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The role of inter-household transfers in coping with post-disaster losses in Madagascar

Danamona Andrianarimanana,
University of California at Berkeley

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Abstract

While the intensity of a natural disaster can be uniformly measured across space, its impact largely depends on the economic conditions of the receiving households and communities. Richer countries can experience greater absolute financial losses but poorer nations often suffer greater relative financial losses (relative to GDP) and significantly more human losses: nearly 90% of disaster-related deaths between 1991-2005 occurred in developing nations. Moreover, setbacks from loss of businesses, assets, and livelihoods can have irreversible or very long-term consequences in developing countries. Therefore, how policy makers and communities cope with post-disaster losses is extremely important. In this paper, I evaluate the impacts of cyclones on households in Madagascar and find that inter-household transfers play an important role in coping with post-disaster losses.

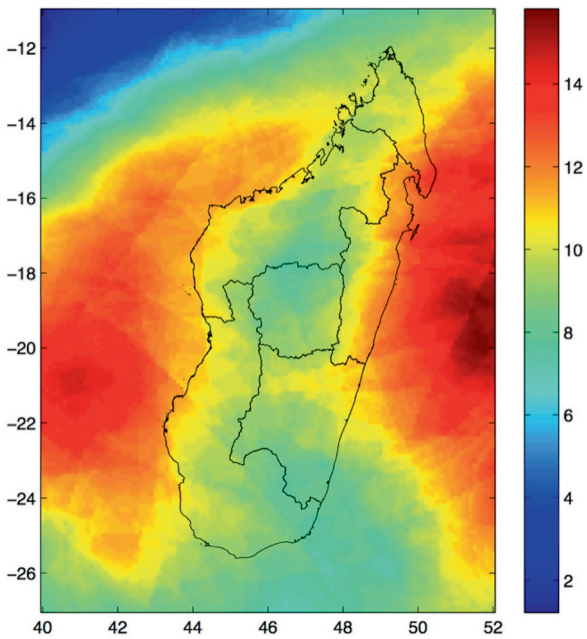
policy brief
117
November
2015
note brève

I first identify rural households as being most affected by weather shocks: for them, cyclones have a negative and significant impact on access to electricity, assets, and income, resulting in higher poverty. While urban households are not directly impacted by cyclonic shocks, they do suffer from the indirect impacts of rural shocks through transfers. A rural shock in the previous year leads to reduced expenditure and higher probability of being poor among surrounding urban households. The net effects of benefits to rural households from urban transfers versus any possible missed opportunities of urban households due to social assistance is unclear and needs further research.

Introduction

Madagascar is the second most exposed country to multi-disaster risks in Africa, and experiences multiple episodes of cyclones, droughts, floods, and locust invasions every year. In particular, Madagascar experiences three to five cyclones a year, which results in a high exposure varying in intensity across the island (Figure 1).

Figure 1. Madagascar's cyclone exposure, calculated as average of yearly maximum wind speeds (in meter per second) achieved over provinces between 1950 and 2008.



Five out of the twenty million people inhabiting the island were identified as living in zones at risk of natural disasters (Global Facility for Disaster Reduction Recovery, 2013). Using a lagged exposure model following Anttila-Hughes and Hsiang (2012)'s empirical estimation of post-disaster losses within households in the Philippines, I evaluate the impacts of tropical cyclones on urban and rural households in Madagascar and the role of inter-household transfers in coping against post-disaster losses. I find that, in rural households, the average cyclone that hits during the previous year leads to a 2.4% decrease in the probability of having access to electricity in the current year, has a significant negative impact on households' assets and expenditure, hence increasing the probability of being poor in the year following the cyclone. While urban households do not appear to be directly impacted by cyclonic shocks, they do indirectly suffer from cyclones impacting rural households due to the negative income shocks in the form of transfers.

Research question

What are the direct and indirect impacts of weather shocks on households' well-being (access to public goods, assets, and income) in a developing country setting?

Data

Cyclone data are obtained from the International Best Track Archive for Climate Stewardship (IBTrACS) database compiled by the National Oceanic and Atmospheric Administration (NOAA). This database contains cyclone tracks for Madagascar from the year 1970 to 2010 and are recorded as 6-hour observations over every 1/34°×1/34° pixel. Information on household assets, income, consumption and transfer is obtained from the cross-sectional periodical household survey, EPM (Enquête Périodique Auprès des Ménages), conducted by Madagascar's National Statistics

Bureau (INSTAT). The EPM consists of a series of multi-thematic surveys, representative at the national and the regional levels. The EPM survey was collected in 1993, 1997, 1999, 2001, 2004, 2005, and 2010.

Empirical strategy

I use the following cyclone lagged exposure model:

$$Z_{hct} = \Sigma_{L=0}^{5} [\alpha_L W_{c,t-L}] + \tau_t + \mu_c + \xi X_{(hct)} + \epsilon_{(hct)}$$

where h indexes households, c indexes communes, and t indexes years.
Z is the outcome of interest (asset, income, health outcome, etc) while W is the cyclone windspeed. τ is a year fixed-effect, μ is a commune fixed-effect, and X is the vector of observable household characteristics. ϵ_{hct} is an error term for household-level disturbance. Five-year lags are included and Conley clusters are used for calculation of standard errors. Finally, maximum windspeed, the variable of interest in all future regressions is calculated as the maximum windspeed reached by each cyclone within the commune (maximum windspeed over all 1/34°×1/34° pixels constituting a commune).

Identification comes from the random nature of the timing, path, frequency, and intensity of cyclones. Furthermore, I have conducted a randomization check (running the baseline regression on household characteristics) that showed that there is no self-selection of certain types of households based on exposure. This is also consistent with the analysis on migration that showed that migration movements are extremely rare among the households in the sample.

Results

To estimate the impacts of weather shocks on household well-being, I focus on three categories of outcomes: 1) access to public goods measured as access to electricity, 2) households' short run outcomes: assets and expenditure, and 3) poverty status which is a composite measure calculated based on assets, income, and consumption. Since rural and urban households are expected to be differentially impacted by cyclones due to differences in quality of infrastructure and choices of economic activities, estimation of the main regression above is always done separately for the two subgroups.

Impact on rural households

As expected and as reported in Table 1 panel A (see Table 1, page 7), cyclones lead to significant reduction in wellbeing among rural households:

• **Access to electricity:** Column 1 reports the impact of being hit by a cyclone on a household's probability of living in a house with electricity: a one-meter per second increase in maximum windspeed is associated with a 0.1% decrease in the probability of living in a house with electricity the year after the cyclone, significant at the 5% level. Given that the average cyclone has a maximum windspeed of 24.6 meter per second (88.6 kilometer per hour), the average effect of a cyclone on a rural household is a 2.4% decrease in probability of having access to electricity. This small effect is not surprising given that access to electricity in rural household is as low as 26%.

• **Assets:** The dependent variable in the regression reported in column 2 is the variable "Solid Walls", a dummy equal to 1 if the household lives in a house made with brick, concrete or hard wood and equal to 0 otherwise. It can be seen that the impact of cyclones on housing is persistent, significant, negative and extremely large in magnitude: -0.009*** for the same year and for the first lag (22.1% per cyclone), -0.016*** for two lags (40% per cyclone). The negative and significant sign of the cyclone occurring in the past twelve months is expected as this is saying

that assets reconstruction takes time: if parts of the house (a wall, the roof), were taken down by a cyclone in the past year, it might take a household more than twelve months to rebuild a sturdy replacement, regardless of whether previous walls were solid or not, due to high costs of building such asset. The persistence of the coefficients on the lagged years however seem to suggest that solid walls are not build or rebuild even for shocks that have happened as far as three years before the survey.

• **Expenditure:** The impact of cyclones on household expenditures (logarithmic form) is reported in column 3. In rural households, the average cyclone is associated with a 12.3% (0.5 percentage change * 24.6) decrease in household expenditure. Since this is the impact on general expenditure, it must be a result of decrease in income or increase in savings. The earlier is a much more probable explanation as agricultural yield and income were also shown to have significantly decreased due to cyclones (Table not shown).

• **Poverty:** Finally, column (4) of Table 1 reports the effects of being hit by a cyclone on the probability of being below the national poverty line. The national poverty line is calculated by INSTAT based on an evaluation of households' assets, income, and consumption. A cyclone occurring during the 12 months prior the survey is associated with a 7.4% increase in the probability of being categorized as poor during that same year.

Impact on urban households

As shown in Table 1 Panel B, none of the coefficients for cyclones occurring in the immediate year prior to survey are significant, even for electricity and solid walls, consistent with the fact that urban areas have better infrastructure. Lagged cyclone coefficients suggest that in urban areas, a household that was hit by a cyclone three years ago has an 8.4% higher probability of being poor in the current year, a result that has no obvious explanation.

Overall, these results are not too surprising and add to the literature of weather shocks showing that natural disasters are important phenomena that lead to statistically significant differentiated effects: urban households seem unaffected whereas rural households suffer from cyclones along several dimensions. These results are robust to functional form of wind speed variable (quadratic and cubic form), number of lags included in the model as well as lengths of lags (from three-month lags to three-year lags instead of yearly lags). We expect that both rural and urban households will be negatively impacted by extreme events, with higher magnitudes of losses for urban households. However, we do not have enough data points to test this and we are left with the story of urban households being unaffected by storms. However, this is not the full story. There is a more complex coping mechanism that can be understood by looking at inter-household transfers.

Indirect effect on urban households through transfers

Transfers play an important role in the Malagasy society: intra-household transfers alone amounted to USD 160 millions in 2010. 59.7 % of households in the household survey sample were involved in such transactions (35% of the households in the sample have sent a transfer to another household and 24% have received a transfer).

Transfer data consist of records of whether a household has received (sent) a transfer as well as the amount, reason, and frequency of the transfer received (sent). The categorized reasons of transfer are: pension, indemnization, scholarship, festivities and customs, support, support to family, taxes and other. The transfer data have some limitations. First, the existing categorization of reasons for transfer does not include natural disasters hence I define my "Received relief

transfer" variable as having received a non-regular transfer while living in a commune that had experienced a cyclone. I only focus on transfers that were labeled for support, support to family, and others. Second, data on the other end of the transfer including sender location is not available so that I am not able to directly code the flow of transfers by location (urban-rural, rural-urban, rural-rural and urban-urban).

Focusing on disaster relief related transfers, 87% of transfers come from family members and less than 1% of relief comes from the government. As reported in Table 2 (see table 2 page 7), windspeeds are important predictors of relief transfers in both urban and rural areas: the probability of receiving a transfer for a household that lives in a commune hit by a cyclone increases with windspeed. The average cyclone is associated with a 12.3% higher probability of receiving a transfer in urban areas and a 7.4% higher probability of receiving a transfer in rural areas. This evidence is in support of strong solidarity between households and a good response of transfers to natural disasters.

Finally, Table 3 (see table 3 page 7) shows the indirect effects of a shock impacting rural (urban) households on urban (rural) households. Since the unit of observation is at the household level, it is impossible to observe a shock for both rural and urban. So far, what we have seen is the impact of cyclones on households that were actually hit by cyclones or direct effects. To look at indirect effects, we want to test whether urban (rural) households'wellbeing are affected when rural (urban) households receive a weather shock. To test this, I proxy for rural (urban) shocks by calculating the average windspeed across rural (urban) communes within a district. A higher rural (urban) shock will reflect a higher intensity of storm or a higher share of the rural (urban) communes within the district being hit by a cyclone. In both cases, the likelihood of receiving a transfer should be higher. This implies that we assume that ties between rural and urban households are bound within district (recall Madagascar is divided into 111 districts and 1200 communes), an assumption that we have to make given the data limitation. We are then able to not only look at how urban (rural) households themselves are affected by cyclones themselves, but also to control for shocks happening to their rural (urban) counterparts.

As can be seen from column (1) and (2), while the coefficients of windspeed on expenditure and poverty are not significant for urban households, cyclones impacting rural households within the same district lead to large and significant decreases of expenditure and increases in poverty for urban households. While the coefficients for the same year are not significant, for the year before the survey, a one-meter per second increase in the average windspeed in rural areas surrounding urban households within a same district is associated with a 3% reduction in expenditure. That is, if all rural areas in the district experienced an average cyclone then this would lead to a 70% decrease in urban households' expenditure. It is of course unlikely that all communes of a district would be hit by a cyclone. Similarly, a one-meter per second increase in the average rural shock is associated with a 2% increase in the probability of the urban household of being poor. (Average effect of a cyclone hitting all rural communes within a district on urban household is 42% increase in the probability of being poor.) For rural households, direct shocks of being themselves hit by cyclones on expenditure and poverty are significant but there are no indirect impacts from urban shocks.

Conclusion

To sum up, we have seen that, while looking at access to electricity, assets, expenditure, and poverty, rural areas are most vulnerable to cyclones and urban areas appear to be largely unaffected. These results are not surprising given the better infrastructure in urban areas (cyclones have no significant impact on housing)

and since urban households do not rely as much on agricultural income and activities as rural households do. These results do not change when conducting several robustness checks.

When looking at transfers, however, we find that transfers to both rural and urban areas are very responsive to cyclone shocks. A very large majority of transfers come from relatives and from urban households. Looking into the possible indirect effects of rural shocks on urban households, we find a large and significant reduction in well-being of urban households associated with rural shocks happening the year before the survey. That is, a rural shock in the previous year leads to lower expenditure and higher poverty. A possible explanation for this is that relief transfers might divert resources away from urban households that could have been used on insuring basic needs as well as on investments on productive assets in the current year. I do not find a similar indirect impact channel for rural households. The net effects of benefits to rural households from receiving urban transfers versus the costs to urban households of social assistance as well as the potential impacts of having formal insurance are unclear and require further research.

References

- **Anttila-Hughes, J. K.** and **S. M. Hsiang**. 2012. "Destruction, Disinvestment, and Death: Economic and Human Losses Following Environmental Disaster." isites.harvard.edu.
- **Global Facility for Disaster Reduction Recovery**. 2013. Country Program Update, Madagascar, May 2013.

Table 1. Impacts of cyclones on household wellbeing

VARIABLES	(1) Electricity	(2) Solid Walls	(3) Log Exp	(4) Poverty
Maximum Windspeed	Panel A: Rural			
t and t-12 months	-0.001**	-0.009***	-0.005**	0.003***
t-12 and t-24 months	0.001**	-0.009**	-0.001	0.005
t-24 and t-36 months	0.001	-0.016***	-0.005	0.005**
	Panel B: Urban			
t and t-12 months	0.000	-0.004	-0.000	-0.002
t-12 and t-24 months	0.000	0.001	-0.001	-0.001
t-24 and t-36 months	-0.000	-0.006	-0.001	0.004***

Robust standard errors in parentheses /// *** p < 0.01, ** p < 0.05, * p < 0.1
Note: Coefficients are estimated using Year and Commune Fixed-Effects and Conley clustered standard errors. Demographic covariates are controlled for in all regressions. Five year lags are included but only the first three lags are reported here.

Table 2. Probability of receiving and sending a relief transfer

	(1)	(2)
VARIABLES	Received a transfer	
Maximum Windspeed	Urban	Rural
t and t-12 months	0.005***	0.003***
t-12 and t-24 months	0.001**	-0.001
t-24 and t-36 months	0.000	-0.000

Robust standard errors in parentheses /// *** p < 0.01, ** p < 0.05, * p < 0.1
Note: Coefficients are estimated using Year and Commune Fixed-Effects and Conley clustered standard errors. Demographic covariates are controlled for in all regressions. Five year lags are included but only the first three lags are reported here.

Table 3. Direct and indirect impacts of cyclones

VARIABLES	(1) Log Exp	(2) Poverty	(3) Log Exp	(4) Poverty
Maximum Windspeed	Urban households		Rural households	
t and t-12 months	-0.000	-0.002	-0.005**	0.004***
t-12 and t-24 months	-0.000	-0.001	-0.001	0.006
	Indirect shocks through rural		Indirect shocks through urban	
t and t-12 months	-0.007	-0.007	-0.007	-0.005
t-12 and t-24 months	-0.028***	0.017*	-0.003	-0.013

Robust standard errors in parentheses /// *** p < 0.01, ** p < 0.05, * p < 0.1
Note: Coefficients are estimated using Year and Commune Fixed-Effects and Conley clustered standard errors. Demographic covariates are controlled for in all regressions. Five year lags are included but only the first three lags are reported here.

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Contact
www.ferdi.fr
contact@ferdi.fr
+33 (0)4 73 17 75 30

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policy brief
117
November
2015
note brève