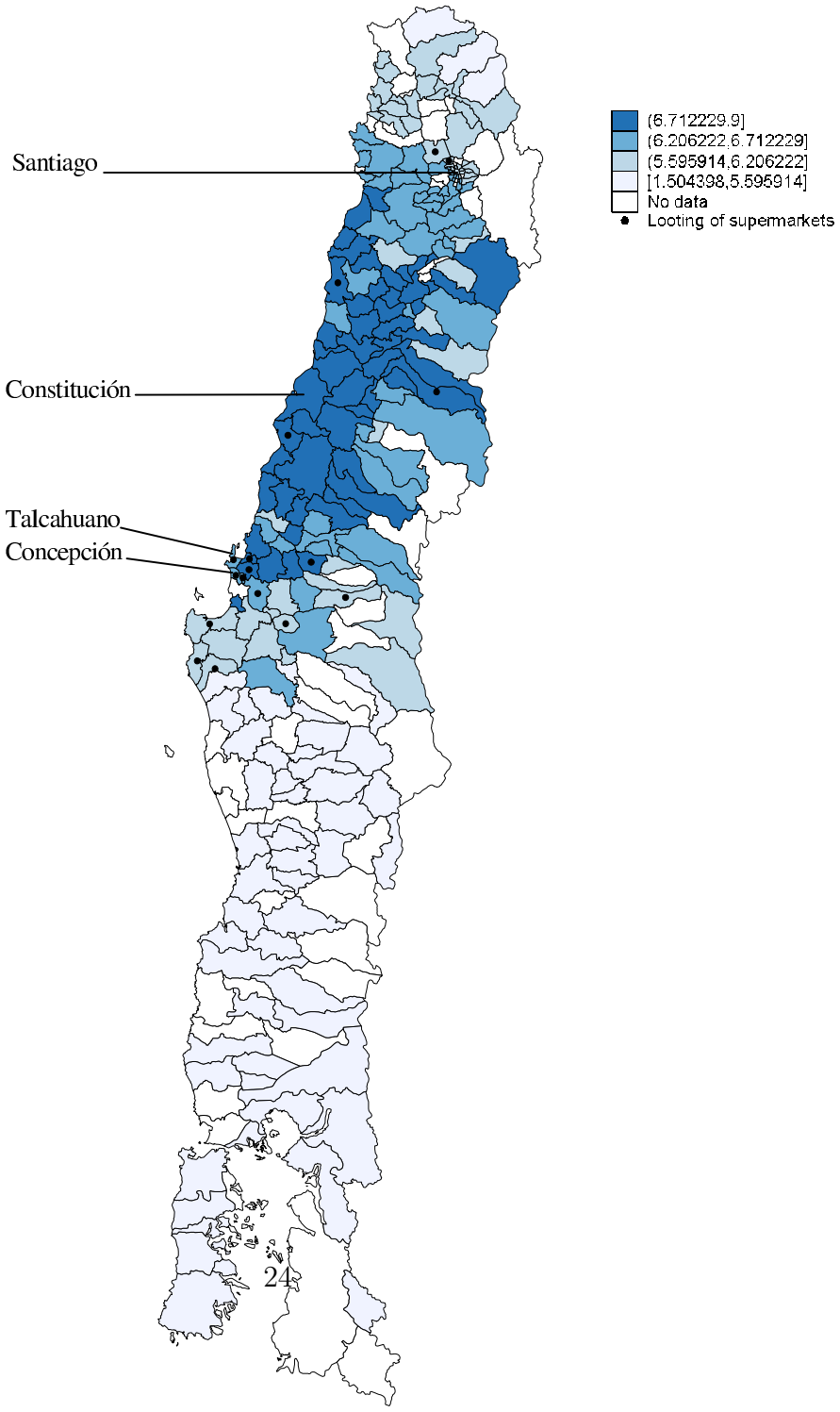
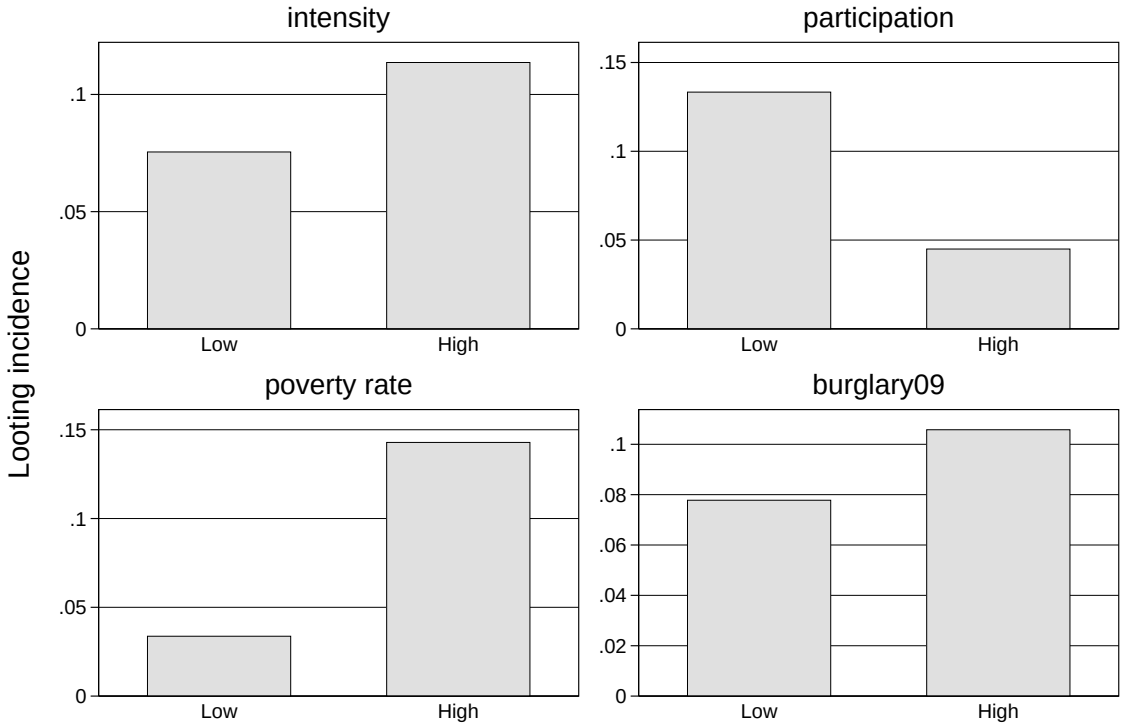
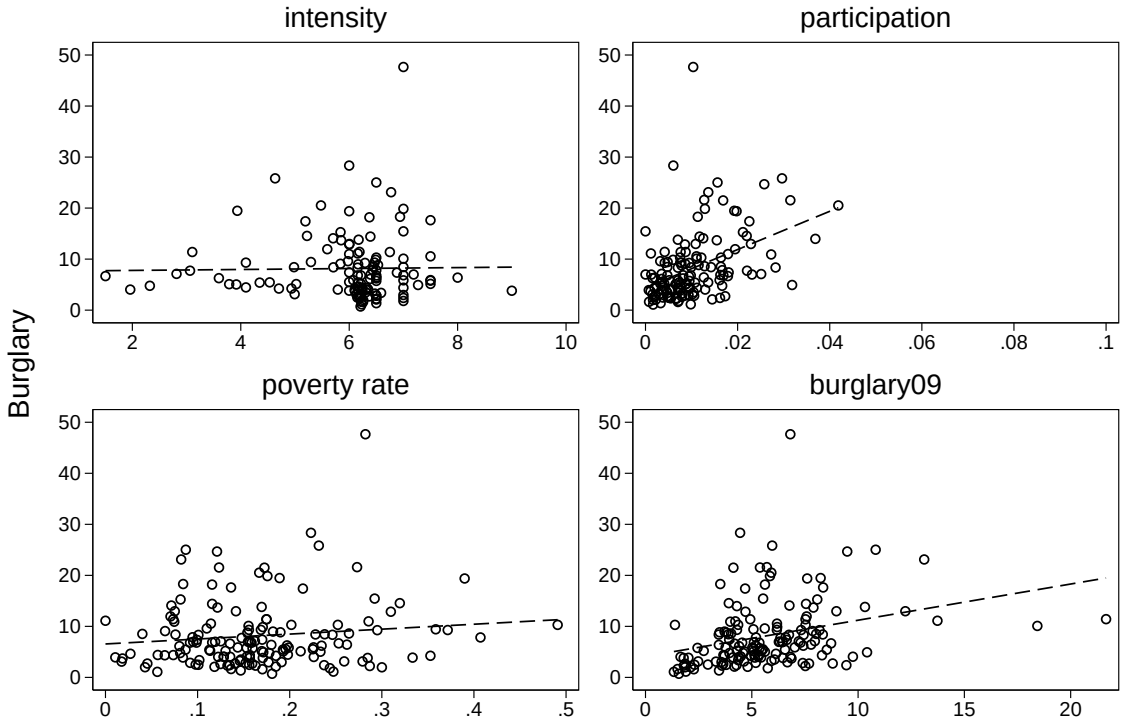


Figure 2: Looting by selected municipality characteristics



Note: High and Low are defined with respect to the median.

Figure 3: Burglaries by selected municipality characteristics



Note: High and Low are defined with respect to the median.